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YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF FOREIGN LANGUAGES EDUCATION
FOREIGN LANGUAGES (ENGLISH) EDUCATION PROGRAM

MASTER'S THESIS

A MIXED METHOD STUDY ON TPACK OF PRE-SERVICE EFL TEACHERS DURING EMERGENCY REMOTE TEACHING

BELKIS BENLİOĞLU

20708005

THESIS ADVISOR

Asst. Prof. SEMİN KAZAZOĞLU

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BELKIS BENLİOĞLU
20708005
ORCID NO: 0000-0002-1828-3534

THESIS ADVISOR
Asst. Prof. SEMİN KAZAZOĞLU

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The study titled “A Mixed Method Study on TPACK of Pre-Service EFL Teachers during Emergency Remote Teaching,” prepared by Belkıs BENLİOĞLU, was found successful with unanimity as a result of the defense exam held on **16/02/2023.** It has been accepted as **MASTER’S THESIS** in the Foreign Language Teaching Department Foreign Language (English) Teaching Program.

Advisor	**Signature**
Asst. Prof. Semin KAZAZOĞLU	…….....

Jury Members	**Signature**
Prof. Hatice Gülru YÜKSEL	……..
Asst. Prof. Mehdi SOLHİ	...…….

ABSTRACT

A MIXED METHOD STUDY OF TPACK OF PRE-SERVICE EFL TEACHERS DURING EMERGENCY REMOTE TEACHING

With technology and digitalization, critical transformation processes have been expedited in education. This inevitable transformation requires pre-service teachers to blend their area and pedagogical knowledge with technology use competencies. The literature has revealed that Technological Pedagogical Content Knowledge (TPACK) model provides a comprehensive model for pre-service teacher training. This study aimed to identify pre-service EFL teachers' TPACK and its constituent knowledge levels across class levels by adopting a sequential explanatory mixed-method approach. Two hundred nineteen pre-service EFL teachers participated in the study, being administered the TPACK-EFL scale developed by Baser et al. (2016). Additionally, lesson plans (N=14) designed by senior-year participants were collected and evaluated through the Technology Integration Assessment Rubric developed by Harris et al. (2010). Then, participants (N=14) were observed during the practicum through the Technology Integration Observation Instrument developed by Hofer et al. (2011) based on the lesson plans they designed. A focus group discussion (N=14) was conducted to gain insight from the data. The results indicated that pre-service EFL teachers' TPACK formation followed an increasing linear path until the third year, but a slight decrease occurred in the last year. Two integrated knowledge domains, technological content knowledge and technological pedagogical knowledge, were positively and strongly correlated with the overall TPACK. Additionally, core domains PK and TK significantly predicted TPACK. The decline in the last year was attributed to the practicum effect, in which the participants reflected on their teaching performances in an authentic teaching environment. The lesson plan and observation analysis confirmed this finding.

Key Words: Emergency remote teaching (ERT), technological pedagogical content knowledge (TPACK), pre-service EFL teacher education, mixed method, ELT practicum

ÖZET

ACİL UZAKTAN ÖĞRETİM SÜRECİNDE İNGİLİZCE ÖĞRETMEN ADAYLARININ TPAB'LARI ÜZERİNE KARMA YÖNTEM ÇALIŞMASI

Teknoloji ve dijitalleşme ile eğitimde kritik dönüşüm süreçleri hızlanmıştır. Bu kaçınılmaz dönüşüm, öğretmen adaylarının alan ve pedagojik bilgilerini teknoloji kullanım yeterlikleri ile harmanlamalarını gerektirmektedir. Literatür, Teknolojik Pedagojik Alan Bilgisi (TPAB) modelinin hizmet öncesi öğretmen eğitimi için kapsamlı bir model sağladığını ortaya koymuştur. Bu çalışma, sıralı bir açıklayıcı karma yöntem yaklaşımı benimseyerek, hizmet öncesi yabancı dil öğretmeni adaylarının TPAB'ını ve onu oluşturan bilgi düzeylerini sınıf seviyelerinde belirlemeyi amaçlamıştır. Başer vd. (2016) tarafından geliştirilen TPACK-EFL ölçeğine 219 İngilizce öğretmeni adayı katılmıştır. Ek olarak, son sınıf katılımcıları tarafından tasarlanan ders planları toplanmış (N=14) ve Harris vd. (2010) tarafından geliştirilen Teknoloji Entegrasyon Değerlendirme Rubriği aracılığıyla değerlendirilmiştir. Daha sonra Hofer vd. (2011) tarafından geliştirilen Teknoloji Entegrasyonu Gözlem Aracı ile katılımcılar (N=14) uygulama sırasında tasarladıkları ders planlarını uygularken gözlemlenmiştir. Verilerden iç görü elde etmek için bir odak grup görüşmesi yapılmıştır (N=14). Sonuçlar, İngilizce öğretmeni adaylarının TPAB oluşumunun üçüncü yıla kadar artan bir doğrusal yol izlediğini, ancak son yılda hafif bir düşüş olduğunu göstermiştir. İki entegre bilgi alanı olarak teknolojik alan bilgisi ve teknolojik pedagojik bilgi türleri, genel TPAB ile pozitif ve güçlü bir şekilde ilişkili olarak bulunmuştur. Ek olarak, çekirdek alanlar olan pegagojik bilgi ve teknolojik bilgi, teknolojik pedagojik alan bilgisini önemli ölçüde yordamıştır. Yapılan odak grup görüşmesinde, son senedeki düşüş, katılımcıların otantik bir öğretim ortamında öğretim performanslarını yansıttıkları staj etkisine bağlanmıştır. Ders planı ve gözlem analizi bu bulguyu doğrulamıştır.

Anahtar Kelimeler: Acil Durum Uzaktan Öğretimi (ERT), Teknolojik Pedagojik İçerik Bilgisi (TPAB), Hizmet Öncesi İngilizce Öğretmeni Eğitimi, Karma Desen, Staj Uygulaması

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LIST OF ABBREVIATIONS

CK	: Content Knowledge
EFL	: English as Foreign Language
ELT	: English Language Teaching
ERT	: Emergency Remote Teaching
IWB	: Interactional White Board
MONE	: Ministry of National Education
PCK	: Pedagogical Content Knowledge
PK	: Pedagogical Knowledge
TALIS	: The OECD Teaching and Learning International Survey
TCK	: Technological Content Knowledge
TPK	: Technological Pedagogical Knowledge
TPACK	: Technological Pedagogical Content Knowledge

1. INTRODUCTION

This chapter introduces the present study with background information, the aim, and the importance of the present study, respectively. Definitions of the acronyms and keywords are provided.

1.1. Background of the Study

Technology plays an indispensable role in today's world with its opportunities in life. Technological developments in the 21st century have altered the way of acting and thinking in many aspects of life, including education. These new ways of manipulating, seeing, and understanding have always been promising in terms of revolutionizing society, along with education (Mishra et al., 2009). Indeed, innovation and change have been one of the characteristics of life in history.

The teachers' need for technological tools and technology skills was echoed in educational research within a comprehensive framework in the first years of the millennium. The technological, pedagogical content knowledge framework, which has been known by its acronym TPACK, includes the knowledge types of teachers required for effective instruction.

The history of teaching has emphasized different knowledge types and competencies that teachers need to acquire according to the context of the time. For instance, competent teachers were defined as ones who have a good command of content knowledge regarding the subject matter with little focus on their pedagogical knowledge levels until the 1890s (Shulman, 1986a, 1897). The research pedagogical knowledge that encapsulates knowing different learning theories, being capable of managing the classroom, and having adequate knowledge of assessment and evaluation is accepted both by researchers and practitioners (Richardson, 1990; Shulman, 1986b). However, the recognition of the pedagogical aspects was overemphasized, and the content knowledge was ignored. Indeed, Shulman (1986b)

criticizes the phenomenon as a "missing paradigm." The missing paradigm, according to Shulman (1986b, pp. 7-8), refers to “a blind spot with respect to content that now characterizes most research on teaching and, as a consequence, most of our state-level programs of teacher evaluation and teacher certification." According to him, one of the most critical points in teacher training programs was the absence of content knowledge, which created the missing element.

Shulman’s concept of integrating these two dimensions, pedagogic and content knowledge (PCK), has paved the way for further research approaches in teacher training (Shulman, 1987). Shortly after, the epistemological foundation of PCK has been highly accepted in teacher training research (Mishra & Koehler, 2006). Mishra and Koehler (2006) revised Shulman’s (1986b) framework by adding technological knowledge, which can be defined as a comprehensive framework that includes “thinking about teacher knowledge and how it informs the debate on what teachers need to know and how they might develop it” (Mishra & Koehler, 2006, p. 1019). This framework acknowledges the complex nature of teaching activity regarding contextual factors, cognitive dimensions, having a dynamic environment, and the requirement of “flexible access to highly organized systems of knowledge” (Mishra & Koehler, 2006, p.1020).

With the rapid changes in technological development in the upcoming years, especially the digitalization of knowledge, the interaction between individuals, and the presence of individuals, the PCK framework has necessitated a new dimension to understanding teacher competencies. Mishra and Koehler (2006) added a new dimension to the technology (T) framework to capture the new way of teaching with the use of technological-digital tools. Nevertheless, adding one more knowledge dimension to the existing criterion should be discussed with precaution since the theoretical understanding would not remain the same. Simply put, the conceptualization of teacher competencies is converted into the interplay between pedagogy, content, and technology.

In this dynamic interplay, 21st-century teachers are expected to perform congruently with the latest scientific research outcomes, along with skillful use of technological tools that foster learners' education (Guerriero, 2020). Analyzing the Teaching and Learning International Survey (TALIS) data, Ceylan et al. (2020) indicated that 30 percent of teachers working at the K12 levels showed little readiness to utilize

information communication technologies (ICT), ranging from none to little in the Turkey context. This outcome could be interpreted as an indicator of a need for technology training. Although in-service training programs can be useful for meeting professional development requirements, they can be a challenge for teachers due to the heavy workload and the demands on their time and finances (Ceylan et al., 2020). Fostering teacher training programs with the needs of time seems promising in terms of bringing up well-equipped educators.

With similar concerns, Turkey's Higher Education Council amended the teacher training programs in 2017. The reform redefined the qualities of teachers who graduated from four-year bachelor's degree programs. Regardless of the content domain, the graduation criteria for these programs require that participants be able to demonstrate literacy in technology and possess the researcher-teacher identity.

In concern to the English language teaching (ELT) programs, Information technologies Instructional Technologies have become compulsory courses; the curriculum has also been enriched with electives, such as Open and Distance Education, Media Literacy, and Material Design courses. It has been expected that alumni of the university's first cycle become well-qualified teachers in terms of pedagogy, technology, and subject matter.

In light of the exposition above, the new paradigm of quality teaching can be achieved with the help of teacher training programs that require teacher knowledge domains to be elaborated, practiced, and developed by pre-service teachers. However, this goal cannot be achieved unless the knowledge domains of pre-service teachers are delved into according to the specific features of the content.

1.2. Significance of the Study

The 21st century has been marked by information, communication, and digital technologies since the way of human conception, perception, and behavior have consolidated and reshaped. Although the transformation process is obvious, it is hard to come up with analytical and reasonable answers to how technology is being integrated and why it is crucial to analyze the strategies. One possible reason for this challenge is the invisible characteristics of the technology, which means "the greater its integration into daily practices, the less it is seen as a technology at all" (Bruce &

Hogan, 1998, p. 270). Hence, technology integration in different dimensions of life, including educational praxis, requires exclusive attention in order to explore and understand the phenomenon.

Given the importance of the current situation in educational settings reshaped by technological practice, enhancing prospective teachers with technological competencies along with their content and pedagogic knowledge structures has attained the utmost importance. Besides, the TPACK framework enables researchers to operationalize knowledge constructs for both pre-service and in-service teachers by providing a useful model (Angeli et al., 2016; Angeli & Valanides, 2005; Niess, 2005). Since the framework offers more than integrating technology into the teaching praxis (Voogt et al., 2013), domain-specific research is always needed to understand and implement what to teach, how to teach, and the role of technology.

The TPACK framework inherently encompasses the interactions between pedagogical decisions, technology integration, and the subject matter of the teaching point. In other words, the content knowledge of the teacher plays an indispensable role in order to design and act on the lessons. Indeed, knowledge of technology and a combination of technology to the pedagogical aspects do not necessarily manifest effective teaching unless there is a meaningful connection regarding the subject matter. Thus, the knowledge of the content, which is the teacher's expertise, should be included in any investigation aimed at measuring teachers' technology integration competencies.

In a detailed literature review, Tseng et al. (2022) acknowledge that the need for TPACK studies in EFL contexts is excessive. Since pedagogic reasoning is the fundamental aspect of the framework, the researchers are advised to conduct integrative studies to shed light on the cognitive phase of knowledge forming with the content in question. Even though studies on English teachers' TPACK have increased after 2009 (Wu, 2013), the advances in technology and digitalization have been the front runner in this race, which makes it noteworthy to investigate the knowledge types of teachers in developing encounters with technology.

In a newly experienced context, the pandemic restrictions forced students, teachers, and faculty instructors to work with technology. During the covid-19 breakdown, more than a billion students experienced online learning (UNESCO, 2022),

characterized by distance communication with teachers and peers, and conceptualized as Emergency Remote Teaching (ERT) (Hodges et al., 2020). Being competent with technology, both in hardware and software practice, had to mean more than ever since the shift from face-to-face to online was mandatory rather than a choice. Pandemic restrictions and the ERT context have proved the necessity of teachers' ability to implement their technical knowledge into content and pedagogic knowledge to perform efficient teaching practices.

While the necessity of TPACK-competent EFL teachers has resonated, prospective teachers are being trained in online settings like their future students in the context of ERT. As the teachers' technology usage is highly related to the context in which their learning takes place (Porras-Hernández & Salinas-Amescua, 2013), TPACK study on pre-service EFL teachers might indicate new insights for teacher trainers and curriculum developers.

Besides, according to the theory of experience, each experience creates a unique way of learning and acting (Dewey, 1938). Additionally, teachers' background on their learning experiences impacts their teaching with other factors (Zimmer et al., 2021). This simple fact necessitates looking at the experiences shaped by societal changes iteratively.

As a major change in society, there was a shift of educational practices into the online setting due to pandemic restrictions. In other words, teacher candidates enrolled in teacher training programs had a chance for hands-on experience with technology in their program. Given this, all participants in the study were trained online, which required a good command of technological knowledge.

This study aims to investigate TPACK levels of pre-service teachers of the English language to see whether the training program delivered in online settings is adequate for their knowledge development. It also aspires to investigate the TPACK quality in practice with pre-service teachers to understand the pedagogic reasoning development via lesson plans, observations, and interviews. While doing so, this study adopts a mixed methodology by utilizing both quantitative and qualitative data collection and analysis.

1.3. Research Questions

Considering the background and significance of the study presented in this chapter, the research questions were formulated as follows,

1- What are the TPACK levels of pre-service English teachers according to their study year in the current English Language Teaching program?

2- Do the TPACK competency levels of pre-service English language teachers differ with respect to their academic levels?

3- Which TPACK domains best predict the total TPACK scores of the participants?

4- How do the lesson plans resonate within the TPACK framework?

5- How do the performances of the pre-service teachers of English manifest themselves during the practicum within the TPACK framework?

6- How do pre-service senior-year English teachers interpret their TPACK levels based on the teacher training program and the practicum experience?

1.4. Definitions of Terms

This section presents brief definitions of terms used in the present study. Provided definitions are restricted to the scope of the study.

Technology: Technology has been acknowledged as one of the most intricate terms since no definition neither subsumes comprehensively nor excludes it completely (Nightingale, 2014). Nevertheless, in a broader sense, technology refers to the tools, techniques, and processes used to create, produce, and communicate goods and services (Trif, 2022). The term includes using machines, software, and infrastructure to perform tasks more efficiently and effectively, as well as the knowledge and expertise of people to develop and use these tools (Herschbach, 1995). In the scope of the present study, technology has been conceptualized as from the "tacit knowledge" dimension (Polanyi, 1997). In this sense, along with the bearer of an "imposed" rather than possessing an "intrinsic" function, (Searle, 1995).

Online education: Online education refers to the delivery of instruction, which web technologies have utilized as the medium of learning and teaching processes (Lee, 2017; Moore et al., 2011). Although the term “online learning” has been used

interchangeably for online education (Singh & Thurman, 2019), the meaning of these two terms has been found to be referring to the same phenomena; that is, utilizing web tools for delivering the content, using web-based tools for maintaining educational processes, such as assessment and evaluation, and providing interaction through the medium of the internet (Singh & Thurman, 2019). Moreover, the web's ubiquitous nature enables learners and instructors to connect with no restriction concerning physical boundaries.

Online Teaching: Online teaching directly indicates the efforts and affordances of a trainer, teacher, and instructor using internet-based technologies (Punia et al., 2022). In this sense, activities and learning opportunities provided by the teacher characterize teaching online. Online teaching can be provided in two forms: asynchronously, where the content and delivery are prepared in advance of the instruction, or synchronously, where the content delivery occurs concurrently with the teacher's presentation (Moore et al., 2011). Nevertheless, online teaching and online learning can be subsumed under online education as the latter is conceptualized as an umbrella term (Singh & Thurman, 2019).

Emergency Remote Teaching (ERT): Emergency Remote teaching implies a tentative process of educational processes characterized by distance due to emergencies threatening a specific dimension of life. Named after covid-19 breakdown and coined by Hodges et al. 2020, this phenomenon pertains to the online education praxis when no communities were allowed to gather, including the classrooms. According to Hodges et al. (2020), ERT is marked by compulsory change aiming for no recess in education rather than a planned and predetermined educational program. Thus, it cannot be the same with online education conceptions (Hodges et al., 2020).

Information and Communication Technologies (ICT): Information and communication technologies, most known as ICT, are "a diverse set of technological tools and resources used to transmit, store, create, share or exchange information" (Unesco IIEP LearningPortal, n.d.).

Technological Knowledge: Technological knowledge is the ability to use information technology, from basic hardware peripherals to essential software designs. According to Koehler et al. (2013), this definition refers to the development

of a comprehensive understanding of technology so as to choose, use, and enhance it in a sensible manner.

Pedagogical Knowledge: Pedagogical knowledge is a general understanding of learning and teaching processes that are eligible for fundamental learning theories. These processes include classroom management, measurement, and evaluation, as well as educational philosophy that accounts for systematic development, values, and beliefs.

Content Knowledge: Content knowledge stands for the "knowledge about the subject matter to be learned or taught (Koehler et al., 2013, p.14). This knowledge type depends on the teacher's expertise in their field.

Pedagogical Content Knowledge: This knowledge type falls into the intersection of content and pedagogical knowledge. It is defined as "a particular form of knowledge that embodies the aspects of content most germane to its teachability" (Shulman, 1986b, p. 9).

Technological Content Knowledge: Technological content knowledge is "an understanding of the manner in which technology and content influence and constrain each other" (Koehler et al., 2013, p.16) within the contexts created by technological developments.

Technological Pedagogical Knowledge: Technological pedagogical knowledge refers to the ongoing interplay between technological affordances and learning and teaching style and strategies.

Technological Pedagogical Content Knowledge (TPACK): Technological pedagogical content knowledge, TPACK, is a constituted framework regarding teacher knowledge encompassing utilizing pedagogical understanding and content knowledge expertise in combination with technological knowledge (Angeli et al., 2016; Archambault & Barnett, 2010; P. Mishra & Koehler, 2006).

Pre-service teacher: Pre-service teachers can be defined as a particular group of students enrolled in a "course or program of study which they complete before begin to teach" (Richards & Schmidt, 2010, p. 454). In general, pre-service teachers earn a degree that certificates their teaching competencies at the end of the program. Specifically, in the present study, pre-service teachers refer to a group of students who enrolled in an education faculty to study the teaching profession and the subject

matter expertise. At the end of the four-year first-cycle diploma program, students graduate with a bachelor's degree and are deemed competent to become a teacher.

Practicum: Practicum is defined as “a course of study designed especially for the preparation of teachers and clinicians that involves the supervised practical application of previously studied theory” (Merriam-Webster, n.d.). In the field of education, practicum provides opportunities to pre-service teachers so that they can put their teaching training knowledge into practice. For the present study’s context, pre-service teachers are obliged to fulfill the practicum requirements in their last year under the supervision of mentor teachers and university academics.

2. LITERATURE REVIEW

This section defines the TPACK framework in detail, starting from the historical background in the development of the model. Consecutively, conceptual underpinnings are summarized with an elaboration of the dimensions of TPACK. Last but not least, previously conducted TPACK studies are demonstrated with the focus of relevancy to the present study. At the end of the chapter, a brief summary of this section is provided.

2.1. Historical Background of TPACK

Knowledge types that a teacher should possess have always gotten researchers' attention as these knowledge repertoires have been deemed as the indicator of teaching quality. The teachers' quality based on the knowledge types they have was discussed from different points of view, from philosophical to epistemological, theoretical to practical, by the researchers in the field of education (Harris et al., 2017). The pedagogical content knowledge type proposed by Shulman (1986a, 1986b, 1987) was one of the conceptualizations focused on "what forms and types of knowledge are required to teach competently" (Fenstermacher, 1994, p. 6) and received great attention from both practitioners and researchers.

Shulman criticized the absence of content when evaluating and analyzing teacher research and asserted that there was a "missing paradigm" in the literature, which is the "content" itself (Shulman, 1986b, p. 6). According to him, teacher knowledge cannot be divided into content knowledge and pedagogical knowledge, but it evolves into something different and more comprehensive than the pieces. On the other hand, pedagogical content knowledge is the new form of teacher knowledge which is defined as "a particular form of knowledge that embodies the aspects of content most germane to its teachability" (Shulman, 1986b, p. 9). Based on the concepts he formulated, he categorized teacher knowledge into content knowledge, general pedagogic knowledge, curriculum knowledge, pedagogical content knowledge,

knowledge of the students along with the context in which the teaching takes place, and knowledge of educational purposes, history, and philosophy (Shulman, 1987, p. 8). In this perspective, teacher knowledge has been regarded as complex and dynamic in nature rather than transferring specific knowledge pieces from the teacher to the learner.

The curriculum knowledge type was used as an umbrella term by Shulman (1987), indicating diversified tools during the instruction along with computers and technology. However, in these early works, clarification and required discussions related to the power and influence of the technological aspects in educational practices remained superficial (Angeli & Valanides, 2009). For this reason, technological advances, especially in the information and communication fields, necessitated more sophisticated theoretical and epistemological foundations to elaborate the effects of the technology knowledge transformation on the other knowledge types of teacher knowledge.

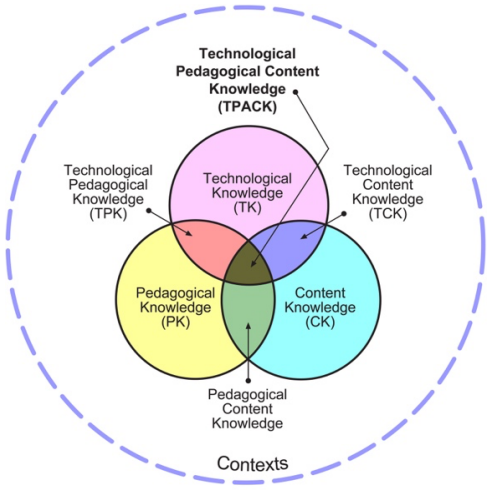
In the early 2000s, researchers claimed that there was a need to define teacher knowledge types in light of incipient technological developments since effective teaching activities were reshaped based on technological tools both in the classroom and outside of it (Angeli & Valanides, 2005; Koehler et al., 2007; Niess, 2005; Pierson, 2001). Chapelle (2003) posed a different point of view and emphasized the changing nature of the learners and the subject matter due to technological advances. According to her, the transformation of learners' characteristics and of the language itself due to the permeating nature of digital technologies has necessitated rethinking language learning and teaching processes (Chapelle, 2003, pp. 2–33).

Following Shulman's (1986b, 1987) argumentation on teacher knowledge formation and the necessity to think about technology in education, technological pedagogical content knowledge (TPACK, TPCK in the earlier works) was established by Mishra and Koehler (2006) and echoed in the teacher education literature (Voogt et al., 2013). The framework encompassed three core knowledge types, technological knowledge, pedagogical knowledge, and content knowledge, to constitute higher-order knowledge types, those are technological content knowledge, technological pedagogical knowledge, and pedagogical content knowledge. The highest-order knowledge type of the framework was formulated as technological pedagogical content knowledge, which was at the intersection of all knowledge types in question.

Even though the framework was elaborated in detail by Mishra and Koehler (2006), systematic research was done until then, was paved the way for its conceptualization (Angeli et al., 2016). With the emerging cruciality of the framework, research on TPCK accelerated, and scholars offered different conceptualizations. For instance, Pierson (2001) anticipated a necessity for a technology component for the already discussed PCK concept and spelled out the importance of technology integration into the teaching process within the framework of PCK. Following her work, Niess (2005) emphasized the dynamic knowledge structure of TPCK, in which the development of each construct contributed to the development of general technological pedagogical content knowledge. In 2006, Koehler and Mishra contributed to the literature and conceptualized the TPCK. Subsequently, technology was attached to the PCK as one of the inseparable parts of the teacher knowledge types (Zhang & Tang, 2021). Angeli and Valanides (2005) contributed the relevant literature with a focus on information and communication technologies and claimed that "ICT-related PCK" would encompass the dimensions regarding teachers' competence to exploit both technical and digital opportunities for effective teaching. Shortly after, Thompson and Mishra (2007) came up with a convenient acronym as, TPACK, which implies the "Total PACKage" to emphasize the interwoven dynamics of the constituent dimensions could not be comprehended as detached parts but rather as a whole (Angeli et al., 2016, p. 16).

Nevertheless, TPACK still has been gathering researchers' and practitioners' attention even though it originated decades ago. According to recent research, the framework has still had an impact on developing, assessing, and evaluating teachers and teacher candidates (Brianza et al., 2022; Irwanto, 2021; Ning et al., 2022; Tseng et al., 2022). Still, it is hard to claim that a consensus on some points related to the theoretical and conceptual foundations of the framework has been built. Mostly cited, a Venn diagram presented in Figure 1 is found to be a successful depiction of the TPACK model. The epistemological foundations of TPACK will be presented in detail, along with conflicts and confirmations, in the next section.

Figure 1. Venn Diagram of TPACK Domains



Source: TPACK.org

2.2. Conceptual Framework of TPACK

The conceptual foundations of TPACK cannot be unfolded unless one understands the PCK, which was proposed by Shulman (1986b, 1987), since his work on the knowledge domains of teachers to be developed set the ground for the reasoning behind TPACK. Shulman's pedagogical content knowledge structure has promoted the intricacy of teacher knowledge construction. In his work, the pedagogical and content aspects have been conceptualized as complex and elaborate systems rather than isolated structures. According to Shulman, teachers should go beyond "being able to comprehend subject matter for themselves, to become able to elucidate subject matter in new ways, recognize and partition it, clothe it in activities and emotions, in metaphors and exercises, and in examples and demonstrations, so that it can be grasped by students" (Shulman, 1987, p. 13). Basically, the PCK accounts for a valuable transformation of the knowledge regarding the subject matter into the way of teaching it.

PCK has been echoed in the literature, enabling teacher trainers and researchers to study teacher competencies comprehensively. The initial reasoning behind Schulman's conceptualization of the intersection of two knowledge sources, the pedagogical content knowledge, inspired education researchers when they came up with a new dimension, technology. According to Mishra and Koehler (2006),

technology was so ubiquitous that the pedagogical content knowledge framework necessitated incorporating technology as a unique aspect to form teacher knowledge.

The epistemological explanation regarding the nature of TPACK was discussed from two distinct viewpoints, integrative and transformative (Angeli et al., 2016). The integrative view positions itself as the concept TPACK was the sum of its constituents. In other words, subcomponents of TPACK mediate the concept in explaining the formation of the ultimate knowledge type. The concomitant result of the integrative position implies that an increase in one subcomponent of the general framework (e.g., TK or PK) brings about a total rise in the concept at the intersection (e.g., TPK) (Angeli et al., 2016). The integrative structure accounts for the complex formation of teacher knowledge along with teacher behavior on a rational basis. Each concept component is acknowledged as the crucial discrete point to be analyzed (Koehler & Mishra, 2009; Mishra & Koehler, 2006).

On the other side, the transformative position of the concept stands for a total transformation of the subcomponents regarding the umbrella concept. According to Angeli and Valanides (2009, 2016), effective conceptualization and implication of TPACK imply the amalgamation of the subcomponents that constitute a different and unique knowledge type. Hence, increasing one knowledge type does not necessarily mean a rise in TPACK level since it has been conceptualized as a new knowledge type and beyond the sum of its components. In other words, the transformative view of the TPACK means something more than the accumulation of the pieces (Angeli et al., 2016; Angeli & Valanides, 2009; Archambault & Barnett, 2010; Cox & Graham, 2009; Graham, 2011; Papanikolaou et al., 2017; Yeh et al., 2014).

Based on the discussions on the epistemological foundations of TPACK, it may be concluded that the research having been conducted in pursuit of whether the framework was transformative or integrative provided little insight into explaining and manipulating further studies. More precisely, the transformative and integrative perspectives effectively demonstrate TPACK development in teacher competencies without erasing each other. Indeed, both views seem advantageous in evaluating and understanding TPACK competencies, and each has some deficits that cannot fully encompass the concept. Nevertheless, it is clear that the transformative power of the framework cannot be achieved unless the subcomponents are fully comprehended

and integrated into teacher reasoning. In other words, both epistemological viewpoints are valuable and work consistently in the formation of teacher reasoning.

The teachers' reasoning shapes the teaching expertise, a dynamic knowledge-construction process. This process is characterized by utilizing a myriad of knowledge resources, such as student thinking and knowledge of the content itself (Mishra & Koehler, 2006), the teaching contexts (Chai et al., 2013; Glaser, 1984; Putnam & Borko, 2000; Rajagopalan, 2019; Shulman, 1986b, 1987) and the culture and community (Oktay & Osam, 2013). Nevertheless, the content knowledge dimension manifests itself as a founding milestone and should be elaborated further in the conceptual framework.

Apart from being founded as transformative and integrative, the TPACK is also elaborated on the approaches to the content knowledge domain. Theoretical views on the content knowledge of TPACK have been scrutinized in two different aspects, general and specific. The early research targeted TPACK as a general construct with little focus on how to deal with the content in detail. For instance, content knowledge was defined briefly as "knowledge about the actual subject matter that is to be learned or taught" (Mishra & Koehler, p. 1026) or "language proficiency level and command of English" for EFL teachers (Rahimi & Pourshahbaz, 2019, p. 55). Even though some researchers argue the necessity of a broad base for content presentation in research (Angeli & Valanides, 2016), the virtue of conducting specific subject matter base research is undeniable since content-specific inquiries would delve into the strengths and weaknesses of TPACK. Besides, language teaching is differentiated from other teaching disciplines since many contextual factors play roles that matter of "who teaches what to whom, where" (Freeman & Johnson, 1998, p. 405). Given the importance of domain-specific interrogation, accumulating works on TPACK showed the contrary. The studies aiming to measure general TPACK, regardless of the domain, outnumbered domain-specific research until 2013 (Wu, 2013; Chai et al., 2013; Voogt et al., 2013). Language teaching, on the other hand, was found to be only 12.1% of those studies' scope of content knowledge after five further years (Willermark, 2018). Language education has lagged in domain-specific studies regarding TPACK, especially when compared to science and mathematics education (Tseng et al., 2020). It is clear that the need for content-specific TPACK studies in EFL still continues.

Apart from the research agenda, EFL teacher training programs started to integrate technology into the curriculum in several modalities and functions (Kaufman, 2015), such as material design and development, open and distance education, instructional technologies, and information technologies in education, to prepare proficient teachers in the field. Even though there are some doubts about the effectiveness of those courses to the EFL pre-service teachers' competencies (Aşık et al., 2020), prospective teachers are highly aware of the cruciality of becoming technologically competent teachers (Özpınar, 2020; Valtonen et al., 2021).

To summarize, the dynamicity of teacher knowledge formation is highly susceptible to societal developments and changes. Given the speed of changes in technological enhancement, it can be clearly asserted that the way of thinking, acting, and performing of a teacher has been in the process of ongoing adjustments. These adjustments require getting to know technology in hardware and software and unifying these knowledge types to the pedagogical and subject matter. The concomitant result of the requirements for teacher knowledge construction explicitly implies that pre-service teacher training regarding technological competencies plays a vital role in future teachers' knowledge construction (Lambert & Gong, 2010). In a more detailed consideration, teachers' content-specific knowledge fundamentally shapes the reasoning and the practice of their actions.

The interwoven relationship between different knowledge types constitutes TPACK, and "this framework posits implicitly that teachers' TPCK can be developed through the integration of PCK, TCK, and TPK" (Angeli et al., 2016, p. 16). Since these knowledge types and the relationships between them form the frame for the concept, they will be represented in the following subtitles to elaborate on the unifying characteristic of TPACK.

2.2.1. Technological Knowledge (TK)

Technological knowledge is a normative type of knowledge and manifests itself when making judgments regarding the effectiveness of the tools' function (de Vries, 2005). In other words, having this specific knowledge type deals with what works and what is useful rather than coming up with general laws in pursuit of the truth (Nordlöf et al., 2022). In educational contexts, technological knowledge refers to the knowledge type to use and exploit technologies, from essential tools to sophisticated

ones. Even though technology connotates with computers and digital systems, this broad definition includes commonplace tools used in classrooms, such as blackboards, textbooks, or overhead projectors. Similarly, within the TPACK framework, it has been categorized as the ability and knowledge to be able to operate web tools, basic software programs, computers, and peripheral devices (Mishra & Koehler, 2006) and also defined as the "knowledge about various technologies, ranging from low-tech technologies such as pencil and paper to digital technologies, such as the Internet, digital video, interactive whiteboards, and software programs" (Schmidt et al., 2009, p. 125). TK domain has a significant positive impact on the overall TPACK development (Ozgun-Koca, 2009).

2.2.2. Pedagogical Knowledge (PK)

Pedagogical knowledge (PK) refers to general knowledge about teaching methods, assessment and evaluation processes, classroom management, and preparing lesson plans (Mishra & Koehler, 2006), along with teacher's strategies to improve students' motivation and communication with students and parents (Cox & Graham, 2009), that should be known and practiced by teachers regardless of the subject domain. According to Guerriero (2020), the general pedagogic knowledge type encompasses some psychological components, such as having adequate knowledge of the learning processes in addition to the individual learner characteristics with cognitive and affective dimensions.

The all-encompassing nature of this knowledge type requires a deep understanding of student learning and the implementation of the target skills accordingly. The premise of having a good command of PK then can be characterized as comprehension of learning and development theories that are required for an influential learning atmosphere regardless of what to and whom to teach (Malva et al., 2020).

2.2.3. Content Knowledge (CK)

Content knowledge (CK) is the isolated knowledge type that indicates a teacher's expertise in their specific field of teaching, such as science, geography, or language (Cox & Graham, 2009). Additionally, content knowledge can be traced to the ability of teacher's establish patterns between the content area subdimensions, their solution developments for daily life problems with the help of the expertise in the content knowledge, and their alignments in updating this knowledge type constantly

regarding current developments (Çetinkıran, 2022; Kabakci Yurdakul & Coklar, 2014). In a general sense, this knowledge type is "the amount and organization of knowledge per se in the mind of the teacher" (Schwab, 1972, p. 9) and includes primary concepts and frameworks in a specified discipline (Deng, 2018). A good command of content knowledge is acknowledged as a prerequisite for teaching the subject matter effectively (Deng, 2018; Leader-Janssen & Rankin-Erickson, 2013; Shulman, 1986a).

While the content knowledge type refers to the subject matter itself, and generally, these two phrases are used interchangeably, Grossman (1990) used "content knowledge" as a subsumed element of the subject knowledge along with substantive knowledge, syntactic knowledge, and personal belief of the teacher. All of these knowledge dimensions affect a teacher's expertise in the field of their profession (Bourdillon & Storey, 2013). Nevertheless, content knowledge has been one of the most salient knowledge dimensions among the others since the sphere of influence size contributes the most significantly.

However, some scholars speculated whether teachers' content knowledge could be separated from pedagogical content knowledge since knowing "what" inherently includes knowing "how to teach" (McEwan & Bull, 1991; Segall, 2004). When it comes to language teaching, especially in ESL and EFL contexts, this distinction between content and pedagogical knowledge types gets more blurred.

Delving into the blurred position of the PK and the CK intersection becomes a thought-provoking process in explaining the realm of the CK. First of all, in teaching English, the CK involves a high level of proficiency; those are a good command of knowledge in use along with the structural information about English, but insufficient unless cultural awareness regarding the contexts the language has been used and sociolinguistic recognition were incorporated (Pachler et al., 2007). Given that language teaching has unique since the language is both the medium of knowledge transfer and the content that is taught (Freeman & Johnson, 1998), one of the reasons for the complexity in separating the PK and the CK can be implied.

In a similar vein, some scholars argue about the distinctive factors of these two different knowledge domains. Specifically, in teaching foreign language contexts, it is hard to distinguish content knowledge from pedagogic knowledge. To illustrate,

Bunch (2013) included knowledge about and theoretical aspects regarding second language acquisition in the field of pedagogical content knowledge for language teachers, even though these concepts were in the mainstream of content knowledge type. Still, it should be noted that most of the research regarding language teachers of English have addressed the discussion of teachers' knowledge base from the eyes of native English teachers. It is clear that the single-sided point of view is able to offer too few contributions to the growing literature (Zhang & Tang, 2021). This situation creates a need for studies aiming to explore and explain the knowledge needs of non-native English teachers (Borg, 2003, 2006). In addition to all these, contextual clues in the teaching and learning processes should be taken into consideration when interpreting the outcomes.

2.2.4. Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge (PCK) refers to "how a teacher's understanding of subject matter is transformed to make it 'teachable'" (Gudmundsdottir & Shulman, 1987, p. 60) and enables teachers to act more flexibly while teaching the subject matter according to content, curriculum, and learners. The PCK is situated at the intersection of the CK and PK, and it is characterized as the combined version of the knowledge of the specific representation of the subject matter in order to facilitate the learning process (Cox & Graham, 2009).

In a longitudinal study, researchers observed and interviewed teachers from different backgrounds in terms of their experience and found out that pedagogical content knowledge could be enhanced with reciprocal consideration of the specific content with appropriate teaching methods (Gudmundsdottir & Shulman, 1987). Simply put, meaningful reflections on the subject matter should be considered according to the specific content before and after practice. In other words, content and pedagogic knowledge cannot be thought of as solo pieces that sum up as pedagogic content knowledge. Instead, it can be said that the pieces equal something more significant than the sum.

Shulman (1987) emphasizes the pedagogical reasoning of the teachers when adapting and applying PCK. According to him, comprehension of the subject matter and the transformation of the target content into tailored chunks are the initial processes of pedagogical reasoning. Instruction with appropriate methods, evaluation of student's

understanding, and critical reflection occurs in a useful reasoning cycle. The cycle repeats over with a new comprehension stage (Shulman, 1987). As a consequence, PCK refers to the way "ensuring that have mastered both the content they will teach and the best ways of teaching it" (Mirel, 2011, p. 11).

2.2.5. Technological Content Knowledge

Being an integrated knowledge domain, Technological Content Knowledge (TCK) is characterized as the knowledge domain related to the content in question and refers to the ability to manage technological devices in accordance with the content on specialized. The TCK posits itself in a more general knowledge type regardless of the teaching concerns. In other words, an individual's technology-usage disposition in alignment with the content expertise contributes to the TCK levels.

Koehler and Mishra (2009) claim that the content-technology relationship has a deep root in the history of humanity. According to their premise, existing technologies constantly interact with subject-related knowledge development. The interaction defines how we learn along with what we learn by drawing boundaries in a meta-cognitive dimension. To illustrate, language learning technologies create new pathways that did not exist before, such as receiving instant feedback from word processing software, communicating with people regardless of geographic restrictions, and developing cultural awareness in a more authentic way. To put it simply, in the activation of TCK (Technological Content Knowledge), a teacher must be aware of how technology and content are connected and how they can impact each other. They must also have a strong understanding of how to use technology effectively to teach the subject matter in their field and how the use of specific technologies may influence the subject matter. It is important for teachers to understand how technology can support and enhance the content they are teaching and also how the content they are teaching may impact the use of technology in the classroom (Koehler & Mishra, 2009).

Although a robust conceptual picture was drawn, the empirical studies demonstrated the difficulty of separating this construct from other knowledge types in TPACK, especially for the language teachers (Archambault & Barnett, 2010; Baser et al., 2016; Cox & Graham, 2009; Koh et al., 2010). On the other hand, high levels of

TCK significantly affect pre-service teachers' decisions on teaching with technology (Mouza et al., 2014).

2.2.6. Technological Pedagogical Knowledge (TPK)

Technological Pedagogic Knowledge (TPK) is the combination of PK and TK and refers to the skillful transformation of these two knowledge domains. Koehler and Mishra (2009) indicate that the pedagogic consideration of a teacher interacts with the technological affordances so that the teacher's design, instruction, and strategies convert. In the development of TPK, teachers take pedagogical choices and limitations and advantages of technologies into close consideration. The reasoning shaped by the mentioned consideration paves the way for future decisions on the teaching process.

The contextual realities that occurred in idiosyncratic also incorporate into the TPK formation. Adjusting the technology integration according to the contextual factors, understanding learners' needs and meeting them properly, and manipulating the technologically advanced materials based on the needs are critical elements that construe the TPK. As many technological tools have been designed for purposes other than education, such as business-related work and corporation systems, the teacher's ability to transform these tools into educational ends reflects a good level of TPK.

Unsurprisingly, the previously mentioned issue regarding the separation of one domain from the others appears for the TPK, as well. Empirical research to date demonstrated that the interwoven dynamics of TPACK's components made it difficult to discern the TPK from the TPACK (Angeli & Valanides, 2009; Baser et al., 2016). Furthermore, as the knowledge type becomes more complex, separating them becomes more challenging.

2.2.7. Technological Pedagogical Content Knowledge (TPACK)

The overarching concept of technological pedagogical content knowledge (TPACK) stands for the intersection of PCK, TCK, and TPK, forming the most intricate dimension of the knowledge domain. As understood from the previous statements, TPACK refers to effectively teaching content using appropriate teaching methods and technologies (Schmidt et al., 2009). According to Koehler and Mishra (2009),

the TPACK is not simply a combination of these three types of knowledge but rather a unique form of understanding that is essential for effectively using technology in teaching. In other words, TPACK includes understanding how to represent concepts using technology, how to use technology in effective teaching methods, and how technology can be used to address challenges in student learning. It also involves understanding students' prior knowledge and theories of learning and how technology can be used to build on that knowledge. Essentially, TPACK is the foundation for skilled teaching with technology.

It should be noteworthy that TPACK formed a new dimension in teaching rather than adding technology to the PCK diagram. Utilizing technology for learning and teaching purposes creates and necessitates new reasoning pathways unavoidably. Thus, it makes a unique base for teacher knowledge that alludes to further implications stemming from a different way of reasoning (Smart et al., 2016).

2.3. TPACK and EFL Teacher Education

From the learners' perspectives, technology-integrated courses positively affect the success rate (Tamim et al., 2011; Xu et al., 2019), moderating the motivation of the learners and providing enriched opportunities for information transition between peers and the teacher. Additionally, technological tools facilitate instruction by decreasing the cognitive load stemming from the content itself. For example, providing interactive visuals and collaborative concept maps support education by forming a more concrete base for abstract thinking. In addition to all this, the instant feedback feature embedded in technology-integrated lessons enables the learners to get informed regarding their work by the time the performance is accomplished (R. F. Schmid et al., 2014). Moreover, technology-enhanced teaching enriches the input that is known to be necessary for language learning and hence functions as a facilitative tool in the language learning process (Kazazoğlu, 2014).

The literature supports the effectiveness of technology-integrated educational practices. The most robust meta-analyses regarding the effectiveness of technology on learning outcomes show enhanced learning results on the learners, even though the reported effect size values are different (Ghanizadeh et al., 2015; Schmid et al., 2014; Tamim et al., 2011; Xu et al., 2019). Consequently, technology-integrated courses contribute to constructive learner outcomes with multiple dimensions.

Teachers' technology integration competencies are of utmost importance for creating effective learning outcomes.

Technology expands a plethora of opportunities to make use of authentic resources that are necessary for a practical language teaching environment. Hence, digital communication technologies are indispensable to EFL classrooms (Berrett et al., 2012; Hoopingarner, 2009; Liu et al., 2014). In a similar vein, the literature indicates that successfully integrating technology into language teaching is possible only if the teachers have TPACK (Aniq & Drajati, 2019). Indeed, a successful integration process can be actualized when practitioners take into account a synthesis of technology, content, and pedagogy (Voogt et al., 2013).

Altun (2007) claims that teachers fail to effectively synthesize their technological knowledge into teaching practice unless they get the training during the teacher training programs. Indeed, the necessary training should be integrated into the teaching training programs rather than extra in-service training so that pre-service teachers assimilate the requirements, literacy, and reasoning behind the instructional choices. (Maeers et al., 2000).

Technology integration into teaching practices is highly related to the teachers' self-efficacy levels in addition to having been educated regarding technology integration during the pre-service training (Hall & Trespalacios, 2019; Wang et al., 2004). Hence, boosting pre-service teachers' self-efficacy assumptions would aid with sustainable technology adoption in their teaching practices (Holden & Rada, 2011).

In the literature, EFL pre-service teachers' self-efficacy levels and attitudes toward technology use seem high. However, when it comes to actual practices in classrooms, a discrepancy between efficacy, attitudes, and behaviors occurs. Examining 202 English instructors in Turkey, Yaprak and Tüm (2021) revealed a significant difference between utilizing Web 2.0 tools in instruction and attitudes toward these tools. The teachers showed little endeavor in integrating technological tools even though they had positive perceptions regarding the influence of technology-integrated lessons on learner success.

Similarly, Arıkan and Özel (2015) investigated 112 EFL instructors' technology usage behavior based on personal and instructional usage along with the participants' self-reported data regarding their competence in technology skills. EFL instructors

showed high competency in utilizing technology overall. At the same time, the use was limited to personal goals such as searching for information on the web, using word processor tools, and social networking. Surprisingly, they expressed high merits of using similar tools for engaging instruction; however, most of them expressed that they were insufficient in utilizing technology for instructional purposes.

Investigating the reasoning behind EFL teachers' selection of materials when they were forced to teach online due to pandemic restrictions, Suharyadi and Wulyani (2022) found out that the most frequent purpose was user-friendly tools, which were categorized as “easiness,” both for teachers and students. Similarly, Mirriahi et al. (2015) gathered responses from 23 faculty enrolled in Foreign Language Schools in order to reveal the possible factors for technology adoption in instruction. After coding the qualitative data, they reached a similar result; easiness of accessing information was one of the most frequently cited factors (N=18).

With a more practical consideration, Uzundurdu (2022) analyzed EFL pre-service teachers' technological readiness along with their competence in using relevant digital technology tools for the EFL context. The study focused on competence and background knowledge regarding the appropriate tools for effective English language teaching. They claimed that there was a relationship between technology integration readiness and their disposal in utilizing it in the classroom. The readiness and positive attitude toward integrating technology were closely linked to the background knowledge and familiarity of the tools in question. This outcome can be deemed as evidence of the importance of technologically enriched curricula for pre-service teacher education (Uzundurdu, 2022).

It is clear that keeping up with the velocity of evolving technology is challenging for an English teacher, yet it is not impossible. However, being accustomed to and competent use of state-of-the-art technological developments for educational purposes does not necessarily indicate the overall effectiveness and competencies of the English teacher. As Salaberry (2001) put forward, overemphasizing technical capabilities may engender misconceptions unless the pedagogical aspects of teaching and learning are considered. Following Saubern et al.’s (2020) remarks, the strength of TPACK should be exploited in order to integrate technology into teaching, and this aim could be achieved by paying close attention to the meaningful

conceptualization of the framework by the practitioners. During the teacher training program, the required reasoning could be inoculated to the pre-service teachers so that they would have solid ground for their practices by the time of their career.

2.4. Relevant TPACK Studies

Given the fact that the TPACK framework provides a rich tool for research and implementation in teacher training, it has been used for a myriad of studies in different contexts. Thus, review studies of TPACK enable a broad perspective in terms of the evolution and future of the technology-pedagogy-content triangle in teacher training.

Pre-service teachers' TPACK levels, on the other hand, have been addressed in different modalities and various research methodologies. In a detailed investigation, Tondeur et al. (2017) focused on the relationship between ICT profiles and TPACK levels of pre-service teachers (n=688) and underlined the dynamic process of acquiring TPACK. Simply put, the teacher training process was a powerful determinant in TPACK development only if the pre-service teachers could synthesize the training principles into practice and collaboration using technology. Yet, this comprehensive study did not differentiate the teacher candidates' subject domains but provided a general view. Hence, interpreting the results according to the subject domain is not possible.

From a different perspective, following Kelly (2010) in his cautions about the absence of context, Rosenberg, and Koehler (2015) conducted a systematic review of TPACK studies that included context in their design. 193 studies met the inclusion criteria, and these studies coded whether the context was apparent in the variables of teacher, students, and at the micro, meso, and macro levels. The results indicated that context was included in 36% of the total number of studies, and there were discrepancies regarding the inference of the concept. However, the subject matter of the participants' expertise was a missing element of this study, and therefore the results did not provide specific conclusions about the pre-service teachers' subject domain.

In more recent research, Wang et al. (2018) searched for commonalities and discrepancies in the TPACK-related literature with a sharp focus on pre-service

teachers. They found out that TPACK development measurements relied on self-reports that participants' self-perceptions on the knowledge domains in question (47,7%, N=88) rather than other measurements such as observations conducted in-class practices, materials designed by pre-service teachers to determine whether TPACK enacted in those artifacts, and reflections elicited from pre-service teachers to demonstrate the reasoning and perceptions.

TPACK inherently includes the “content knowledge” domain, which refers to the subject matter expertise of the teachers. Given the focus on language teaching, Tseng et al. (2020) scrutinized the growing literature with the delimitation of language teachers' TPACK. They concluded that there is still a need for content-specific TPACK studies, and the body of literature is void of TPACK practices in an authentic context.

Open-ended questions are also included in some research designs. The results demonstrated that pre-service teachers’ TPACK development in their self-perceptions appeared due to the modeling of the teacher-trainers (Çalik et al., 2014; Kennedy-Clark, 2011; Tokmak et al., 2013). According to Wang et al. (2018), modeling by teacher trainers, such as demonstrating and offering hands-on experience, contributed significantly to the general TPACK level. Hismanoglu (2012) echoed the importance of practice in internalizing the theoretically formed knowledge. According to him, teacher training should enable pre-service teachers the hands-on experience by adopting a “learning by doing” approach in technology integration (Hismanoglu, 2012, p. 190)

To sum up, TPACK has been assessed by various tools such as self-reported instruments in which participants rate their knowledge repertoire, interviews in which participants share their experiences, intentions, and thoughts, lesson plans in which participants' planned teaching behavior reflected, and observations in which actual teaching performance is evaluated. The next section is devoted to the presentation of reviewed literature according to the research design have been followed.

2.4.1. Survey-Design TPACK Studies

The TPACK framework has been exploited by researchers and practitioners for being effective, comprehensive, and having theoretically sound ground. The surveys

developed on the basis of the theoretical ground of TPACK were utilized to measure teachers' competencies.

For example, Berber and Erdem (2015) investigated pre-service teachers' TPACK perceptions by gender, age, program, along with field experience. They also examined the predictive power of TK, PK, and CK on the overall TPACK. The results indicated that the difference was significant in gender and TK, and male students yielded better outcomes than female students. When it comes to analyzing the predictive power of the subcomponents, CK and PK significantly and positively contributed to the overall model, while TK did not contribute significantly. In other words, the technological knowledge of pre-service teachers could not be incorporated into the TPACK development. In total, the model predicted 31% of the variation in TPACK. While the study encapsulated 491 pre-service teachers among various fields of teaching programs, foreign language teachers lagged behind their colleagues with regard to reporting their TPACK competencies, which were in primary education, mathematics, and social sciences (Berber & Erdem, 2015).

Atar et al. (2019) examined pre-service EFL teachers' TPACK levels through the TPACK-Deep scale, which was developed by Kabakçı-Yurdakul et al. (2012). The scale targeted EFL teachers' knowledge levels and followed a domain-specific focus for TPACK development. The subdimensions of the survey were designed as "design, exertion, ethics, and proficiency." These sub-dimensions were examined by Atar et al. (2019) according to gender, daily use of the internet, everyday use of social media, and class levels. They found that pre-service English teachers had a high level of TPACK even though some differences occurred in the subdimensions.

Sarıçoban et al. (2019) conducted a survey-design study that shows descriptive characteristics of Turkish pre-service ELT students. Seventy-seven pre-service English language teachers were administered the TPACK-EFL survey developed by Baser et al. (2016). The results indicated that pre-service English teachers have moderate to high TPACK competencies operationalized with seven factors. Demographic data showed no significant difference in terms of age, but differences occurred in some subfactors in terms of gender. Male participants showed more confidence in utilizing their technological knowledge ($p = 0.015$, $< \alpha = 0.05$). The results were similar to the other survey design studies conducted in Turkey to measure self-reported TPACK competencies. For example, a study conducted by

Solak and Recep (2014) showed that male participants were more competent than female coeds in terms of technological knowledge. In contrast, female students achieved better scores in pedagogical subcomponents. They also incorporated the students' overall achievements as a variable to be investigated and found no significant difference.

Examining the TPACK of language teachers' teaching in different languages, Erten (2022) adopted a survey-design method in the Turkey context. The prominent results indicated that a significant difference occurred between the Turkish language teachers and other participant groups (English Language Teachers and Oriental Language Teachers), while no significant difference was found in the gender variable.

Nonetheless, teachers' TPACK is susceptible to many contextual factors. Yet, the most prominent factor has been indicated as teachers' attitudes toward technology and the technology in use in teachers' lives (Raygan & Moradkhani, 2020).

2.4.2. Lesson Plans and Observations in TPACK

It is generally accepted that while professional knowledge is vital for teachers, it is not the only factor determining their practical ability (Blömeke et al., 2015; Sailer et al., 2021). From the perspective of the current inquiry, it can be concluded that the TPACK levels of the teachers might contribute to their teaching competencies, yet the inference would remain insufficient. In order to gain a deeper understanding of the phenomenon, this study utilized more than TPACK scores to explain pre-service teachers' competencies, such as lesson plans, observations, and a focus group discussion.

Webb and Cox (2007, p. 276) state that "teachers need to use their knowledge of learners and their subject expertise to select appropriate ICT resources that will provide affordances to enable students to meet the learning objectives." Taking into account the merits other than relying upon only declarative statement base measurements (Shavelson, 2010), teachers' decision-making processes can be traced through the lesson plans (König et al., 2022).

Lesson plans are the structured to-do lists of a teacher in which the subject, objectives, goals, and activities are arranged. Indeed, planned activities and course structure manifest themselves in a well-designed lesson plan, and TPACK

implementations can be detected from those plans (Backfisch et al., 2020; Chai et al., 2016; König et al., 2020).

Karakaya (2017) analyzed data regarding the TPACK levels of pre-service teachers via a survey in which participants assessed themselves and through lesson plans that they designed. Lesson plans were evaluated through the rubric developed by Harris et al. (2010). The results showed high levels of self-perceptions of TPACK domains, while the same rate did not reflect in the lesson plans. In a similar consideration but with a different analysis method, Schmid et al. (2021) coded lesson plans designed by student-teachers who were enrolled in a master's degree program of various subjects (STEM, social sciences, and language) to see whether a difference occurred between the subject expertise. They collected plans from 173 participants and, as an initial process, coded them to determine whether technology was included or not. While 21,4% of the lesson plans did not integrate any technological tools, language teachers lagged far behind the STEM teachers in the number of technology-integrated plans (62,8%, and 20%, respectively). When it comes to the quality and pedagogic reasoning implementation in regard to the content and the digital tools, teachers were found to be the user of technology rather than the students (73,4%, for the language teachers who included technology) (Schmid et al., 2021). This result indicates that technology usage has been conceptualized as "teachers' use of technology" only, which seems pedagogically problematic.

In addition to the observation data, studies targeted at exploring TPACK formation also have utilized reflections, discussions, and other qualitative data collection procedures to elicit responses from the pre-service English language teachers. For instance, Pamuk (2012) gathered data from junior-level pre-service ELT students' project reports, designed teaching materials, and open-ended questionnaires along with observations. The TPACK formation was found to be unsatisfactory, although the participants acknowledged the essential value of integrating technology. The interpretation of the results emphasized the importance of the PCK domain since the pedagogical content knowledge base was thought to be the best indicator of emerging TPACK level (Pamuk, 2012).

When the filter was minimized to lesson plan data analysis with the rubrics, the "Technology Integration Assessment Rubric" developed by Harris et al. (2010) was utilized in multitudinous studies. For instance, Koyunkaya and Taşdan (2019) used

this instrument to examine the lesson plans developed by pre-service teachers and indicated that the integration was limited to the use of smart whiteboards and dynamic software related to the content expertise and insufficiency in integrating tools for effective teaching strategies. The same instrument was used by Mustafa (2016) on 17 teachers to evaluate their reasoning in technology integration through teacher-designed documents and follow-up interviews. Similar findings were found; the teachers failed to synthesize the instructional goals and the technology integration.

The same instrument was also frequently used to measure the effects of a training program as a pre and post-test design. Ansyari (2015) evaluated the professional development program designed for English language teachers. The result showed that after completing the program, English lecturers (N=12) showed an excellent improvement in performance in designing lesson plans.

Last but not least, Konig et al. (2022) reviewed the accumulated literature in the scope of the TAPCK framework and ICT-integrated lesson plans. They systematically analyzed the growing body of research and reached 12 studies that empirically investigated the lesson plans within the TPACK framework. According to their inclusion criteria, no research identified concerns about language teaching context. Therefore, it can be said that there is still a need for TPACK studies that combine lesson plan analysis with other data collection and analysis procedures in language teaching and learning contexts.

2.4.3. Focus groups in TPACK

Focus group discussions and interviews are one of the most common data collection instruments in TPACK studies in order to interpret the quantitative data in a meaningful way. Sadeeq (2020) interviewed 72 participants after collecting survey results. The participants' low level in the TPACK component was then attributed to the physical limitations and limited technological opportunities. In a similar design, Nazari et al. (2019) investigated TPACK levels of both experienced and inexperienced EFL teachers and found that experienced teachers had higher scores in PK and PCK than their inexperienced colleagues, while the latter group showed higher performance in TK, TCK, TPK, and TPACK subscales. The interview phase of their study indicated that TPACK and its components could be developed through

meaningful instruction, and professional development courses had the utmost importance in actualizing this goal.

In another study conducted by Aşık et al. (2018), pre-service English language teachers' voices were incorporated into the study in the form of focus group discussions. A hundred pre-service teachers agreed that utilizing technology-driven materials enhances the learning experience and the teaching profession's feasibility. They also emphasized the vital role of learning with peers, which was the most significant contributor to their competencies.

Understanding the effects of ERT on student EFL teachers, Mariette (2022) conducted a follow-up interview after the microteaching lessons. The interview data showed that self-competence in TPACK formation and positive attitude toward technology usage in teaching were reasonably high. However, pre-service teachers claimed the drawbacks of teaching with technology for classroom management considerations, which were highlighted as to need for development in the problematic fields.

2.5. Summary

As the OECD report states, "Technology can strengthen great teaching, but great technology cannot replace poor teaching" (OECD, 2015, p. 4). In other words, regardless of technical proficiency, a teacher who does not combine this knowledge with the expertise and pedagogical approach of the field would not be a valuable resource for future generations. Furthermore, it is evident that the technology integration would remain a simple move unless it is connected to pedagogical inferences and the teacher's subject expertise.

With its encompassing construct, the TPACK framework is a powerful guide for teacher education in this respect. Unsurprisingly, TPACK has been attracting the researchers' attention since it was promulgated. The body of literature is replete with TPACK measurement, assessment, and treatment studies that target different teaching contexts. However, Su and Foulger (2019) express that there is still more and more need for TPACK studies. Following their words and given that technology is integrated into social life with increasing momentum, this study aims to complement the growing literature rather than an iterative work.

3. METHODOLOGY

This chapter elaborates on the research setting, participants, and data collection tools, as well as the research design and data analysis in detail. It starts with explaining the research design. After, the research questions are defined within the scope of the previous literature review. Along with the research questions, the participants, the context of the study, and the role of the researcher are presented. Last but not least, trustworthiness, acknowledged assumptions, and limitations are exposed at the end of the chapter.

3.1. Research Design

The present study sought to explain pre-service English teachers' TPACK levels according to their academic levels as teacher trainees to see whether a stratification of those knowledge types has occurred between four-year students from freshman to senior. While doing this, TPACK competencies of the each-year class of pre-service teachers were explained using quantitative data. In order to get insights into those competencies, senior-year students' lesson plans were analyzed, their actual classroom experiences were observed, and their reflections were collected to enrich the data. In order to reach this aim, an explanatory sequential mixed-methods design was used in the study.

An explanatory sequential design is one of the mixed methods designs in research. In general, mixed methods are defined as "a type of research design in which QUAL and QUAN approaches are used in types of questions, research methods, data collection, and analysis procedures, and/or inferences" (Tashakkori & Teddlie, 2003, p. 711), and imply collecting and analyzing both qualitative and quantitative data in a study with the aim of utilizing both data resources and analysis (Creswell, 2014; Tashakkori & Creswell, 2007) to "complete the picture a research problem" (Creswell, 2002, p. 568).

A quantitative perspective enables the researcher to generalize the results of the data analyzed; however, the details within the contextual clues are vulnerable to elide. Thus, the present study combines both data collection and analysis types to describe and interpret the TPACK levels of pre-service teachers of the English language in an EFL context.

Using a mixed-methods design is known as a complex and structured way of researching; thus, it is divided into several types systematically. Sequential mixed-methods design is one of the structured types of mixed-methods and is characterized as follows:

> "In sequential mixed designs, the QUAN and QUAL strands of the study occur in chronological order. Questions or procedures (e.g., the sample or data collection techniques) of one strand emerge from or are dependent on the previous strand. The research questions for the QUAL and QUAN phases are related to one another and may evolve as the study unfolds" (Teddlie & Tashakkori, 2009, p. 31).

In alignment with the definition above, sequential explanatory mixed methods are structured as collecting and analyzing the quantitative and qualitative data in order. The explanatory dimension of the sequential design means that the first phase of the data collection and analysis is devoted to the quantitative data. The second step involves qualitative data collection, shaped by the first step analysis results (Creswell, 2014).

In summary, as Tashakkori and Teddlie (2009) indicated, mixed-methods design studies are guided by research questions to get better insights into the scope of the investigation. For the present study, the research questions have been the determinant factor for selecting the research design.

3.2. Research Setting and Participants

The participant group background is also another dimension worth incorporating into a TPACK study. All of the pre-service teachers were experienced in terms of using technological tools from a teacher-trainee perspective because of the ERT conditions. In other words, the pre-service English language teachers in this study were trained to develop content, pedagogical, and technological knowledge in online settings

where they had a chance to integrate theoretical standpoints in their own learning process.

As the initial phase of the study was to collect the self-reported quantitative data, the EFL-TPACK survey developed by Baser et al. (2016) was distributed to the EFL pre-service language teachers online after permission was gained from the survey developer. For the participant selection, the convenience sampling method was used. This sampling method is known as nonprobability sampling and "occurs when researchers select individuals to study because they are available and convenient, and meet some criteria or characteristics that the investigator seeks to study" (Plano-Clark & Creswell, 2015, p. 236). Although it is weak to represent most of the population, this sampling approach is the most frequently used sampling method among other sampling methods and is more practical than other nonprobability methods if the population size is high and it is impossible to reach every individual (Maheshwari, 2017). In this study, the survey questions were distributed through an online survey tool in which the required information for the study, the researcher's contact information, and an informed consent form took place. At the end of the survey, e-mail addresses were collected who would like to join further tasks and discussion sessions regarding the TPACK framework. For this question, the required section was not selected in the online form, so participants were free to skip the contact information question. When the procedure was completed, 219 pre-service English teachers responded to the TPACK-EFL survey. The descriptive information of the participants is presented in Table 1 below.

Table 1. Descriptive Statistics of the Participants (TPACK-EFL)

	Freshman	**Sophomore**	**Junior**	**Senior**	**Total**
Female	37	41	21	47	161
Male	15	14	13	14	58
Total	52	63	40	64	219

The descriptives of the participants present the ones who have included the first phase of the study. For the following phases, only senior pre-service teachers' lesson plans and the actualization of those plans in an authentic classroom atmosphere were included in the investigation. Descriptives regarding the participants of the following steps are presented below in Table 2.

Table 2. Descriptive Statistics of Participants (TIAR, TIOI, FGD)

	Lesson Plans Analyzed	Observations	Focus Group Discussion
Female	10	10	10
Male	4	4	4
Total	14	14	14

3.3. Data Collection Tools

Data collection tools for the present study are listed in Table 3.

Table 3. Data Collection Tools with Steps, Participant Numbers, and Purpose

The phase of the study	Data collection tool	Participant Number	Purpose
First Step	TPACK-EFL survey	219	To evaluate the TPACK levels of pre-service teachers To see whether a stratification occurs in subdimensions of TPACK between different class levels
Second Step	Technology Integration Assessment Rubric (TIAR)	14	To see the actualization of self-reported TPACK levels on lesson-plan basis from the TPACK framework perspective
Third Step	Technology Integration Observation Instrument (TIOI)	14	To see the actualization of lesson plans in actual teaching basis from the TPACK framework perspective
Fourth Step	Focus Group Discussion	14	To understand the teaching experience of pre-service teachers in depth from the TPACK framework perspective

As listed above, various data collection tools were utilized in this study. The TPACK-EFL survey developed by Baser et al. (2016) was selected as the quantitative collection step. At the end of this step, a general overview in concern to the perceived TPACK levels of pre-service teachers of English was drawn.

Additionally, foundation subcomponents of TPACK were evaluated to determine whether there was a significant difference between them across the class levels.

The rest of the study is devoted to the senior pre-service teachers' TPACK formation. In view of the fact that teacher education covers a period of four years, the senior group of trainees was selected on purpose. Thus, it is thought that a better insight regarding the pre-service teacher training could be captured with respect to the online trainee experience.

The following step includes collecting the lesson plans of pre-service teachers. Lesson plans were evaluated through Technology Integration Assessment Rubric developed by Harris et al. (2010). Those lesson plans were designed for the practicum experience in which teacher candidates perform teaching in their assigned K-12 schools. The schools were visited before the study to see whether the context was convenient for any teaching attempt that requires technology integration.

While the pre-service teachers were actualizing the teaching according to their lesson plans, the Technology Integration Observation Instrument designed by Hofer et al. (2011) was used. In addition to the instrument, field notes were taken to enrich the next step, which is the focus group interview. The focus group interview was conducted in a face-to-face environment with the participation of 14 students. The session was recorded, and at the end of the interview, the data was transcribed verbatim. A detailed description of each data collection tool is explained below.

3.3.1. TPACK-EFL Survey

The TPACK-EFL survey was developed and validated by Baser, Kopcha, and Ozden (2016) as a domain-specific tool for TPACK evaluation. The survey contains seven factors, which are TK, CK, PK, TPK, TCK, PCK, and TPACK. All 39 items were loaded under seven factors designed as positive expressions targeting participants' perceived competence. The distribution of the number of items for each factor is presented in Table 4.

Thus, participants are asked to read the statements and rate themselves whether they agree or not by selecting the number from 1 to 9. The structure of the rating system follows " 'nothing/ none' (1) to 'very little' (3) to 'some' (5) to 'quite a bit' (7) to 'a great deal' (9)" (Baser et al., 2016, p. 7). According to the developers of the survey, employing a 9-point rating system rather than a 5-point Likert commonly used may

increase the accuracy of the self-assessment results. The survey items can be seen in appendix 1.

The factors of the survey are compatible with the literature regarding TPACK. Constituent elements of TPACK proficiency, such as TK or TPK, have been addressed under separate factors, which increase the capability of interpretation of the results.

The survey was validated through EFA, and the internal consistency of the items was found to be greater than .70, which is an acceptable number of reliability coefficients. The reliability coefficients of the survey reported by Baser et al. (2016) and recalculated values for the present study are presented in Table 4.

Table 4. Factors and Reliability Scores of the TPACK-EFL Survey

Factor	Item Number	Cronbach Alpha (Baser et al., 2016)	Cronbach Alpha (Present Study)
TK	9	.89	.87
CK	5	.88	.90
PK	6	.92	.90
PCK	5	.91	.93
TCK	3	.81	.80
TPK	7	.91	.90
TPACK	4	.86	.85
Total	39		

In order to ensure the validity of the survey, the Pearson correlation coefficient values regarding the domains were calculated. To this end, the relationship between total TPACK scores, as measured by in TPACK-EFL scale separately, and technological knowledge (as measured by TK), pedagogical knowledge (as measured by PK), content knowledge (as measured by CK), pedagogical content knowledge (as measured by PCK), technological content knowledge (as measured by TCK), and technological pedagogical knowledge (as measured by PCK) was examined using a Pearson product-moment correlation coefficient. Before running the correlation test, preliminary analyses were conducted to determine whether there were violations of the assumptions for normality by checking the skewness and kurtosis values.

Scatterplots were examined to ensure no violation of the linearity assumption. The results of the correlation test are presented in Table 5.

Table 5. Findings of Pearson Correlation Analysis

	TK	CK	PK	PCK	TCK	TPK	TPACK
TK	1						
CK	.522**	1					
PK	.489**	.518**	1				
PCK	.456**	.503**	.864**	1			
TCK	.577**	.571**	.575**	.599**	1		
TPK	.612**	.616**	.779**	.792**	.749**	1	
TPACK	.580**	.488**	.653**	.626**	.704**	.760**	1

***. Correlation is significant at the 0.01 level (2-tailed)*

The results indicated that there were strong positive correlations between TPACK scores and its domains. Among all domains in correlation with TPACK, the largest one was found in TPK (r = .76, n = 219, p < .001). The correlation between CK and TPACK was measured to be the weakest (r = .48, n = 219, p < .001). Nevertheless, according to Cohen (1988), the CK domain can be interpreted as having a medium effect.

3.3.2. Technology Integration Assessment Rubric (TIAR)

The knowledge of pedagogy manifests itself in lesson plans as to what extent the teacher considers the learners' active participation and the student-centered classroom dynamics (OECD, 2018). Similarly, the degree and effectiveness of the technology integration into the teaching practice could be detected in the lesson plans.

The Technology Integration Assessment Rubric, TIAR, used in the present study was developed by Harris et al. (2010) for evaluating technology integration in lesson plans. The TIAR contains four criteria that are aligned with the TPACK subdomains

of TCK, TPK, TPACK, and TPACK fit (Harris et al., 2010). These criteria are defined as the “Curriculum Goals & Technologies,” “Instructional Strategies & Technologies,” “Technology Selection(s),” and “Fit.” The descriptions of each criterion were provided in the categories, which rate each criterion from 1 to 4. The TIAR is presented in appendix 2.

As for Curriculum Goals & Technologies, the target subdomain was designated as the TCK. This criterion specifically addresses the alignment of selected technologies with the goals of the curriculum, thereby of the lesson objectives. The lesson plan gets the highest score from the criterion, which is four, only if at least one technology fulfills the condition. The “Instructional Strategies & Technologies” criterion inspects the supportive role of technologies planned into the instructional effort. The target TPACK domain for the criterion is thought to be the TPK. The "Technology Selection(s)," on the other hand, quantifies whether the selected technologies are consistent with the goals of the lesson and with the strategies of instruction designed. The last criterion, the "Fit," combines all dimensions in the TPACK framework and seeks for harmony between the content, pedagogy, and technology.

Apart from the substantial compatibility with the TPACK, this instrument was found to be successful in terms of validity and reliability analyses. After forming the Technology Integration Assessment Rubric, TIAR, the developers received feedback from six TPACK experts to improve its validity. The interrater reliability of the revised rubric was determined using Intraclass Correlation (.85) and score agreement (84.1%). The internal consistency of the instrument was also tested using responses from 15 in-service teachers and teacher educators who evaluated lesson plans using the rubric. The test-retest reliability of the instrument was calculated by having the in-service teachers re-evaluate a subset of the lesson plans. The reported test-retest reliability of the TIAR was 87%. This instrument has been acknowledged as a reliable and valid rubric for evaluating teacher-made artifacts from the TPACK perspective.

Given the convincing results of instrument development phases and the consistency with the main focus of the research, this instrument was selected to be used in the present study.

3.3.3. Technology Integration Observation Instrument (TIOI)

According to Borg (2003), researchers restrict the implications of their study's findings in teacher knowledge inquiry without analyzing instructors' instructional methods. Indeed, the analysis of the teaching experience may bridge the possible gaps between the planned and actualized behavior. In order to achieve this goal, pre-service teachers were observed during their teaching in the practicum with the help of the Technology Integration Observation Instrument developed by Hofer et al. (2011).

The Technology Integration Observation Instrument (TIOI) was developed by Hofer et al. (2011), aiming at the assessment of pre-service or novice teachers' instructional practices. The TIOI is an advanced version of the TIAR (Teacher Instructional Assessment Rubric). It includes all of the criteria from the TIAR, as well as two additional criteria: "Instructional Use" and "Technology Logistics." The "Instructional Use" criterion evaluates the effectiveness of the technologies used in the instruction, while the "Technology Logistics" criterion assesses the teacher's ability to manage technology in a way that does not disrupt the lesson. The TIOI is provided in appendix 3.

The development process for the TIOI followed the same rigorous process as the TIAR. Two teachers piloted the first draft of the TIOI, and precautions were made to clarify the items. Next, seven experts in the TPACK domain revised the instrument concerning the construct validity. 12 teachers and teacher trainers tested the instrument on recorded videos. The TPK, TCK, and TPACK domains were taken into consideration in the development phase. The reliability of the instrument was ensured by calculating the ICC value (.80), Cronbach's alpha (.91), and percentage agreement score (90.8%). Overall, the TIOI strongly aligns with the present study’s scope and hence, was selected to be utilized for the observation phase.

3.4. Data Analysis

Since the present study makes use of various data collection instruments, analysis of those data followed different methods. The data collected by the TPACK-EFL survey, which was used to obtain a general look for pre-service English teachers’ knowledge levels regarding technology, pedagogy, content, and the intersection

domains of them, were analyzed through descriptive and interpretive statistics using SPSS program version 26. The lesson plans of the student-teachers were evaluated with the TIAR, which contains four criteria aligned with TPACK's conceptual framework. The actualization of those lesson plans in an authentic classroom atmosphere was also evaluated through the TIOI in order to see to what extent planned instruction was performed by the pre-service teachers. Finally, a focus group discussion was conducted to understand the justifications for troublesome moments during their performance and the reasoning behind the designation of the plans. All of these steps are presented in the next sections.

3.4.1. Data Analysis of the First Step: TPACK-EFL Survey

The TPACK-EFL survey developed by Baser et al. (2016) was distributed to pre-service English teachers enrolled in a private university. Along with the items in the survey, class-level information was also collected to interpret the results. The survey items were designed in an online form, and the link was shared with the participants. The informed consent information was included at the beginning of the survey, and consent was taken from all participants.

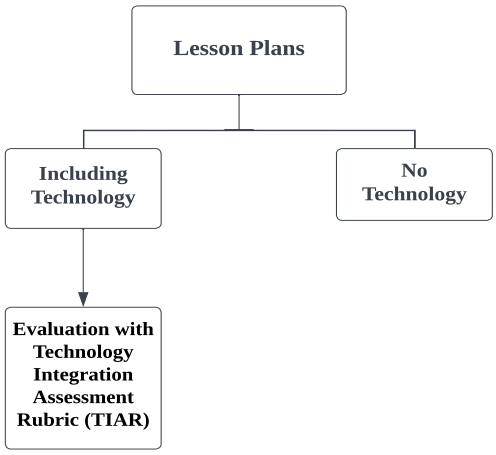
After collecting data, the reliability test was run for all items, and Cronbach's alpha values were checked. The normality of the data was checked as the next step to determine the test types to be conducted. Skewness and kurtosis values were examined along with histograms and scatterplots to see whether the normality assumptions were met. Further, the data were tested for each analysis to determine whether they met the criteria for the statistical tests.

3.4.2. Data Analysis of the Second Step: Technology Integration Assessment Rubric (TIAR)

The data source in answering the question was the lesson plans designed by the senior-year pre-service teachers. The lesson plans were collected from the participants voluntarily, and no instruction was given to the participants on their designations of the plans. In other words, participants were free to decide on using technological tools in the lesson plans. The reason for not mentioning any instruction regarding the use of technology was to see whether the intended use of technology was to have appeared from an authentic perspective.

Hence, the collected lesson plans were coded using a method adapted from Schmid et al. 2020. This method includes two steps. As an initial step, two coders analyzed the lesson plans to determine whether they intended technology integration in any stage of the planned lesson. The second step was accomplished by rating the lesson plans with the TIAR. The schema of lesson plan analysis is presented below in Figure 2.

Figure 2. The Coding Scheme of the Lesson Plans



Source: Schmid et al., 2021, p. 4

Ensuring the reliability and validity of the two stages of analyzing lesson plans, interrater reliability and the interrater correlation coefficient were calculated, respectively. For the first stage, in which whether the use of technology is apparent in the lesson plans, Cohen's kappa calculated for 25% of the collected lesson plans and indicated high reliability (Cohen's kappa = 0.85). Following Schmid et al. (2021), the rest of the lesson plans were coded by a coder.

For the second stage of analyzing lesson plans, TIAR was used. In order to establish the reliability and validity of the results, interrater correlation coefficient values were calculated for each criterion in the rubric. Interrater Correlation Coefficient (ICC) "relates to the proportion of variance attributable to subjects being measured" (Gisev et al., 2013, p. 336) and reveals the reliability levels in terms of consistency when two raters rate the same group of participants' performance (Koo & Li, 2016). Thus, scores to TIAR given by two raters were analyzed for ICC at a 95% confidence interval for each component. The result of the analysis is presented in Table 6.

Table 6. ICC Values of the TIAR

Rubric Criteria	ICC Values	Interpretation of the ICC Value
Curriculum Goals & Technologies	0.82	Good
Instructional Strategies & Technologies	0.86	Good
Technology Selections	0.75	Good
Fit	0.91	Excellent

Given the threshold values in interpreting the ICC proposed by Bobak et al. (2018), it can be concluded that lesson plan analysis with the TIAR instrument shows good reliability between the raters at a 95% confidence level in the present study.

3.4.3. Data Analysis of the Third Step: Technology Integration Observation Instrument (TIOI)

In order to see the technology-integrated lesson plans in action, pre-service teachers were observed during the practicum. Fourteen lessons were observed and evaluated by two different observers. Technology Integration Observation Instrument (TIOI) was used along with field notes. Two independent observers graded the performances of the pre-service teachers in the classroom, and Interrater Correlation Coefficient (ICC) was again calculated to ensure the reliability between raters. The ICC values for each section in the instrument are presented in Table 7.

Table 7. ICC Values of the TIOI

Instrument Criteria	ICC Values	Interpretation of the ICC Value
Curriculum Goals & Technologies	0.75	Good
Instructional Strategies & Technologies	0.83	Good
Technology Selections	0.88	Excellent
Fit	0.80	Good
Instructional Use	0.90	Excellent
Technology Logistics	0.85	Excellent

The ICC values were calculated for each criterion in the observation instrument. According to the cut scores for labeling the reliability between observers, it can be said that the observation procedure was reliable from good to excellent degrees.

3.4.4. Data Analysis of the Fourth Step: Focus Group Discussion

A focus group is defined as "a group discussion on a particular topic organized for research purposes" (Mishra, 2016, p. 3), and its usage in educational research has been growing (Cohen et al., 2007). Forming focus groups is one of the easiest ways to explore phenomena nested in the experiences of a particular group of people in which "the focus is the interaction inside the group" (Mishra, 2016, p. 2). The interviewer took place as the moderator and orchestrated the discussion. Nevertheless, since interaction is key among the group members, the data obtained from the group is highly unstructured and open to interpretation. This method is found to be useful for exploring group dynamics and giving voice to the participants so that they can negotiate the common factors designed by the researcher based on specific purposes (Cohen et al., 2007).

The focus group discussion session was conducted with the participants whose lesson plans were coded as "including technology" in the first step in the lesson plan evaluation and who were observed in the practicum schools based on their teaching performances. The recommendations proposed by Nyumba et al. (2018) was taken into consideration such as creating a comfortable atmosphere at the beginning of the discussion, allowing all participants to speak freely, and acting flexibly according to the flow of the meeting.

The discussion included questions asked by the researcher initially, then moved on to participants' significant experiences and reflections. At the beginning of the session, the researcher asked for the language choice of the participants and maintained the session in the mother tongue of the participants. A 45-minute focus group discussion was then transcribed verbatim and coded by the researcher. Emerging codes and themes were translated into English by the researcher.

3.5. Ethical Considerations

Before conducting the study, ethical approvement was taken from Yıldız Technical University Social and Humanities Sciences Ethics Committee. Additionally, an

informed consent form designed for the study was distributed to the participants in which the name and general purpose of the study were explained. The prepared consent form also included the principle of volunteering the participants, the information that they could withdraw from the study at any time, the commitment to the confidentiality of personal data, and the researcher's contact information for any questions and further information regarding the study. This form is provided in appendix 4. Besides, the participants' contact information who would like to be included in additional phases (for the lesson plans, observation, and interview) were collected at the end of the consent form.

3.6. Assumptions of the Research

In order to interpret the results of the present study, some assumptions should be taken into consideration. The first assumption is related to the honesty of the participant group in answering the questions of the instruments, the survey, and the interview. Since the survey items directly ask for the perceived knowledge levels of the participants, the results from the survey data should be interpreted in this consideration. The interview section also includes questions that were expected to be answered sincerely. Thus, it is assumed that the participants honestly answered all the questions in the study.

The second assumption is related to the researcher. It is assumed that the researcher was impartial in evaluating the lesson plans, making the observations, and conducting the focus group discussion. It is also assumed that participants of the focus group interview session were sincere in their emotions and thoughts.

4. RESULTS

In this chapter, the findings and results are presented according to the research questions. Firstly, pre-service English language teachers' TPACK levels were analyzed and reported descriptively. Secondly, participants' TPACK levels were compared on the basis of class levels, and findings were demonstrated. Thirdly, the correlation between the TPACK domains was analyzed and noted. After the predictive domains of TPACK development were reported, lesson plans collected from senior-level pre-service teachers were evaluated. Then, classroom observation results were presented. As the last step, focus group discussion results were given. The results were provided in subtitles referring to the research question.

4.1. Research Question 1: TPACK Levels of Pre-service English Language Teachers across Class Levels

The first question was designed to explain the TPACK levels of pre-service English language teachers enrolled in a foundation university across the class levels, namely, freshman, sophomore, junior, and senior. The data regarding pre-service English language teachers' TPACK levels were gathered through the TPACK-EFL survey. Descriptive results of the survey data are presented according to the groups marked by class levels in Tables 8, 9, 10, and 11. Survey items yielded maximum and minimum mean scores identified in detail. To this end, the demonstration of the results is presented in the following subtitles.

4.1.1. TPACK levels of Freshmen Pre-service English Language Teachers

The results obtained from the first-year pre-service English language teachers in the form of descriptive statistics regarding TPACK and TPACK dimensions are presented in Table 8.

Table 8. Descriptive Results of the TPACK-EFL Survey for Freshman Pre-service EFL Teachers

	Item number	N	Min	Max	Mean	SD	Skewness	Kurtosis
Technological Knowledge (TK)	9	52	4.22	9	7.06	1.27	-.282	.-942
Content Knowledge (CK)	5	52	4.60	9	7.96	1.08	-1.369	1.487
Pedagogical Knowledge (PK)	6	52	4.17	9	7.18	1.18	-.554	-.362
Pedagogical Content Knowledge (PCK)	5	52	4.80	9	7.30	1.29	-.416	-.880
Technological Content Knowledge (TCK)	3	52	4.67	9	7.86	1.14	-.956	.178
Technological Pedagogical Knowledge (TPK)	7	52	4.57	9	7.47	1.07	-.699	-.016
Technological Pedagogical Content Knowledge (TPACK)	4	52	4.50	9	7.07	1.19	-.336	-.500

The mean scores of the pre-service English language teachers who are in the first year of the teacher training program ranged between 7.0-7.9. The pre-service English language teachers in the first year of the program reported that they were most competent in content knowledge among the other six knowledge types. The mean

score of the content knowledge was found as 7.96, followed by TCK (*M* = 7.86, *SD* = 1.14) and TPK (*M* = 7.53, *SD* = 1.07).

The highest score was obtained in the content knowledge type by the freshmen (*M* = 7.96, *SD* = 1.08). Scrutinizing the CK of the freshmen, the highest score manifests itself in the reading ability (item 13, *M* = 8.23, *SD* = 1.07), as the lowest ability of the content was the listening ability (item 14, *M* = 7.75, *SD* = 1.28). The TCK levels were found to be the second-highest knowledge type for freshmen (*M* = 7.86, *SD* = 1.14). Within the same knowledge domain, the highest mean value was obtained in item 26 (*M* = 8.0, *SD* = 1.34), which addressed the ability to exploit multimedia tools for language-related purposes. The lowest mean score in the TCK was obtained from item 28 (*M* = 7.71, *SD* = 1.24), which measured the ability to work together with people around the globe with collaboration tools.

Freshmen students indicated that they have the third highest score in their perception of TPK (*M* = 7.47, *SD* = 1.07). The highest mean score of TPK was yielded in item 35 (*M* = 7.21, *SD* = 1.36), which was formulated as the ability to use digital tools such as websites and videos to facilitate language learning. TPK domain received the lowest score in item 29 (*M* = 7.21, *SD* = 1.56), which was asking about the ability to provide the individualized need of the learners with the help of information technologies. The PCK and the PK domains yielded high scores from the first-year pre-service teachers (*M* = 7.30*, SD* = 1.29; *M* = 7.18, *SD* = 1.18, respectively). The highest mean score in PCK was found to be in item 23 (*M* = 7.38, *SD* = 1.33), which aimed to select convenient language teaching methods, while the lowest score was obtained from item 22 (*M* = 7.23, *SD* = 1.57), which encompassed evaluation competence of teachers Examining the PK domain, the highest mean score was from item 19 (*M* = 7.60, *SD* = 1.19), which was designed to measure the ability to reflect upon professional development experiences, while the lowest mean score was gained from item 16 (*M* = 6.69, *SD* = 1.67) that targeted the teacher candidates' ability to tailor the learning according to the learners' language levels.

The lowest scores among the seven knowledge types of freshmen teachers were gained from TK and TPACK domains (*M* = 7.06, *SD* = 1.27; *M* = 7.07, *SD* = 1.19, respectively). In TK, the lowest score was gained from item 8 (*M*= 5.83, *SD* = 2.26), which addressed collaborative working skills with the help of digital tools. Freshmen teachers reported the highest competency concerning technological knowledge type

in item 3 (*M*= 8.0, *SD* = 1.48), in which they were asked to report their technical abilities in terms of hardware knowledge. Regarding TPACK, participants' mean scores were the lowest in item 38 (*M* = 6.40, *SD* = 1.47), which was an indicator of efficacy in exploiting Web 2.0 tools for enhancing students' language abilities. The highest mean score was obtained through item 39 (*M* = 7.63, *SD* = 1.23), which was designed to measure the perceived ability to maintain professional development to polish teaching skills in a continuum.

From a general perspective, freshmen pre-service teachers of English language teaching have a large amount of TPACK knowledge, along with its subdomains. The data obtained through the TPACK-EFL survey was normally distributed since the skewness and kurtosis values were between ± 1.5, an indicator of normality (Tabachnick & Fidell, 2013).

4.1.2. TPACK Levels of Sophomore Pre-service English Language Teachers

The sophomore pre-service teachers' results obtained from the descriptive statistics regarding TPACK and TPACK dimensions are presented in Table 9.

Table 9. Descriptive results of the TPACK-EFL Survey for Sophomore Pre-service EFL Teachers

	Item number	N	Min	Max	Mean	SD	Skewness	Kurtosis
Technological Knowledge (TK)	9	63	3.44	9	7.17	1.28	-.782	-.942
Content Knowledge (CK)	5	63	4.80	9	7.96	1.20	-1.311	.535
Pedagogical Knowledge (PK)	6	63	4.17	9	7.03	1.30	-.120	-.799
Pedagogical Content Knowledge (PCK)	5	63	3.6	9	6.88	1.47	-.158	-.915
Technological Content Knowledge (TCK)	3	63	4.67	9	7.26	1.42	-.279	.162
Technological Pedagogical Knowledge (TPK)	7	63	3.86	9	7.21	1.28	-.463	-.544
Technological Pedagogical Content Knowledge (TPACK)	4	63	4.25	9	6.88	1.48	.010	-1.343

The mean scores of pre-service English language teachers in the second year of the program ranged between 7.96 to 6.88. The highest score was gained from CK, while the lowest results were observed in PCK and TPACK domains. Like freshmen, sophomore student-teachers perceived CK levels outnumbered the other type of knowledge fields (M = 7.96, SD = 1.20). Examining the item-based CK domain for sophomores, the highest mean value was detected at item 13 (M = 8.17, SD = 1.17), which targeted reading skills, while the lowest mean score was detected at item 14 (M = 7.57, SD = 1.51), which addressed the listening ability of the participants. The second-highest mean value was obtained from the TCK domain (M = 7.26, SD = 1.42). Addressing the ability to use multimedia tools for interpersonal skills, item 26 yielded the highest mean value of sophomore's TCK (M = 7.70, SD = 1.34), while

the lowest mean score appeared in item 28 (*M* = 6.90, *SD* = 1.91) which targeted the ability to work collaboratively with technology. Sophomore's self-perceived TPK manifested itself as the third highest knowledge domain (*M* = 7.21, *SD* = 1.28). Pre-service teachers of English in this group had the highest perception of their TPK in item 33 (*M* = 7.54, *SD* = 1.36), which was formulated for the perceived ability to decide the timing of utilizing technology aligned with the curriculum framework. On the other hand, the lowest mean value was obtained from item 29 (*M* = 6.89, *SD* = 1.79), which asked about the ability to meet learners' individualized needs with the help of information technologies. The next knowledge domain with the highest mean score was TK in the sophomore's self-perceived levels (*M* = 7.17, *SD* = 1.28). The highest and the lowest mean scores of this knowledge domain resonated with those of freshmen; item 3 (*M* = 8.02, *SD* = 1.58) was found to be the highest, while item 8 (*M* = 5.97, *SD* = 2.26), the lowest mean score obtained from the survey. Sophomore pre-service teachers' perceived knowledge level regarding PK was found to be as *M* = 7.03 and *SD* = 1.30. Within the PK domain, the maximum mean score was obtained from item 15 (*M* = 7.19*, SD* = 1.40), which aimed to measure the perceived ability to use teaching methods in concern with creating learning environments, while the minimum mean score was detected at item 16 (*M* = 6.75, *SD* = 1.48), as was obtained from the freshmen.

The lowest scores were found in the PCK and TPACK domains (*M* = 6,88 in both domains, *SD* = 1.47; *SD* = 1.48, respectively). Sophomore pre-service teachers' item-based means indicated that they were little able to utilize convenient teaching methods and techniques related to developing the language skills of the learners and received the lowest mean score from item 23 (*M* = 6.81, *SD* = 1.57). The highest mean score was identified in item 21 (*M* = 7.05, *SD* = 1.62), which means the perceived ability to manage a classroom was higher than other perceived pedagogical content knowledge levels. Scrutinizing the TPACK, the maximum mean score was obtained from item 37 (*M* = 7.32, *SD* = 1.37), which targeted the ability to make use of technology aligned with the students' technology usage for language skills development. Similar to the freshmen group, sophomores deemed themselves least competent in utilizing Web 2.0 tools (item 38, *M* = 6.40*, SD* = 1.98), among other TPACK items. In general, sophomore pre-service teachers' survey results indicate that they have a large amount of TPACK knowledge along with subdomains of it. As

in the freshmen group, the data distribution was normal, and skewness and kurtosis values ranged between -1.311 and 0.535.

4.1.3. TPACK Levels of Junior Pre-service English Language Teachers

The third-year student teachers' mean scores, along with maximum, minimum, and standard deviation values for each knowledge domain, are presented in Table 10.

Table 10. Descriptive Results of the TPACK-EFL Survey for Junior Pre-Service EFL Teachers

	Item number	N	Min	Max	Mean	SD	Skewness	Kurtosis
Technological Knowledge (TK)	9	40	4.89	9	7.48	1.18	-.422	-.615
Content Knowledge (CK)	5	40	7	9	8.46	0.48	-.611	.397
Pedagogical Knowledge (PK)	6	40	5.33	9	7.97	0.88	-1.278	1.667
Pedagogical Content Knowledge (PCK)	5	40	5	9	7.80	0.95	-1.154	1.624
Technological Content Knowledge (TCK)	3	40	4	9	7.85	1.20	-1.393	1.898
Technological Pedagogical Knowledge (TPK)	7	40	5.14	9	8.00	0.96	-1.243	1.282
Technological Pedagogical Content Knowledge (TPACK)	4	40	4.25	9	7.80	1.25	-1.391	1.156

The results indicate that mean scores ranged between 7.48 – 8.46, implying a substantial amount of TPACK along with its subdomains. Similar to the previously mentioned class levels, junior pre-service teachers showed the greatest competency in the content knowledge field (M = 8.46, SD = 0.48). The third group of the study

reported that they were quite competent in all language skills, but the highest mean score was detected at item 13 (M = 8.73, SD = 0.45), the same as the previously mentioned groups. Item 12 and item 14 yielded the minimum scores obtained for the junior group concerning the self-perceived CK (M = 8.28, SD = 0.63; SD = 0.45, respectively). While the former item aimed to elicit perceived pronunciation knowledge level, the latter was to listening skills. Even though the scores from all items are higher than the previous two class levels, the pattern regarding the skill-based pattern seems to have remained the same- listening to the conversations in English is more challenging than other skills.

Junior students of the English language teaching program showed the second-highest self-perceived knowledge in their TPK (M = 8.0, SD = 0.96). Within the TPK, the maximum score was obtained from item 35 (M = 8.28, SD = 1.03), which indicates a good command of perceived ability in utilizing multimedia tools for language teaching ends. Item 29, on the other hand, yielded the minimum mean score (M = 7.70, SD = 1.34), similar to the previous groups mentioned above. PK knowledge domain indicated that a high level of knowledge was perceived by the junior pre-service teachers (M = 7.97, SD = 0.88). Item 20 had the highest mean value among other PK items (M = 8.10, SD = 1.03), which targeted the teachers' supportive role outside of the class. The lowest mean value in the PK domain was observed at item 16 (M = 7.80, SD = 1.13), likewise the previous groups. TCK domain was found to be high in junior student-teacher perception (M =7.85, SD = 1.20). The lowest and highest mean scores were identical with the freshmen and sophomore groups though the values showed a difference. Item 26 had the highest mean score (M = 8.38, SD = 0.92), while item 28 yielded the lowest (M = 7.48, SD =1.73). The same mean scores were observed at TPACK and the PCK domains (M = 7.80, SD = 1.28, SD = 0.95, respectively).

The lowest scores of junior pre-service teachers were detected as technological knowledge type (M = 7.48, SD = 1.18). Similar to the previous groups, the highest mean score was detected at item 3 (M = 8.20, SD = 1.32). Item 4 yielded the lowest mean value (M = 6.80, SD = 2,16). This item addressed problem-solving skills regarding technical issues. Nevertheless, the overall scores gained from the TK domain indicated that junior pre-service teachers' competencies regarding self-reported data showed great excellence. Likewise, in the previous groups' data, the

distribution was normal. While the skewness and the kurtosis values in between ±1.5 range showing the normal distribution were observed, kurtosis values of PK (1.667), PCK (1.624), and TCK (1.898) domains were slightly above the proposed range according to Tabachnick and Fidell (2013), but still tolerable since the value was yet in ± 2.0 range (George & Mallery, 2010).

4.1.4. TPACK Levels of Senior Pre-Service English Language Teachers

Pre-service English language teachers in the last year of the teacher training program showed a large amount of TPACK knowledge and TPACK domains. The mean scores ranged between 8.08 – 7.46, along with the TPACK domain and its subdomains. The descriptive results of senior pre-service teachers' TPACK-EFL survey outcomes are presented in Table 11.

Table 11. Descriptive results of the TPACK-EFL Survey for Senior Pre-service EFL Teachers

	Item number	N	Min	Max	Mean	SD	Skewness	Kurtosis
Technological Knowledge (TK)	9	64	4.22	9	7.50	1.18	-1.034	.520
Content Knowledge (CK)	5	64	5.60	9	8.08	0.84	-.816	-.032
Pedagogical Knowledge (PK)	6	64	4.83	9	7.66	0.90	-.526	.408
Pedagogical Content Knowledge (PCK)	5	64	6.20	9	7.68	0.80	-.136	-1.101
Technological Content Knowledge (TCK)	3	64	3.67	9	7.60	1.18	-.983	.958
Technological Pedagogical Knowledge (TPK)	7	64	5.14	9	7.67	0.93	-.353	-.736
Technological Pedagogical Content Knowledge (TPACK)	4	64	3.75	9	7.46	1.25	-.998	.596

As in the previous levels, the largest mean values appeared in the content knowledge (*M* = 8.08, *SD* = 0.84). Within the CK domain, item 13 addressed the reading ability yielded the highest mean (*M* = 8.45, *SD* = 0.71), while item 14 was found to be the lowest mean (*M* = 7.67, *SD* = 1.32). The second highest mean value was detected at the PCK domain (*M* = 7.68, *SD* = 0.80). The highest mean value in PCK was identified at item 22 (*M* = 7.89, *SD* = 0.94), which elicited the ability regarding the assessment and evaluation processes. The lowest mean score was observed at item 24 (*M* = 7.55, *SD* = 1.14), which asked for the ability to design curricular activities for learners. The TPK was found to be the third-highest mean score among others (*M* = 7.67, *SD* = 0.93). The item regarding exploiting the multimedia (item 35) gained the highest mean value (*M* = 8.06, *SD* = 1.12); likewise, the previous groups; however, the lowest score in the TPK domain was identified at item 30 (*M* = 7.38, *SD* = 1.36), which aimed to elicit the perceived ability to guide learners in ethical considerations in the digital medium. PK scores of senior group student-teachers were found to be high (*M* = 7.66, *SD* = 0.90). The highest mean scores were obtained from items 16 and 19 (*M* = 7.77, *SD* = 1.05 and 1.03, respectively). Reminding that item 16 was one of the common lowest mean scores in the previous groups; seniors showed a higher perception than them regarding the levels of the students in designing lessons. The lowest score was obtained from item 18 (*M* = 7.48, *SD* = 1.03), which addressed the collaboration skills of the participants in terms of stakeholders of the educational environment, such as other teachers and parents. The TCK scores were high in senior pre-service teachers' survey reports. (*M* = 7.60, *SD* = 1.18). Similar to the freshmen and junior groups, senior pre-service teachers' competencies regarding TK perceptions were lower than the other knowledge domains (*M* = 7.50, *SD* = 1.18). The highest mean score was detected at item 3 (*M* = 8.05, *SD* = 1.43), which addressed the ability to use external hardware devices of a computer competently, whereas the lowest mean score was obtained from item 4 (*M* = 7.00, *SD* = 1.79), which asked for the ability to solve general computer problems stemmed from technical issues autonomously. As in the sophomore group, the TPACK domain received the lowest mean scores among other knowledge domains for the senior group of pre-service teachers (*M* = 7.46, *SD* = 1.25). Item 39 had the highest mean score (*M* = 7.78, *SD* = 1.20), which referred to the continuous professional development of the teachers with the help of technological tools. Item 36 (*M* = 7.09, *SD* = 1.85), on the other hand, addressed the ability to use digital collaboration tools

as a teacher to foster students' language development, yielded the lowest mean value of senior pre-service teachers' self-perception regarding their TPACK competency. Nevertheless, the overall results gained from the survey for senior pre-service English language teachers indicated that they were quite competent in the TPACK framework, including its subdomains. Additionally, since the skewness and kurtosis values ranged between ± 1.5, the normal distribution of the data was guaranteed.

4.2. Research Question 2: Comparing the Domains of the TPACK Across Class Levels

The second research question aimed to determine whether a statistically significant difference occurred in the TPACK domains in concern to the class levels of pre-service English language teachers. In order to answer this question, variance analysis was aimed. A One-Way ANOVA was run after determining that the requirements for parametric analysis were met.

In the beginning, the level of measurement and the independence of the observation criteria were ensured. The normality of the data was controlled with skewness and kurtosis values. As presented in the previous subtitles, results regarding the normality were met as the skewness values ranged between -1.393 – 0.010. Tabachnick and Fidell (2013) state that the interval of ±1,5 indicates a normal distribution of data. However, the ±2.0 range also was reported as an indicator of the normality for kurtosis values of specific applications (George & Mallery, 2012). The present results mostly ranged between ±1.5, while only the kurtosis values of third-grade participants were found to be 1.624 for PCK, 1.667 for PK, and 1.898 for TCK subcomponents. According to the literature, it can be claimed that the distribution of the data was normal for all components of the survey. The results regarding pre-service English language teachers' TPACK levels in concern of class levels are presented in Table 12.

Table 12. One-Way ANOVA Results in concern for Class Levels

	Class Level	N	Source of Variance	Sum of Squares	df	Mean Square	F	Sig.
TK	1	52	Between Groups	7.872	3	2.624	1.701	.168
	2	63	Within Groups	331.596	215	1.542		
	3	40	Total	339.468	218			
	4	64						
CK	1	52	Between Groups	7.319	3	2.440	2.568	.055
	2	63	Within Groups	204.287	215	.950		
	3	40	Total	211.606	218			
	4	64						
PK	1	52	Between Groups	28.528	3	9.509	7.869	.000
	2	63	Within Groups	259.810	215	1.208		
	3	40	Total	288.337	218			
	4	64						
PCK	1	52	Between Groups	28.507	3	9.502	6.879	.000
	2	63	Within Groups	296.967	215	1.381		
	3	40	Total	325.473	218			
	4	64						
TCK	1	52	Between Groups	13.367	3	4.456	2.844	.039
	2	63	Within Groups	336.858	215	1.567		
	3	40	Total	350.225	218			
	4	64						
TPK	1	52	Between Groups	16.654	3	5.551	4.746	.003
	2	63	Within Groups	251.503	215	1.170		
	3	40	Total	268.157	218			
	4	64						
TPACK	1	52	Between Groups	24.944	3	8.315	4.821	.003
	2	63	Within Groups	370.804	215	1.725		
	3	40	Total	395.748	218			
	4	64						

A one-way between-groups analysis of variance was conducted for the TPACK and its components to determine whether a significant difference occurred among pre-service teachers across year levels in participating in the English Language Teaching program. The ANOVA test results indicated that there is no significant difference was found across four groups characterized by year levels and the TK component of the TPACK framework: TK (F (3,215) = 1.70, p=1.68). Similarly, the CK yielded no significant difference between groups; however, the p-value was found to be .055, which was around the significance level set at .05., CK (F (3,215) = 2.44, p=0.55). On the other hand, in other components, namely, PK, PCK, TCK, TPK, and TPACK, there was a statistically significant difference found at p<.05 level: PK (F (3,215) = 7.87, p<.01); PCK (F (3,215) =6.88, p<.01); TCK (F (3,215) =4.46, p=.04); TPK (F (3,215) = 4.74, p=.003); TPACK (F (3,215) = 8.32, p=.003). In order to gain insight into the differences, the effect size of the variables contributed to the TPACK, and post hoc analyses were run.

The effect size was calculated to explain the actual difference in mean scores using eta squared by the sum of squares between groups divided by the total sum of squares (Pallant, 2020). The results of the effect size calculation and interpretation of the obtained results are presented in Table 13.

Table 13. Effect Size Values in concern to Significantly Differed TPACK Domains

Domain	Effect Size	Interpretation of the Value
PK	.099	Large
PCK	.088	Medium
TCK	.038	Small
TPK	.062	Medium
TPACK	.063	Medium

According to Cohen (1988), effect size values can be interpreted as small (.01), medium (.06), or large (.1). The current results demonstrate that the PK has a larger effect size η^2 = .099, explaining 10% of the variance. TCK, on the other hand, has the smallest effect size η^2 = .038, explaining 3% of the variance. Other domains, namely, PCK, TPK, and TPACK, had a medium effect size, which explained 6% of the variance.

Table 14. Post Hoc Test Results

Dependent Variable	(I) Current Education Level	(J) Current Education Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
PK	1	2	.14830	.23269	.920	-.4586	.7552
		3	-.79647*	.21577	.002	-1.3613	-.2317
		4	-.47877	.20028	.086	-1.0026	.0451
	2	1	-.14830	.23269	.920	-.7552	.4586
		3	-.94478*	.21529	.000	-1.5072	-.3823
		4	-.62707*	.19977	.012	-1.1482	-.1060
	3	1	.79647*	.21577	.002	.2317	1.3613
		2	.94478*	.21529	.000	.3823	1.5072
		4	.31771	.17977	.296	-.1534	.7888
	4	1	.47877	.20028	.086	-.0451	1.0026
		2	.62707*	.19977	.012	.1060	1.1482
		3	-.31771	.17977	.296	-.7888	.1534
PCK	1	2	.41111	.25861	.389	-.2633	1.0855
		3	-.50000	.23547	.154	-1.1164	.1164
		4	-.38437	.20627	.252	-.9254	.1567
	2	1	-.41111	.25861	.389	-1.0855	.2633
		3	-.91111*	.23954	.001	-1.5369	-.2854
		4	-.79549*	.21090	.002	-1.3470	-.2440
	3	1	.50000	.23547	.154	-.1164	1.1164
		2	.91111*	.23954	.001	.2854	1.5369
		4	.11562	.18180	.920	-.3625	.5937
	4	1	.38437	.20627	.252	-.1567	.9254
		2	.79549*	.21090	.002	.2440	1.3470
		3	-.11562	.18180	.920	-.5937	.3625
TCK	1	2	.60083	.23946	.064	-.0236	1.2253
		3	.00705	.24752	1.000	-.6421	.6562
		4	.25601	.21715	.641	-.3104	.8225
	2	1	-.60083	.23946	.064	-1.2253	.0236
		3	-.59378	.26100	.111	-1.2766	.0890
		4	-.34482	.23240	.450	-.9503	.2606
	3	1	-.00705	.24752	1.000	-.6562	.6421
		2	.59378	.26100	.111	-.0890	1.2766
		4	.24896	.24070	.730	-.3823	.8802
	4	1	-.25601	.21715	.641	-.8225	.3104
		2	.34482	.23240	.450	-.2606	.9503
		3	-.24896	.24070	.730	-.8802	.3823
TPK	1	2	.26439	.21946	.625	-.3079	.8367
		3	-.52473	.21281	.073	-1.0821	.0326
		4	-.20106	.18892	.712	-.6945	.2924
	2	1	-.26439	.21946	.625	-.8367	.3079
		3	-.78912*	.22201	.003	-1.3694	-.2089
		4	-.46545	.19922	.096	-.9849	.0540
	3	1	.52473	.21281	.073	-.0326	1.0821

		2	.78912*	.22201	.003	.2089	1.3694
		4	.32366	.19187	.337	-.1797	.8270
	4	1	.20106	.18892	.712	-.2924	.6945
		2	.46545	.19922	.096	-.0540	.9849
		3	-.32366	.19187	.337	-.8270	.1797
TPACK	1	2	.19200	.25037	.869	-.4609	.8449
		3	-.72308*	.25898	.032	-1.4023	-.0439
		4	-.38792	.22819	.329	-.9831	.2073
	2	1	-.19200	.25037	.869	-.8449	.4609
		3	-.91508*	.27322	.006	-1.6299	-.2003
		4	-.57992	.24424	.088	-1.2162	.0563
	3	1	.72308*	.25898	.032	.0439	1.4023
		2	.91508*	.27322	.006	.2003	1.6299
		4	.33516	.25306	.550	-.3284	.9987
	4	1	.38792	.22819	.329	-.2073	.9831
		2	.57992	.24424	.088	-.0563	1.2162
		3	-.33516	.25306	.550	-.9987	.3284

**. The mean difference is significant at the 0.05 level.*

As presented in Table 14, post-comparisons using the Games-Howell test demonstrated that mean scores obtained from PK across four class levels differed statistically between freshmen (*M*= 7.18, *SD* = 1.18) and juniors (*M* = 7.97, *SD* = 0.88), and sophomores (*M*= 7.03, *SD* = 1.30) and juniors (*M* = 7.97, *SD* = 0.88), and sophomores (*M*= 7.03, *SD* = 1.30) and seniors (*M* = 7.66, *SD* = 0.90). In other words, pre-service teachers in their third year in the ELT program had a higher perception of their PK levels than the students in the first and second years. Similarly, pre-service teachers in their last year in the program yielded significantly higher mean scores than sophomores concerning the PK domain.

Examining the PCK, the difference was found to be significant between sophomores (*M* = 6.88, *SD* = 1.47) and juniors (*M* = 7.70, *SD* = 0.90), and sophomores *M* = 6.88, *SD* = 1.47) and seniors (*M* =7.68, *SD* = 0.80) in favor of the third-year and fourth-year pre-service teachers. No difference marked by significance between other groups was observed.

With respect to the TPK, a significant difference in the mean scores between the sophomores (*M* = 7.21, *SD* = 1.28) and the juniors (*M* = 8.00, *SD* = 0.96) was obtained in favor of the third-year group. Other groups yielded no significant differences in the mean score comparisons.

Finally, scrutinizing the TPACK domain indicated that the mean scores of the junior group (*M* = 7.80, *SD* = 1.25) were significantly different from the freshmen (*M* =

7.07, *SD* = 1.19) and the sophomore groups (*M* = 6.88, *SD* = 1.48). However, the senior group (*M* = 7.46, *SD* = 1.25) did not significantly differ from the other groups enrolled in the first, second, and third years. During conducting the post hoc analyses, the alpha value was set at .05.

4.3. Research Question 3: Findings Related to Predicting Pre-service English Language Teachers' TPACK

Examining the predictive power of which subdomains predict the total TPACK scores of the pre-service English language teachers, standard multiple regression analysis was conducted on the separate knowledge domains. Before conducting the analysis, preliminary assumptions were checked. First of all, sample size requirements were controlled, and it was found that 219 participants were reasonable to conduct multiple regression analysis based on the formula provided by Tabachnick and Fidell (2013, p.123). (According to the equation, $N > 50 + 8m$, and $219 > 98$, where *m* stands for independent variables, 6 in the present study). The standard multiple regression analysis results showed that independent variables PCK, TCK, and TPK did not meet the multicollinearity assumption ($r > .7$), which means those variables were highly correlated with the dependent variable (TPACK). Since the highly correlated variables interfere with the determination of the separation of the unique contribution of each variable (Pallant, 2020), PCK, TCK, and TPK were excluded from the analysis. Further preliminary analyses indicated that there was no violation of assumptions of normality, linearity, multicollinearity, and homoscedasticity for variables in the analysis (TK, PK, CK, and TPACK). Moreover, the normal probability plot was checked, and the scatterplot of the standardized residuals was examined. Multicollinearity assumption was ensured by VIF and tolerance values, which were indicated in Table 15. Additionally, outliers were checked by calculating Mahalanobis distances as proposed by Tabachnick and Fidell (2013, p. 123). The cases did not exceed the critical value (16.27 as set by in the literature) for the independent variables in the present study (the largest Mahal distance was calculated as 14.01). Table 15 presents the results of standard multiple regression.

Table 15. The Results of Multiple Regression Analysis

Variable	B	Std. error	β (Beta)	T	p.	Toleran.	VIF
Constant	-.553	2.222		-.249	.804	.662	1.511
TK	.149	.028	.310	5.340	.000*	.637	1.570
CK	.100	.065	.092	1.549	.123	.666	1.501
PK	.354	.045	.454	7.847	.000*	.662	1.511
R=0.72		R^2=.051			F (3,215) = 77.89, $p < 0.01$		

The results regarding the multiple regression test indicate that there is a linear relationship between the dependent variable (TPACK) and the independent variables (TK, CK, PK). The assumption of multicollinearity among the independent variables was ensured (VIF values < 10), and the regression model was found to be significant (F (3,215) = 77.89, $p < 0.01$) with an R^2 of .0.51. In other words, TK, CK, and PK subdomains explain 51% of the variance of the TPACK framework. Pre-service teachers' predicted TPACK score was equal to -.553 + .149 (TK) + .354 (PK)+ .10 (CK). In this model, TK and PK were found to be significant predictors of TPACK formation.

4.5. Research Question 4: Analysis of Lesson Plans

The fourth research question addresses the TPACK levels of senior pre-service English language teachers in their decisions on lesson plans. For this purpose, 42 lesson plans designed by the senior pre-service teachers were collected. During the initial coding process, it was seen that 33.3% of the total number of lesson plans included technology (N=14). The rest of the lesson plans were designed with more traditional methods, such as using the whiteboard, distributing worksheets to the pupils, and flashcards.

Fourteen lesson plans were evaluated by using the Technology Integration Assessment Rubric. The upper point to be scored was 4 for each criterion. The results of the analysis are presented below in Table 16.

Table 16. Descriptive Values of the Lesson Plan Assessment as regards TIAR Scores

TIAR Criteria	N	Min	Max	Sum	Mean	SD
Curriculum Goals & Technologies	14	2	4	38	2.71	0.63
Instructional Strategies & Technologies	14	1	3	34	2.43	0.47
Technology Selection	14	1	3	23	1.64	0.49
Fit	14	1	2	16	1.14	0.36

The highest score can be obtained from the rubric was 16, while pre-service teachers' total scores ranged between 6 to 12. The results of the lesson plan assessment indicated that pre-service English language teachers showed the highest performance in the Curriculum Goals & Technologies criterion, which addressed the match between the objectives of the lesson to the technology (M = 2.71, SD = 0.63). For example, using the interactive whiteboard for an ice-breaker activity at the beginning of the lesson was aligned with the objectives the pre-service teacher set in the lesson plan. According to the mentioned criterion, the lesson plan got the highest score (4) if at least one curriculum objective strongly aligned with the technology (Harris et al., 2010). The participants in the present study designed lesson plans which were "strongly aligned – aligned" with the curriculum goals. The second criterion targeted the usage of technology as a supportive function for instructional strategies. The results showed that senior pre-service English language teachers' scores in this criterion ranged between 2-3, and they used the technology as a facilitator tool for their instructional goals (M = 2.43, SD = 0.47), mainly for presenting the course material using the IWB. The third criterion delved into the technology selection of the pre-service teacher and its appropriateness in terms of lesson objectives. According to the rubric, the technology selection criterion yields the highest score if the lesson plan presents an exemplary technology selection model. In the present study, pre-service teachers' lesson plan scores ranged between 1-3 (M = 1.64, SD =

0.49). This outcome can be interpreted as "marginally appropriate - inappropriate" based on the interpretation of the designers of the rubric.

When the scope was turned into the last criterion, which is the “Fit,” pedagogy, instruction, and appropriate technology integration were synthesized, the lowest scores can be observed (M = 1.14, SD = 0.36). The scores ranged between 1-2, and little concordance occurred between the pedagogical reasoning, technology selection, and lesson objectives. The results revealed that senior pre-service English language teachers were limited in selecting technologies with little exemplary choice. In general, they relied on slide shows and video demonstrations in planning lessons.

4.5. Research Question 5: Analysis of the Implementation of the Lesson Plans in the Practicum

The fifth research question was formulated to determine how senior pre-service English teachers implement their lesson plans in their teaching concerning the TPACK framework. To this end, senior pre-service teachers of the English language were observed during the actualization of their lesson plans in their practicum schools. The results of the descriptive statistics regarding the observation instrument are presented below in Table 17.

Table 17. Descriptive Values of the Observation as regards TIOI Scores

TIOI Criteria	N	Min	Max	Sum	Mean	SD
Curriculum Goals & Technologies	14	2	4	37	2.64	0.516
Instructional Strategies & Technologies	14	1	3	32	2.29	0.816
Technology Selection	14	1	3	23	1.64	0.516
Fit	14	1	2	16	1.14	0.753
Instructional Use	14	2	3	34	2.43	0.816
Technology Logistic	14	1	3	25	1.79	0.548

Each pre-service teacher performed their lesson plans for a 40-minute lesson in the practicum school. Technology Integration Observation Instrument (TIOI) developed

by Hofer et al. (2011) was used as the assessment tool during the observations. The TIOI included the same criterion as the Technology Integration Assessment Rubric (TIAR), along with two additional criteria, which were "Instructional Use" and "Technology Logistics." The "Instructional Use" delves into the effectiveness of the technological tools during the teaching, and "Technology Logistics" stands for the ability to operate technological tools during the lesson. Aligned with the previous instrument (TIAR), four is the highest score that could be obtained for each criterion in TIOI. As a result, the highest score that can be taken from the TIOI is 24.

The results indicated that pre-service English language teachers showed the highest performance in Curriculum Goals and Technologies and in Instructional Use criteria (M = 2.64, SD = 0.51; M = 2.43, SD = 0.81, respectively). Indeed, the technology usage by pre-service teachers in the classroom was congruent with the curriculum goals, which the Ministry of National Education defined as "developing students' creativity and imagination" (MEB, 2018, p. 60) and making them familiar with the language functions used with everyday content. Overall, curriculum goals address the affective dimension of the learners by creating a comfortable atmosphere where the learners develop positive attitudes toward the language learning process (MEB, 2018). Pre-service teachers utilized the technology mainly for the purpose of creating a positive atmosphere for the students and engaging them with the content. The "Instructional Use" criterion was also the highest one among others, which indicated an effective use of technologies aligned with students' engagement. This outcome can be interpreted as the use of technology in the classroom becoming one of the motivation sources for learners, and their engagement with the course is highly susceptible to motivation.

The instructional strategies and technologies criterion yielded a minimally supportive role during the teaching. This result was not expected since the same criterion in the TIAR yielded higher points (M= 2.43, SD = 0.47 for TIAR, M= 2.29, SD = 0.81 in TIAI). Instructional strategies set by the pre-service teachers faced some problems that can be categorized under different themes based on the problem source.

The first problem that hindered the supportive role of technology during the practicum was related to the technical aspects, such as difficulties in operating the IWB, adjusting sound systems in the classroom, and trying to access the personal account when the screen was visible to the classroom. These problems can be

interpreted as an indication that the technological knowledge of the pre-service teachers was not activated since TK scores of the TPACK-EFL survey had shown a high level of self-perceived knowledge. The second theme of the possible reason for the lower performance than the TIAR on the same criterion was related to the classroom management strategies. Using a technological tool in the classroom drew on high enjoyment among the students, turned out the turmoil, and evolved into chaotic moments. Pre-service teachers had difficulty taking control of the chaos, which they did not anticipate in lesson plans. The situation related to the classroom environment and practicum experience will be explained in the next research question.

The criteria "Technology Selection(s)" (M = 1.64, SD = 0.51) and "Fit" (M = 1.14, SD = 0.75) were aligned with the results of TIAR. For the former criterion, pre-service English language teachers demonstrated somewhat convenient technology selection appeared in both lesson plans and observation sessions. The most apparent technology selection was IWB for displaying cartoons and videos. The IWB was also used for slideshows prepared by the pre-service teachers to deliver the content. There were no other tools were used. The "Fit" criterion that pedagogical reasoning, curriculum goals, and technology integration harmony in scrutiny was found to be one of the lowest domains. This result resonated with the outcomes obtained in the same criterion on TIAR. Pre-service language teachers had difficulty in the amalgamation of those concepts in their teaching practice.

The last criterion was "Technology Logistics" in TIOI yielded the lowest mean score (M = 1.79, SD = 0.54). This criterion specifically focuses on the technology operation skills of the pre-service teachers in their teaching practice. The observed sessions indicated that pre-service English language teachers managed to technical aspects in using instructional technologies in the range of "adequately-inadequately," which contradicts their TPACK scores obtained through the TPACK-EFL survey results. The issues confronted by the pre-service teachers during the instruction stemmed from challenges in opening the IWB system, managing the sound system, losing control while conducting activities on the IWB, and adjusting all materials in technological devices according to the learners' needs.

4.6. Research Question 6: Analysis of Focus Group Discussion

The last question aims to enlighten the findings of the previous interrogation of the study. To summarize, TPACK formation was found to be high among pre-service English language teachers according to the self-reported data obtained through the TPACK-EFL survey in all TPACK domains, and the self-perceived TPACK levels increased with the year of education to the junior level. However, senior-year pre-service English language teachers' TPACK levels decreased as compared to the juniors. The lesson plans of senior pre-service teachers indicated a moderate manifestation of TPACK formation. When it comes to the actualization of those lesson plans, senior-year pre-service teachers confronted some difficulties that were not anticipated by them beforehand.

In order that shed light on the discrepancies between data analyzed so far and to get more insights into the experiences of the participants, a focus group discussion was conducted by the senior-year pre-service English teachers whose lesson plans were analyzed and whose performances were observed. The discussion was conducted face-to-face for 55 minutes and recorded by the researcher. After the discussion session, the recorded tape was transcribed verbatim, and the participants controlled the script for the member-checking procedure. Member checking procedure enabled to ensure the validity of the data (Candela, 2019). The data was coded in two steps through a content analysis procedure as proposed by Nyumba (2018). The first step was the initial coding that encompassed all emerging codes that were extracted (Charmaz, 2006). Focused coding was utilized as the second step to identify codes in a more detailed manner, with the subtraction of recurring ones and the merging of iterative ones (Charmaz, 2006; Nyumba, 2018). The results of the final analysis of focus group discussion data are presented in Table 18. All participants negotiated the codes, and they were in consensus on each of the codes.

Table 18. Elicited Codes from the Focus Group Discussion

Elicited Themes	Codes	f	%
The advantages of integration of technology			
	Motivation	8	10
	Engagement	5	6
	Convenience	4	5
The challenges of integration of technology			
	Classroom management issues	9	11
	Technical issues	7	8
	Experienced time vs. Real time	6	7
The reasons for high level of perceived TPACK			
	Experience	12	14
	Modelling	9	11
	Theoretical knowledge	3	4
The reasons for the decrease in perceived TPACK			
	Experiences in practicum	9	11
The reasons for limited technology integration			
	Fear of facing possible technical problems	7	8
	Fear of facing challenges in classroom management	5	6
TOTAL		**84**	**100**

As shown in Table 18, the discussion session enabled the researcher to develop 12 codes that subsumed under five different themes. Motivation (f = 8), engagement (f = 5), and convenience (f = 4) elicited to be in the theme of "The advantages of integration of technology." The participants showed positive and enthusiastic attitudes toward the idea of technology integration. PT2 emphasized the students' engagement in the content "*Our mentor teacher does not use IWB in her classes. When I turned it on, the students' faces lit up as if they weren't in the classroom before; they appeared with the opening of IWB!"* PT14 agreed with their friend, "*By using technology, you can get the students' attention all at once. They show great interest in the subject and forget to count down for the break time bell. After that, what you need to do is to channel that interest in the right place."* PT5 claimed that

"*Sometimes they can be too eager. Happened to me in this type of activity. They were in euphoria as soon as they saw the QR code on the slide I presented, and then it was extremely difficult to get their attention back; it didn't even happen!"*

The codes "Classroom management issues" (*f* = 9), "Technical issues (*f* = 7)", and "Experienced time vs. Real time" (*f* = 6)" were categorized under the theme of "The challenges of integration technology." The members of the group (*N*=14) indicated that they felt less competent than before in terms of technological and pedagogical knowledge since the practicum experience (*f* = 9). The reason for the decreasing self-competence was attributed to the reality of the actual teaching experience. PT3 stated that "*I was thinking that being quite competent in using technologies in the teaching, but the classroom is full of surprises that even I haven't thought of!*" PT7 remarked similarly, "*Indeed, especially the IWB was so painful. I had prepared many activities, but they turned out to be a huge mess since I couldn't operate the touchscreen. That's why I distrust my perception of my competence.*" PT14 clarified that "*As a tech-savvy person, I have no problems using digital tools in my daily life and lesson plans. In reality, it was more complex than I thought. The IWB was not the sole reason for the complexity. I think learning and doing are totally different".* In addition to classroom management and technical issues, the participants were asked to reflect upon other challenges in teaching with technology. They stated that there was a difference between experienced time and real time. PT14 declared that "*In the planning phase, you don't know how to fill a class hour. But in the classroom, the time elapses so fast that you couldn't imagine before. Using classroom technologies is not helpful in that timing issue."* With similar expressions, PT6 agreed, "*Definitely! Time becomes more fluid when you integrate technology. I experienced it even though no technical problem occurred during teaching.*" PT8 forwarded it similarly, "*Whenever I placed technology in my classes, and time flies as if we were in a different dimension, regardless of being novice or expert practitioners."*

Exploring the reasons for self-perceived TPACK domains, which were still found to be relatively higher in the survey results, pre-service teachers were asked about the possible contributors to their knowledge levels. As categorized in the theme "The reasons for high-level of perceived TPACK," "Experience" (*f* = 12), "Modelling (*f* = 9), and "Theoretical Knowledge (*f* = 3) codes were elicited from the discussion. PT7

stated, "*Well, I became more aware of the power of digital tools in the pandemic. At that time, we were forced to use different tools that I had not even known of their existence.*" PT3 contributed, "*Exactly! At the beginning of the restriction days, I had no idea how to deal with technical problems when confronting some of them. But now I feel like an expert in sharing my screen, adjusting my voice, and minor troubleshooting issues when they pop up.*" PT5 highlighted the before-pandemic-after-pandemic dichotomy, "*We were taught the importance of technology integration in the previous years, but we learned it in theory. I had no intention of using my knowledge regarding technology integration in my teaching. Besides, we had little chance for hands-on practice before the pandemic. I can say that pandemic times were the most effective teacher in technology integration in education.*" PT13 put it concisely, "*We used technology a lot. And the best way of learning is by doing.*" When the discussion leader asked for elaboration on the other possible contributing elements to high TPACK levels apart from the pandemic, the participants agreed on the modeling effect of the trainers. "*Some teachers are really being good models in using technology. When you see a different way of conducting lessons as a student, you know how to do the same*." "*We are observing our teachers, and I think it's a big contributor to our future teaching, I guess.*"

After eliciting the reasons and thoughts on participants' TPACK levels, the discussion moved on to the lesson plans. The participants were asked whether they had combined their knowledge in technological, pedagogical, and teaching goals. PT4 stated, "*I think I took every piece of my knowledge into account when designing my plan, including technology. I added enjoyable material, a video so that the students were exposed to the language in a fun way.*" PT7 uttered similarly, "*I used a cartoon as a material with the same ends and designed all the content in a ppt slideshow.*" The teacher candidates proposed similar applications until the question was formulated of whether these activities were successfully aligned with teaching and learning theories. After a brief silent moment, the participants evaluated the quality of their lesson plans and initiated the reasoning. PT2 expressed, "*I think... well... I could have done some additional activities so that the students would be more active.*" PT11 added, "*When I think about the technology integration, I can say that my lesson plan was insufficient, yes, there was a video clip, but we can speculate on whether it can be deemed as technology integration.*" PT14 agreed with their

peers, "*Frankly speaking; I just wanted to fill in some blanks in my plan and put a video. Because you have forty minutes and sometimes showing videos makes sense to reach your goals without thinking about what to do. Moreover, kids love it.*" The inquiry related to the discrepancy between the planned version of teaching and the actual teaching experience in the classroom was the most intriguing question for the participants. Some of the elicited answers are presented below.

"*I know my students, their names, and personality to some extent. Since they love technology in class, I prepared my lesson digitally. However, I had a problem with the IWB. The technical issues were the biggest problem in my experience.*"

"*This was not the first time I taught in the same class. The technical issues had happened to me before; that's why I didn't want to take the risk. I limited my technology usage to a video."*

"I *did feel the same that's why I constrained my activities in traditional methods."*

"When I used the IWB with activities in which the students actively participated, the class became a chaotic place full of noise and turmoil."

"*They show great engagement in the technologically designed activities. That's why the class turns into a chaotic place in which nobody listens to the others, neither to me nor the classmates. It becomes a challenging endeavor to keep the excess energy into a fruitful teaching-learning process. I think I need to develop strategies for classroom management when using technology*."

"*Managing the classroom was the biggest problem that I faced. On top of developing strategies, I guess we need more practice and experience*."

The results of the focus group discussion showed that pre-service English language teachers who were in their last year in their teacher training program had a positive attitude toward using technology in their future classes. The most uttered reasons for the positive attitude were the power of technology in increasing the motivation and engagement of the learners. The participants also identified the ease of conducting lessons with technology and reported that technology could support the instructional design of a teacher. On the other hand, perceived difficulties in integrating technology were also elicited from the responses. The participants stated that the most challenging element was managing the classroom when actualizing a technology-driven lesson plan. Concerning the difficulties, an unexpected code

emerged related to time management. The pre-service teachers indicated that the time perception when integrating technology was somewhat different from the real time.

Senior-year pre-service English teachers had a high (above 7) technological pedagogical content knowledge level as rated themselves on the TPACK-EFL survey. The reasons for high-level self-competency were asked. They clarified that the reasons for high-level self-confidence in TPACK stemmed from the experience they gained in the ERT process. Indeed, the pandemic restrictions made them utilize technological devices as much as they could, and they explicitly stated that the knowledge they gained transferred to their teaching practices.

Reminded that the observed decrease in TPACK levels as compared to the junior level student-teachers, the senior group received the question related to their competence in years. Surprisingly, they indicated that they felt less competent after the practicum experience. The actual teaching experience in an authentic environment made them ponder upon the competencies they had when questioned. When the scope of the interrogation was directed to the planning phase of the lessons, the reasons for the limited technology selection attributed to the fear of facing issues on the technical aspect and drawbacks regarding the classroom management issues.

5. CONCLUSION

The requirement for examining the technological, pedagogical, and content knowledge of the English language teachers was set in the introduction chapter. Then, the growing literature was reviewed from the perspective of formulated research questions. Subsequent to the literature review, the methodology of the current study is explained in full, including information on participants, data gathering methods, and data analysis. The previous chapter contains the answers to the research questions. This chapter consists of two sections; the former provides an overview of each research question's results and contrasts them with earlier studies that pertained to the research field. In order to make the comparison between the current study and earlier research significant, an interpretation of the results is also given. The latter presents some recommendations for future research studies based on the current study's findings.

5.1. Discussion

This study investigated the TPACK development of pre-service teachers who enrolled in a four-year teacher training program. The curriculum of the program was designed by the Council of Higher Education and implemented in a foundation university under the Education Faculty bachelor's degree level. The data was obtained from the participants who had been taught during the pandemic in the context of emergency remote teaching.

The main findings can be summarized as follows. Pre-service English teachers' TPACK development followed a linear line until the third year of the program. There were significant differences in the TPACK domains with respect to the class year. The TPACK, which is a complex knowledge formation, was slightly above "quite a bit" for freshmen, juniors, and seniors, as defined by the survey developers. Additionally, the data showed that TPACK positively correlated with all domains,

but the strongest correlations were apparent in the domains TPK, TCK, and PK. It was also found that the domains of TK and PK significantly predict TPACK.

With concern to the subdomains of the TPACK construct, namely, TK, PK, CK, PCK, TPK, and TCK, strong positive correlations were detected. Higher order knowledge domains, namely, TPK, TCK, and TPK, were found to be more effective on the TPACK, as resonated in Lin et al. (2013). The most considerable correlation on TPACK was detected at TPK, while the lowest was at CK. This result is similar to Bostancığlu and Handley's (2018) findings, in which the strongest correlation on TPACK was revealed from the TPK. Indeed, on such a scale, a correlation has also been interpreted as multicollinearity: the complexity of separating the concepts. Previous research has shown that there is often a high correlation between the various subdomains of TPACK, which has been attributed to the overlap and complexity of the concepts within TPACK (Archambault & Barnett, 2010; Bostancıoğlu & Handley, 2018; Cox & Graham, 2009). From a transformative perspective, this finding may be seen as a result of the difficulty separating the different concepts within TPACK. From a general point of view, it can be claimed that TPACK formation is a highly complex knowledge formation.

Additional to the self-assessed data obtained from the survey, pre-service teachers of the last year prepared lesson plans and implemented those in the practicum lessons. The lesson plan evaluation showed that pre-service teachers moderately aligned the technologies with the curriculum aims yet lagged behind in merging technological knowledge with pedagogical reasoning and subject knowledge. When those plans were put into practice in an authentic school atmosphere, pre-service teachers were challenged by the effectiveness of the lesson with technology and handling technical drawbacks. To explore the possible reasons and integrate participants' perspectives, a focus group discussion was conducted. The reasons for perceived competencies in TPACK domains were attributed to the receiving good role models during the training as well as the experiences in the remote emergency context. The results also demonstrated that perceived difficulties in managing the classroom increased with the existence of technology-driven lessons. Confronted difficulties made them question themselves in competencies framed by the TPACK.

The next sections were organized in subtitles that refer to the research questions to compare these results with the literature to position the findings of the current research.

5.1.1. Discussion on Research Question 1

What are the TPACK levels of pre-service English teachers according to their study year in the current English Language Teaching program?

The first research question was formulated to explain TPACK levels of pre-service English language teachers enrolled in a four-year teacher education program in a foundation university in Turkey according to the class levels. The results indicated that pre-service English language teachers showed considerable levels of TPACK competencies as per the survey descriptions. High levels of TPACK based on self-rated data gathered through survey instruments were found in the literature that resonates with the current study's findings (Atar et al., 2019; Ersanli, 2016; Öz, 2015; Sarıçoban et al., 2019; Solak & Recep, 2014; Vereshchahina et al., 2018).

Delving into the subdomains' descriptive results, the present study yielded the highest mean value from the CK for all class levels. The TPACK-EFL survey results showed that English language teachers feel confident in their subject knowledge, specifically in the area of the English language. This is expected, as it is critical for instructors to possess a strong understanding of all four competencies within their subject area in order to teach effectively. That result aligned with the studies found in the literature in terms of the CK domain and was reported as the most competent knowledge type (Erten, 2022; Kayacan Köse, 2016). Similarly, in a study in which junior pre-service English language teachers enrolled, participants reported that they felt most self-competent in the content-related field of the TPACK framework (Pamuk, 2012). In the present study, following the CK, the TCK domain gained the second-highest mean scores from the first and second-year class levels, while the TPK ranked the same for the third-year class level. Similar results echoed in the previous studies and interpreted as the technical knowledge contributed to the technology-related subdomains. This result indicates that pre-service English language teachers have relied on technology-related knowledge domains in the initial phase of teacher training. On the other hand, the PCK domain of pre-service teachers in their last year was higher than other domains except for the CK. This result

conflicts with the findings revealed by Öz (2015), in which the pedagogical content knowledge was the weakest knowledge domain of English language pre-service teachers among other TPACK domains.

The PK domain had the third-highest mean score among the junior pre-service teachers, while the other class levels had the highest mean score in the TPK domain. It can be deciphered as pedagogical knowledge-related fields were found to be high self-competence. These results are consistent with those of Öz (2015) and Erten (2022).

Although the TK and TPACK domains received high scores from all class levels, with mean values above 7.0, the lowest mean values were obtained from these domains in the present study. The TPACK was found to be increased by the class level until the third grade, and a small decrease was observed when the third- and fourth-year pre-service teachers' results were compared. The increase in the TPACK levels of pre-service teachers as the year can be detected in the literature (C. S. Chai et al., 2010, 2011; Hu & Fyfe, 2010; Kurt et al., 2014), which implies that teacher education program contributes to the TPACK formation of teacher candidates. Nevertheless, the research on TPACK has indicated that integrating technological knowledge into the other knowledge domains has been one of the biggest challenges for teachers. For example, Ciptaningrum et al. (2021) studied the TPACK domains of pre-service English teachers and found that although the technology-related knowledge domains received high scores in concern to the participants' perceptions, the TPACK domain still needed to be developed for meaningful technology integration into the instruction. Similarly, Ali and Mohammadzade (2022) reported that the lowest scores of TPACK subdomains were identified at TK and TPACK in novice English teachers' knowledge domains, while the upper score was attained from the CK domain, aligned with the current results.

5.1.2. Discussion on Research Question 2

Do the TPACK competency levels of pre-service English language teachers differ with respect to their academic levels?

The second research question was formulated to explain whether significant differences occurred across class levels in TPACK subdomains. Running the variance analysis indicated that differences in TK and CK domains were not

statistically significant among the four groups. However, significant differences were found at PK; junior students' self-reported pedagogical knowledge levels were significantly higher than those of the freshmen and sophomore pre-service teachers. In this study, it was found that junior students reported significantly higher levels of pedagogical content knowledge (PCK) compared to freshman and sophomore pre-service teachers. There was a significant difference in the mean scores of sophomores and juniors in terms of their technological pedagogical knowledge (TPK), with the junior group scoring higher.

With a similar concern, Turgut (2017) conducted a study in which pre-service English language teachers' emerging TPACK was traced across class levels in a teacher training program in Turkey. Self-reports of 174 participants obtained through the survey indicated that senior student-teachers had higher self-perception in their TPACK competencies. Following the senior group (N = 53), sophomore student-teachers (N = 65) were the second-highest in their TPACK scores. In contrast to the current study's findings, junior student-teachers reported the lowest mean scores in pertaining knowledge domains. The differences were significant between senior and junior and sophomore and junior TPACK levels in favor of senior-year pre-service teachers. The results of the study were interpreted as TPACK formation of pre-service English teachers did not follow an increasing linear path; rather, some domains of TPACK-related knowledge developed at different times.

Different from Turgut's (2017) study in which first-year teacher candidates were not included, Valtonen et al. (2011) investigated the freshman student-teachers TPACK-related knowledge in concern in concern to being "net generation" teacher candidates. The results indicated that freshmen pre-service teachers lagged behind in transforming technology-related knowledge into their professional goals. This result resonates with the current study's findings, in which the freshmen group gained the lowest TPACK scores according to the self-report data obtained through the TPACK-EFL survey.

From the perspective of Web-Pedagogical Content knowledge self-efficacies, pre-service English language teachers' TPACK was scrutinized by Kavanoz et al. (2015). The findings of the study showed that there were no significant differences between class levels (from first-year students to seniors) in terms of subdomains of the concept. This outcome was not confirmed by the present study's findings, in which

significant differences were reported on some subdomains of TPACK across class levels. One of the possible reasons for the contradiction might be stemmed from the difference in the instrument used and measured in separate subdomains. The other possible explanation for the difference in TPACK scores could be the participants' prior exposure to the technology used in education. The participants in this study had experience using technology for educational purposes during the pandemic, which may have contributed to their development of TPACK. Another factor that may have influenced the results is the "practice effect" in the curriculum, as higher TPACK scores were found in participants in higher classes. It's possible that the increased class level allowed for more opportunities to practice and develop TPACK.

5.1.3. Discussion on Research Question 3

Which TPACK domains best predict the total TPACK scores of the participants?

Among the core knowledge domains, the most significant predictor of the TPACK was revealed to be the PK and TK, while CK had no significant contribution. In alignment with this result, Chai et al. (2010) found that pedagogical knowledge (PK) was the most crucial factor in predicting the level of technological, pedagogical, and content knowledge (TPACK) in pre-service teachers. The authors concluded that increasing PK is essential for developing TPACK, as it provides a strong foundation for effectively integrating technology into teaching. They suggested that as pre-service teachers build a basic level of PK, they will be better equipped to develop technology integration ideas in their teaching.

Similarly, a study conducted by Kartal and Afacan (2017) it was indicated that a positive correlation was found in each subdomain of knowledge types. However, PK was the most significant predictor of the TPACK level.

In a recent study, PK was also found as the most significant predictor of TPACK formation (Tanak, 2020). The researcher indicated that a high level of TK did not activate the TPACK unless the participants' PK was low.

In a similar vein, Şad et al. (2015) studied the power of subdomains of TPACK to predict the overall TPACK. Their results showed a 61% of the variance of TPACK could be explained by the subdomains. The domains TK and CK did not significantly contribute to the TPACK in their model; however, PK was detected to be a significant predictor ($B = 0.164$, $p < .001$). These results resonate with the present

findings related to PK and CK. However, the insignificance of TK in predicting the total TPACK was not confirmed in the present study.

A study by Absari et al. (2020) found similar results supporting the influence of the PK level on TPACK and TPK. Using an associative research design, the study demonstrated that the PK domain significantly impacted the TPACK and TPK domains. The results also indicated that TK and CK knowledge did not considerably affect TPACK, which is consistent with the findings of the current study regarding CK. However, the present study found that TK was a significant predictor of TPACK, which differed from Absari et al.'s results.

5.1.4. Discussion on Research Question 4

How do the performances of the pre-service teachers of English manifest themselves during the practicum within the TPACK framework?

Similar to the addressed research question, Pamuk (2012) investigated the pre-service English teachers' TPACK competencies through materials designed by the participants. The analysis of the data showed that the students had a deficiency in their comprehension of how to incorporate technology into their teaching using the TPACK framework effectively. In more recent work, Schmidt et al. (2022) investigated the lesson plans designed by language teachers so as to identify TPACK elements. The results were found to be quite similar to the present findings; while technology was not apparent in most of the teacher designs, existing technology use targeted the teachers' use. Similarly, the results related to the lesson plans in the current study indicated that most of the student-teachers did not include technology in their lessons during the planning phase. The existing technology usage, on the other hand, did not include the learners; instead, it functioned as a facilitative tool for the teacher. This result was also echoed in the review study inspected by Tseng et al. (2020), claiming that technology was used mainly for the instructional ends by the English language teachers and emphasized the deficiency of learners' active participation in the process.

Apart from the technology's existence, the lesson plans were evaluated through TIAR developed by Harris et al. (2010). The results indicated that pre-service English teachers had moderate-adequate performances in the first three criteria. At the same time, the lowest scores were extracted from the last one, which was the "Fit." Similar

results were obtained from the literature. Utilizing the same instrument in the analysis of the lesson plans, Koyunkaya and Taşdan (2019) revealed that pre-service teachers were least competent in the "Fit" criterion. In a similar vein, Atakan (2019) revealed that "Fit" was the most problematic criterion for pre-service teachers since it required o good command of TPACK knowledge in action. Indeed, integrating pedagogic, content, and technology knowledge in harmony demands much in terms of internalization of the framework. However, opposite findings also take part in the literature. For example, in exploring the TPACK development, Neumann et al. (2021) illustrated higher scores in total TIAR gathered from pre-service teachers, in which the criteria the "Instructional strategies & technologies" and the "Technology Selection(s)" had the minimum scores. Yet, the difference in scores on the rubric could be attributed to the treatment that pre-service teachers took for five weeks before the lesson plan compositions.

5.1.5. Discussion on Research Question 5

How do the performances of the pre-service teachers of English manifest themselves during the practicum within the TPACK framework?

The results attained from the sixth research question indicated that pre-service senior EFL teachers showed limited performance in teaching practice according to the TPACK framework. This result conflicts with Kwangsawad's (2016), in which the TPACK self-reports aligned with the field experience and yielded higher competence.

In a case study conducted by Kurt et al. (2014), pre-service English teachers' TPACK enactments were observed in the practicum experience. The in-class performances of six student-teachers were evaluated through the Technology Integration Observation Instrument developed by Hofer et al. (2010); however, only three of them were reported. The results indicated that participants achieved high-level performance in their field experience and received full scores in almost every criterion of the instrument. This result might be related to the treatment phase of the study, which encompassed a 12-week instruction on TPACK.

Overall, as indicated by Lawless and Pellegrino (2007), although teachers may feel more confident in their knowledge of a particular subject after participating in professional development, this increased confidence does not necessarily reflect an

actual increase in their skill in applying that knowledge in their practice. In a similar vein, Pamuk (2012) found that while the TPACK model has the potential to help educators understand how to incorporate technology into teaching and learning, this potential was not always evident in their results. The lack of understanding of the overall TPACK framework was attributed to inexperience in terms of pedagogic practice and deficiency in encountering technologically competent role models in the training program.

5.1.6. Discussion on Research Question 6

How do pre-service senior-year English teachers interpret their TPACK levels based on the teacher training program and the practicum experience?

In the current study, senior-level pre-service English language teachers attributed the high level of self-competence in their TPACK to having had good role models in their training years. Similar findings that existed in the literature confirm the effect of good role models on the pre-service teachers' TPACK development. For instance, conducting a qualitative inquiry, Jang and Chen (2010) marked that observing a model trainer was the prerequisite for meaningful TPACK formation. Indeed, in Bandura's (1986) terms, "vicarious learning" occurs. That is, the observation of a more capable model contributes significantly to a pre-service teacher's knowledge repertoire.

In addition to the modeling, theoretical courses were revealed to be a critical element in knowledge formation and reasoning when applying this knowledge. This finding coheres with the previous literature in terms of the effectiveness of the curriculum program in the trainees' conception. For example, at a Turkish university's Department of Foreign Language Education, which offers a four-year undergraduate English Language Teacher Education program, Koçoğlu (2009) performed a study on 27 aspiring EFL teachers. The study results indicated that experiencing technology as a language learner in the "Computer-assisted language learning courses" was one of the significant contributors to their TPACK.

Another positive contributor to their high TPACK levels was reported as the experience during the remote emergency learning context. The participants were exposed to the technology since, during the pandemic, teacher training courses were conducted online in which the technology involved the education endeavors

compulsorily. This involvement encompassed to be practiced different software along with engaging with the hardware. In a review study focusing on the after-pandemic reflections on education, Abu Talib et al. (2021) revealed that exposure to technological tools was one of the positively connotated themes among the flexibility of online learning and developing a mindset that enables one to think in educational foci for technology integration. As theorized by Dewey (1938), experienced contexts ameliorate learning by discovering unique situations on the spot. From the position of the teaching profession, contextual clues of teaching practice are embedded in the training years of a pre-service teacher, and teachers make use of their background learner experiences in their teaching (Zimmer et al., 2021). These notions were confirmed in the present results in which student-teachers declared that the "pandemic was a teacher."

Another salient theme elicited positive perceptions and willingness to take advantage of technology during teaching. Similar findings were reported in the literature that can be interpreted as pre-service teachers heightened awareness of technology integration (Atar et al., 2019; Chung, 2014; Jang & Chen, 2010; Kaya & Dag, 2013).

On the other hand, examining pre-service English language teachers' attitudes toward distance education with ICT tools, Hismanoglu (2012) indicated that the participants negatively perceived the ICT tools in the classroom. The reasons for negative attitudes were attributed to the gap in theory and practice stemming from the inequality in accessing affordances and the void in the experience.

Similarly, Obos et al. (2022) conducted qualitative research exploring whether English language teachers met TPACK requirements during the Emergency Remote Teaching context. When the reflections of two teachers were analyzed, the results indicated that teachers did not effectively integrate their knowledge of technology into the teaching practices. The reasons for the failure were attributed to contextual factors, mainly the problems related to the infrastructure.

The discussion session also revealed that limited technology use in the planned lessons stemmed from fear of failure in classroom management. The difficulties regarding classroom management in the presence of technology in instruction are echoed in the literature (Saritepeci et al., 2016; Usluel et al., 2007). For instance, a study conducted by Durak and Saritepeci (2017) revealed that classroom

management problems arose in technology-assisted courses. Although novice teachers had more competency in technology integration, they reported the disturbance in managing the classroom more than their experienced colleagues (Durak & Saritepeci, 2017).

The practicum provides invaluable insights for pre-service teachers about their strengths and weaknesses in the teaching profession (Farrell, 2007). In this study, senior-year pre-service English language teachers elaborated on their performance displayed in the practicum. The results indicated by Merç (2010) cohere with this finding in terms of different issues that became apparent in the practicum. On the contrary, Yalcin Arslan and Ilin (2018) detected concerns of ELF pre-service teachers' regarding the practicum and uttered that their self-confidence increased after the practicum. However, it should be noted that technology-driven research questions have not been posed in the analysis of practicum elaboration to date.

5.2. Recommendations

This study investigated pre-service EFL teachers' TPACK who have been trained in the process of emergency remote teaching context along with its core and integrated knowledge domains. For future studies, TPACK domains could be investigated with a larger population from different contexts to interpret the general results. Additionally, lesson plans, observations, and focus group discussions could encompass different class levels rather than only the last-year student-teachers. In this way, comparing and tracking the TPACK development would be more effective. In order to understand knowledge formation, the practicum phase of pre-service teacher training could be explored in detail with a longitudinal study. The insight and expectations regarding the practicum with the technology integration focus could be analyzed with pre-post design. In that way, the voices of pre-service teachers could be more apparent, enabling researchers and practitioners to take necessary actions.

REFERENCES

Absari, N., Priyanto, P., & Muslikhin, M. (2020). The effectiveness of technology, pedagogy and content knowledge (tpack) in learning. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *26*(1), Article 1. https://doi.org/10.21831/jptk.v26i1.24012

Abu Talib, M., Bettayeb, A. M., & Omer, R. I. (2021). Analytical study on the impact of technology in higher education during the age of COVID-19: Systematic literature review. *Education and Information Technologies*, *26*(6), 6719–6746. https://doi.org/10.1007/s10639-021-10507-1

Ali, S. S., & Mohammadzadeh, B. (2022). Iraqi Kurdish EFL teachers' beliefs about technological pedagogical and content knowledge: The role of teacher experience and education. *Frontiers in Psychology*, *13*, 969195. https://doi.org/10.3389/fpsyg.2022.969195

Altun, T. (2007). Information and communications technology (ICT) in initial teacher education: What can Turkey learn from range of international perspectives? *Journal of Turkish Science Education*, *4*(2), 45–60.

Angeli, C., & Valanides, N. (2005). Preservice elementary teachers as information and communication technology designers: An instructional systems design model based on an expanded view of pedagogical content knowledge. *Journal of Computer Assisted Learning*, *21*(4), 292–302. https://doi.org/10.1111/j.1365-2729.2005.00135.x

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, *52*(1), 154–168. https://doi.org/10.1016/j.compedu.2008.07.006

Angeli, C., Valanides, N., & Christodoulou, A. (2016). Theoretical considerations of technological pedagogical content knowledge. In M. C. Herring, M. J. Koehler, & P. Mishra (Eds.), *Handbook of technological pedagogical content knowledge (TPACK) for educators* (2nd ed., pp. 11–32). Routledge.

Aniq, L. N., & Drajati, N. A. (2019). Investigating EFL teachers' perceptions on their TPACK development: How EFL teachers view seven domains on TPACK framework. *Leksika: Jurnal Bahasa, Sastra Dan Pengajarannya*, *13*(2), 95–101.

Ansyari, M. F. (2015). Designing and evaluating a professional development programme for basic technology integration in English as a foreign language (EFL) classrooms. *Australasian Journal of Educational Technology*, *31*(6), Article 6. https://doi.org/10.14742/ajet.1675

Archambault, L. M., & Barnett, J. H. (2010). Revisiting technological pedagogical content knowledge: Exploring the TPACK framework. *Computers & Education*, *55*(4), 1656–1662. https://doi.org/10.1016/j.compedu.2010.07.009

Arıkan, A., & Özel, A. (2015). The Use of the Internet and Web 2.0 Tools among EFL Instructors. *Mediterranean Journal of Humanities*, *5*(1), 313–325. https://doi.org/10.13114/MJH.2015111386

Aşık, A., Eroğlu İnce, B. H., & Şarlanoğlu Vural, A. (2018). Investigating learning technology by design approach in pre-service language teacher education: Collaborative and reflective experiences. *Eğitimde Nitel Araştırmalar Dergisi*, *6*(1), Article 1. https://doi.org/10.14689/issn.2148-2624.1.6c1s2m

Aşık, A., Köse, S., Yangın Ekşi, G., Seferoğlu, G., Pereira, R., & Ekiert, M. (2020). ICT integration in English language teacher education: Insights from Turkey, Portugal and Poland. *Computer Assisted Language Learning*, *33*(7), 708–731. https://doi.org/10.1080/09588221.2019.1588744

Atakan, İ. (2019). *Pre-service science teachers' TPACK efficacy levels and technology integration quality: Application of TPACK-IDDIRR model* [Master's Thesis]. Middle East Technical University.

Atar, C., Aydın, S., & Bağci, H. (2019). An investigation of pre-service English teachers' level of technopedagogical content knowledge. *Journal of Language and Linguistic Studies*, *15*(3), Article 3. https://doi.org/10.17263/jlls.631517

Backfisch, I., Lachner, A., Hische, C., Loose, F., & Scheiter, K. (2020). Professional knowledge or motivation? Investigating the role of teachers' expertise on the quality of technology-enhanced lesson plans. *Learning and Instruction*, *66*, 101300. https://doi.org/10.1016/j.learninstruc.2019.101300

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory* (pp. xiii, 617). Prentice-Hall, Inc.

Baser, D., Kopcha, T. J., & Ozden, M. Y. (2016). Developing a technological pedagogical content knowledge (TPACK) assessment for preservice teachers learning to teach English as a foreign language. *Computer Assisted Language Learning*, *29*(4), 749–764. https://doi.org/10.1080/09588221.2015.1047456

Berber, D., & Erdem, A. (2015). An investigation of Turkish pre-service teachers' technological, pedagogical and content knowledge. *Computers*, *4*(3), 234–250. https://doi.org/10.3390/computers4030234

Berrett, B., Murphy, J., & Sullivan, J. (2012). Administrator insights and reflections: Technology integration in schools. *Qualitative Report*, *17*(1), 200–221. https://doi.org/10.46743/2160-3715/2012.1815

Blömeke, S., Gustafsson, J.-E., & Shavelson, R. J. (2015). Beyond dichotomies: Competence viewed as a continuum. *Zeitschrift Für Psychologie*, *223*(1), 3–13. https://doi.org/10.1027/2151-2604/a000194

Bobak, C. A., Barr, P. J., & O'Malley, A. J. (2018). Estimation of an inter-rater intra-class correlation coefficient that overcomes common assumption violations in the assessment of health measurement scales. *BMC Medical Research Methodology*, *18*(1), 93. https://doi.org/10.1186/s12874-018-0550-6

Borg, S. (2003). Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do. *Language Teaching*, *36*(2), 81–109. https://doi.org/10.1017/S0261444803001903

Borg, S. (2006). The distinctive characteristics of foreign language teachers. *Language Teaching Research*, *10*(1), 3–31. https://doi.org/10.1191/1362168806lr182oa

Bostancıoğlu, A., & Handley, Z. (2018). Developing and validating a questionnaire for evaluating the EFL 'Total PACKage': Technological Pedagogical Content Knowledge (TPACK) for English as a Foreign Language (EFL). *Computer Assisted Language Learning*, *31*(5–6), 572–598. https://doi.org/10.1080/09588221.2017.1422524

Bourdillon, H., & Storey, A. (2013). Subject knowledge and preparation for teaching. In *Aspects of Teaching and Learning in Secondary Schools: Perspectives on Practice* (pp. 43–62). Routledge.

Brianza, E., Schmid, M., Tondeur, J., & Petko, D. (2022). *Investigating contextual knowledge within TPACK: How has it been done empirically so far?* 2204–2212. https://www.learntechlib.org/primary/p/221012/

Bruce, B., & Hogan, M. (1998). The disappearance of technology: Toward an ecological model of literacy. In D. Reinking, M. McKenna, L. Labbo, & R. Kieffer (Eds.), *Handbook of literacy and technology: Transformations in a post-typographic world* (pp. 269–281).

Bunch, G. C. (2013). Pedagogical language knowledge: Preparing mainstream teachers for English learners in the new standards era. *Review of Research in Education*, *37*(1), 298–341. https://doi.org/10.3102/0091732X12461772

Çalik, M., Özsevgeç, T., Ebenezer, J., Artun, H., & Küçük, Z. (2014). Effects of 'environmental chemistry' elective course via technology-embedded scientific inquiry model on some variables. *Journal of Science Education and Technology*, *23*(3), 412–430. https://doi.org/10.1007/s10956-013-9473-5

Candela, A. G. (2019). Exploring the function of member checking. *The Qualitative Report*, *24*(3), 619–628.

Çetinkıran, Y. (2022). *Teknolojik pedagojik alan bilgisi (TPAB) ile ilgili yapılan Türkiye kaynaklı uluslararası yayınların bibliyometrik analizi* [Master's Thesis]. Necmettin Erbakan Üniversitesi.

Ceylan, E., Özdoğan Özbal, E., Sever, M., & Boyacı, A. (2020). *Türkiye'deki Öğretmen ve Okul Yöneticilerinin Görüşleri, Öğretim Koşulları: TALIS 2018 Öğretmen ve Okul Yöneticileri Yanıtları Analizi*. Millî Eğitim Bakanlığı Yayınları.

Chai, C., Koh, J., & Tsai, C.-C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society*, *16*(2), 31–51.

Chai, C. S., Koh, J. H. L., & Tsai, C.-C. (2010). Facilitating preservice teachers'

development of technological, pedagogical, and content knowledge (TPACK). *Journal of Educational Technology & Society*, *13*(4), 63–73.

Chai, C. S., Koh, J. H. L., & Tsai, C.-C. (2016). A review of the quantitative measures of technological pedagogical content knowledge (TPACK). In M. C. Herring, M. J. Koehler, & P. Mishra (Eds.), *Handbook of technological pedagogical content knowledge (TPACK) for educators* (2nd ed., pp. 87–106). Routledge.

Chai, C. S., Ling Koh, J. H., Tsai, C.-C., & Lee Wee Tan, L. (2011). Modeling primary school pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) for meaningful learning with information and communication technology (ICT). *Computers & Education*, *57*(1), 1184–1193. https://doi.org/10.1016/j.compedu.2011.01.007

Chapelle, C. A. (2003). *English language learning and technology: Lectures on applied linguistics in the age of information and communication technology* (Vol. 7). John Benjamins Publishing Company. https://doi.org/10.1075/lllt.7

Chung, S. (2014). *Pre-service and in-service ESL teachers' beliefs about the use of digital technology in the classroom* [Master's Thesis, Carleton University]. https://doi.org/10.22215/etd/2014-10485

Ciptaningrum, D. S., Putro, N. H. P. S., Sari, N. K., & Hasanuddin, N. (2021). Evaluation of learning process: Knowledge of ICT integration among pre-service English language teachers. *REID (Research and Evaluation in Education)*, *7*(1), Article 1. https://doi.org/10.21831/reid.v7i1.30521

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers* (2nd ed.). Lawrence Erlbaum Associates.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education (6th ed.). London and New York, NY: Routledge Falmer.* (6th ed.). Routledge Falmer.

Cox, S., & Graham, C. R. (2009). Diagramming TPACK in practice: Using an elaborated model of the TPACK framework to analyze and depict teacher knowledge. *TechTrends*, *53*(5), 60–69. https://doi.org/10.1007/s11528-009-0327-1

Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Merrill.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.

de Vries, M. J. (2005). The nature of technological knowledge: Philosophical reflections and educational consequences. *International Journal of Technology and Design Education*, *15*(2), 149–154. https://doi.org/10.1007/s10798-005-8276-2

Deng, Z. (2018). Pedagogical content knowledge reconceived: Bringing curriculum thinking into the conversation on teachers' content knowledge. *Teaching and Teacher Education*, *72*, 155–164. https://doi.org/10.1016/j.tate.2017.11.021

Dewey, J. (1938). *Experience and education*. Macmillan.

Durak, H., & Saritepeci, M. (2017). Investigating the effect of technology use in education on classroom management within the scope of the FATIH project. *Cukurova University Faculty of Education Journal*, *46*(2), Article 2. https://doi.org/10.14812/cuefd.303511

Ersanli, C. Y. (2016). Improving technological pedagogical content knowledge (TPACK) of pre-service English language teachers. *International Education Studies*, *9*(5), 18–27.

Erten, P. (2022). Technological pedagogical content knowledge (TPACK) proficiency of preservice teachers who will perform language teaching as a foreign language. *Gümüşhane Üniversitesi Sosyal Bilimler Dergisi*, *13*(2), Article 2. https://doi.org/10.36362/gumus.1038099

Farrell, T. S. C. (2007). Failing the practicum: Narrowing the gap between expectations and reality with reflective practice. *TESOL Quarterly*, *41*(1), 193–201.

Fenstermacher, G. D. (1994). Chapter 1: The knower and the known: the nature of knowledge in research on teaching. *Review of Research in Education*, *20*(1), 3–56. https://doi.org/10.3102/0091732X020001003

Freeman, D., & Johnson, K. E. (1998). Reconceptualizing the knowledge-base of language teacher education. *TESOL Quarterly*, *32*(3), 397–417. https://doi.org/10.2307/3588114

George, D., & Mallery, P. (2010). *Spss for windows step by step: A simple study guide and reference, 17.0 update* (10th edition). Allyn & Bacon.

Ghanizadeh, A., Razavi, A., & Jahedizadeh, S. (2015). Technology-enhanced language learning (TELL): A review of resourses and upshots. *International Letters of Chemistry, Physics and Astronomy*, *54*, 73–87. https://doi.org/10.18052/www.scipress.com/ILCPA.54.73

Gisev, N., Bell, J. S., & Chen, T. F. (2013). Interrater agreement and interrater reliability: Key concepts, approaches, and applications. *Research in Social and Administrative Pharmacy*, *9*(3), 330–338. https://doi.org/10.1016/j.sapharm.2012.04.004

Glaser, R. (1984). Education and thinking: The role of knowledge. *American Psychologist*, *39*(2), 93–104. https://doi.org/10.1037/0003-066X.39.2.93

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, *57*(3), 1953–1960. https://doi.org/10.1016/j.compedu.2011.04.010

Grossman, P. L. (1990). *The making of a teacher: Teacher knowledge and teacher education*. Teachers College.

Gudmundsdottir, S., & Shulman, L. S. (1987). Pedagogical content knowledge in social studies. *Scandinavian Journal of Educational Research*, *31*(2), 59–70. https://doi.org/10.1080/0031383870310201

Guerriero, S. (2020). *Teachers' pedagogical knowledge and the teaching profession: Background report and project objectives*. Paris: OECD (Organisation for Economic Co-Operation and Development). https://www.oecd.org/education/ceri/Background_document_to_Symposium_ITEL-FINAL.pdf

Hall, A. B., & Trespalacios, J. (2019). Personalized professional learning and teacher self-efficacy for integrating technology in K–12 classrooms. *Journal of Digital Learning in Teacher Education*, *35*(4), 221–235. https://doi.org/10.1080/21532974.2019.1647579

Harris, J. B., Phillips, M., Koehler, M. J., & Rosenberg, J. M. (2017). TPCK/TPACK research and development: Past, present, and future directions. *Australasian Journal of Educational Technology*, *33*(3), i–viii. https://doi.org/10.14742/ajet.3907

Harris, J., Grandgenett, N., & Hofer, M. (2010). Testing a TPACK-based technology integration assessment rubric. In C. D. Maddux (Ed.), *Research highlights in technology and teacher education* (pp. 323–331). Society for Information Technology & Teacher Education (SITE).

Herschbach, D. R. (1995). Technology as knowledge: Implications for instruction. *Journal of Technology Education*, *7*(1), 31–42. https://doi.org/10.21061/jte.v7i1.a.3

Hismanoglu, M. (2012). Prospective efl teachers' perceptions of ict integration: A study of distance higher education in Turkey. *Journal of Educational Technology & Society*, *15*(1), 185–196.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020, March 27). *The difference between emergency remote teaching and online learning*. Educase Review. https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Hofer, M. J., Grandgenett, N., Harris, J., & Swan, K. (2011). Testing a TPACK-based technology integration observation rubric. In M. Koehler & P. Mishra (Eds.), *Proceedings of SITE 2011-Society for Information Technology & Teacher Education International Conference* (pp. 4352–4359). Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/primary/p/37015/

Holden, H., & Rada, R. (2011). Understanding the influence of perceived usability and technology self-efficacy on teachers' technology acceptance. *Journal of Research on Technology in Education*, *43*(4), 343–367. https://doi.org/10.1080/15391523.2011.10782576

Hoopingarner, D. (2009). Best practices in technology and language teaching. *Language and Linguistics Compass*, *3*(1), 222–235. https://doi.org/10.1111/j.1749-818X.2008.00123.x

Hu, C., & Fyfe, V. (2010). Impact of a new curriculum on pre-service teachers' Technical, Pedagogical and Content Knowledge (TPACK). In C. H. Steel, M. J. Keppell, P. Gerbic, & S. Housego (Eds.), *Curriculum, technology & transformation for an unknown future. Proceedings ascilite Sydney 2010* (pp. 185–189). ascilite.org.au/conferences/sydney10/procs/Chun_Hu-concise.pdf

Irwanto, I. (2021). Research trends in technological pedagogical content knowledge (TPACK): A systematic literature review from 2010 to 2021. *Research Trends in Technological Pedagogical Content Knowledge (TPACK): A Systematic Literature Review from 2010 to 2021*, *10*(4), 2045–2054. https://doi.org/10.12973/eu-jer.10.4.2045

Jang, S.-J., & Chen, K.-C. (2010). From PCK to TPACK: Developing a transformative model for pre-service science teachers. *Journal of Science Education and Technology*, *19*(6), 553–564. https://doi.org/10.1007/s10956-010-9222-y

Kabakci Yurdakul, I., & Coklar, A. N. (2014). Modeling preservice teachers' TPACK competencies based on ICT usage. *Journal of Computer Assisted Learning*, *30*(4), 363–376. https://doi.org/10.1111/jcal.12049

Kabakci Yurdakul, I., Odabasi, H. F., Kilicer, K., Coklar, A. N., Birinci, G., & Kurt, A. A. (2012). The development, validity and reliability of TPACK-deep: A technological pedagogical content knowledge scale. *Computers & Education*, *58*(3), 964–977. https://doi.org/10.1016/j.compedu.2011.10.012

Karakaya, Ö. (2017). *Investigating preservice teachers' TPACK integration into lesson planning* [Master's Thesis, Iowa State University]. https://dr.lib.iastate.edu/entities/publication/93fcc790-0e15-4f7d-adc7-9ecc50309431

Kartal, T., & Afacan, Ö. (2017). Examining Turkish pre-service science teachers' technological pedagogical content knowledge (TPACK) based on demographic variables. *Türk Fen Eğitimi Dergisi*, *14*(1), 1–22. https://doi.org/10.12973/tused.10187a

Kaufman, K. (2015). Information communication technology: Challenges & some prospects from preservice education to the classroom. *Mid-Atlantic Education Review*, *2*(1), 1–11. Scopus.

Kavanoz, S., Yüksel, H. G., & Özcan, E. (2015). Pre-service teachers' self-efficacy perceptions on Web Pedagogical Content Knowledge. *Computers & Education*, *85*, 94–101. https://doi.org/10.1016/j.compedu.2015.02.005

Kaya, S., & Dag, F. (2013). Turkish adaptation of technological pedagogical content knowledge survey for elementary teachers. *Educational Sciences: Theory and Practice*, *13*(1), 302–306.

Kayacan Köse, N. (2016). Technological pedagogical content knowledge (TPACK) of English language instructors. *Journal of Educational and Instructional Studies in the World*, *6*(2), 12–19.

Kazazoğlu, S. (2014). Technology-based interaction in foreign language teaching: The case of second life. *Dil Dergisi*, *164*, Article 164. https://doi.org/10.1501/Dilder_0000000210

Kelly, M. (2010). *Technological pedagogical content knowledge (TPACK): A content analysis of 2006-2009 print journal articles*. 3880–3888. https://www.learntechlib.org/primary/p/33985/

Kennedy-Clark, S. (2011). Pre-service teachers' perspectives on using scenario-based virtual worlds in science education. *Computers & Education*, *57*(4), 2224–2235. https://doi.org/10.1016/j.compedu.2011.05.015

Koçoğlu, Z. (2009). Exploring the technological pedagogical content knowledge of pre-service teachers in language education. *Procedia - Social and Behavioral Sciences*, *1*(1), 2734–2737. https://doi.org/10.1016/j.sbspro.2009.01.485

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education*, *49*(3), 740–762. https://doi.org/10.1016/j.compedu.2005.11.012

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70.

Koh, C. H. L., Chai, C. S., & Tsai, C.-C. (2010). Examining the technological pedagogical content knowledge of Singapore pre-service teachers with a large-scale survey. *Journal of Computer Assisted Learning*, *26*(6), 563–573. https://doi.org/10.1111/j.1365-2729.2010.00372.x

König, J., Bremerich-Vos, A., Buchholtz, C., & Glutsch, N. (2020). General pedagogical knowledge, pedagogical adaptivity in written lesson plans, and instructional practice among preservice teachers. *Journal of Curriculum Studies*, *52*(6), 800–822. https://doi.org/10.1080/00220272.2020.1752804

König, J., Heine, S., Jäger-Biela, D., & Rothland, M. (2022). ICT integration in teachers' lesson plans: A scoping review of empirical studies. *European Journal of Teacher Education*, *0*(0), 1–29. https://doi.org/10.1080/02619768.2022.2138323

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, *15*(2), 155–163. https://doi.org/10.1016/j.jcm.2016.02.012

Koyunkaya, M. Y., & Taşdan, B. T. (2019). Matematik öğretmen adaylarının ders planlarının teknoloji entegrasyonu açısından değerlendirilmesi. *Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi*, *20*, 1137–1166. https://doi.org/10.17494/ogusbd.555139

Kurt, G., Akyel, A., Koçoğlu, Z., & Mishra, P. (2014). TPACK in practice: A qualitative study on technology integrated lesson planning and implementation of Turkish pre-service teachers of English. *ELT Research Journal*, *3*(3), 153–166.

Kwangsawad, T. (2016). Examining EFL pre-service teachers' TPACK trough self-report, lesson plans and actual practice. *Journal of Education and Learning (EduLearn)*, *10*(2), 103–108. https://doi.org/10.11591/edulearn.v10i2.3575

Lambert, J., & Gong, Y. (2010). 21st century paradigms for pre-service teacher technology preparation. *Computers in the Schools*, *27*(1), 54–70. https://doi.org/10.1080/07380560903536272

Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research*, *77*(4), 575–614. https://doi.org/10.3102/0034654307309921

Leader-Janssen, E. M., & Rankin-Erickson, J. L. (2013). Preservice teachers' content knowledge and self-efficacy for teaching reading. *Literacy Research and Instruction*, *52*(3), 204–229. https://doi.org/10.1080/19388071.2013.781253

Lee, K. (2017). Rethinking the accessibility of online higher education: A historical review. *The Internet and Higher Education*, *33*, 15–23. https://doi.org/10.1016/j.iheduc.2017.01.001

Lin, T.-C., Tsai, C.-C., Chai, C. S., & Lee, M.-H. (2013). Identifying science teachers' perceptions of technological pedagogical and content knowledge (TPACK). *Journal of Science Education and Technology*, *22*(3), 325–336. https://doi.org/10.1007/s10956-012-9396-6

Liu, S., Liu, H., Yu, Y., Lİ, Y., & Wen, T. (2014). TPACK: A new dimension to EFL teachers' PCK. *Journal of Education and Human Development*, *3*(2), 681–693.

Maeers, M., Browne, N., & Cooper, E. (2000). Pedagogically appropriate integration of informational technology in an elementary preservice teacher education program. *Journal of Technology and Teacher Education*, *8*(3), 219–229.

Maheshwari, V. K. (2017, September 3). *Sampling Techniques in Quantitative Research*. http://www.vkmaheshwari.com/WP/?p=2455

Malva, L., Leijen, Ä., & Baucal, A. (2020). Towards measuring teachers' general pedagogical knowledge – A mixed method investigation of a pilot test. *Studies in Educational Evaluation*, *64*, 100815. https://doi.org/10.1016/j.stueduc.2019.100815

Mariette, K. S. (2022). Pre-service English teacher's perception and understanding toward TPACK framework during microteaching course. *Journal of Educational Study*, *2*(2), 151–158. https://doi.org/10.36663/joes.v2i2.272

McEwan, H., & Bull, B. (1991). The pedagogic nature of subject matter knowledge.

American Educational Research Journal, *28*(2), 316–334. https://doi.org/10.3102/00028312028002316

MEB. (2018). *T.C. Milli Eğitim Bakanlığı İngilize Dersi Öğretim Programı*. http://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=327

Merç, A. (2010). Self-reported problems of pre-service EFL teachers throughout teaching practicum. *Anadolu University Journal of Social Sciences*, *10*(2), 199–226.

Merriam-Webster. (n.d.). *Practicum*. Merriam-Webster.com. Retrieved December 2, 2022, from https://www.merriam-webster.com/dictionary/practicum

Mirel, J. (2011). Bridging the "widest street in the world": Reflections on the history of teacher education. *American Educator*, *35*(2), 6–12.

Mirriahi, N., Vaid, B. S., & Burns, D. P. (2015). Meeting the challenge of providing flexible learning opportunities: Considerations for technology adoption amongst academic staff. *Canadian Journal of Learning and Technology*, *41*(1), Article 1. https://doi.org/10.21432/T25G71

Mishra, L. (2016). Focus group discussion in qualitative research. *TechnoLearn: An International Journal of Educational Technology*, *6*(1), 1. https://doi.org/10.5958/2249-5223.2016.00001.2

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054.

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same? *The Internet and Higher Education*, *14*(2), 129–135. https://doi.org/10.1016/j.iheduc.2010.10.001

Mouza, C., Karchmer-Klein, R., Nandakumar, R., Yilmaz Ozden, S., & Hu, L. (2014). Investigating the impact of an integrated approach to the development of preservice teachers' technological pedagogical content knowledge (TPACK). *Computers & Education*, *71*, 206–221. https://doi.org/10.1016/j.compedu.2013.09.020

Mustafa, M. E. I. (2016). The impact of experiencing 5e learning cycle on developing science teachers' technological pedagogical content knowledge (TPACK). *Universal Journal of Educational Research*, *4*(10), 2244–2267. https://doi.org/10.13189/ujer.2016.041003

Nazari, N., Nafissi, Z., Estaji, M., & Marandi, S. S. (2019). Evaluating novice and experienced EFL teachers' perceived TPACK for their professional development. *Cogent Education*, *6*(1), 1632010. https://doi.org/10.1080/2331186X.2019.1632010

Neumann, K. L., Alvarado-Albertorio, F., & Ramírez-Salgado, A. (2021). Aligning with practice: Examining the effects of a practice-based educational technology

course on preservice teachers' potential to teach with technology. *TechTrends*, *65*(6), 1027–1041. https://doi.org/10.1007/s11528-021-00672-y

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, *21*(5), 509–523. https://doi.org/10.1016/j.tate.2005.03.006

Nightingale, P. (2014). *What is Technology? Six Definitions and Two Pathologies* (SSRN Scholarly Paper No. 2743113). https://doi.org/10.2139/ssrn.2743113

Ning, Y., Zhou, Y., Wijaya, T. T., & Chen, J. (2022). Teacher education interventions on teacher TPACK: A meta-analysis study. *Sustainability*, *14*(18), Article 18. https://doi.org/10.3390/su141811791

Nordlöf, C., Norström, P., Höst, G., & Hallström, J. (2022). Towards a three-part heuristic framework for technology education. *International Journal of Technology and Design Education*, *32*(3), 1583–1604. https://doi.org/10.1007/s10798-021-09664-8

Nyumba, T. O., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, *9*(1), 20–32. https://doi.org/10.1111/2041-210X.12860

Obos, A. I., Aridah, A., & Rusmawaty, D. R. (2022). Transition to online learning: Implementing the TPACK framework by English teachers due to the covid-19 pandemic. *Journal of Education and Teaching (JET)*, *4*(1), 20–34. https://doi.org/10.51454/jet.v4i1.199

OECD. (2015). *Students, computers and learning: Making the connection*. PISA, OECD Publishing. https://doi.org/10.1787/9789264239555-en

OECD. (2018). *What does innovation in pedagogy look like?* (No. 21; Teaching in Focus, p. 6). https://www.oecd-ilibrary.org/docserver/cca19081-en.pdf?expires=1667644205&id=id&accname=guest&checksum=99C60A33DC9D0E3DD3E6C2F1D934B92C

Oktay, Y. B., & Osam, Ü. V. (2013). Viewing foreign language teachers' roles through the eyes of teachers and students. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *44*(44), Article 44.

Öz, H. (2015). Assessing pre-service English as a foreign language teachers' technological pedagogical content knowledge. *International Education Studies*, *8*(5), 119–130. https://doi.org/10.5539/ies.v8n5p119

Ozgun-Koca, S. A. (2009). The views of preservice teachers about the strengths and limitations of the use of graphing calculators in mathematics instruction. *Journal of Technology and Teacher Education*, *17*(2), 203–227.

Özpınar, İ. (2020). Preservice teachers' use of Web 2.0 tools and perspectives on their use in real classroom environments. *Turkish Journal of Computer and*

Mathematics Education (TURCOMAT), *11*(3), Article 3. https://doi.org/10.16949/turkbilmat.736600

Pachler, N., Evans, M., & Lawes, S. (2007). Pedagogical knowledge and pedagogical content knowledge. In *Modern Foreign Languages* (pp. 53–80). Routledge.

Pamuk, S. (2012). Understanding preservice teachers' technology use through TPACK framework. *Journal of Computer Assisted Learning*, *28*(5), 425–439. https://doi.org/10.1111/j.1365-2729.2011.00447.x

Papanikolaou, K., Makri, K., & Roussos, P. (2017). Learning design as a vehicle for developing TPACK in blended teacher training on technology enhanced learning. *International Journal of Educational Technology in Higher Education*, *14*(1), 34. https://doi.org/10.1186/s41239-017-0072-z

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education*, *33*(4), 413–430. https://doi.org/10.1080/08886504.2001.10782325

Plano-Clark, Vi. L., & Creswell, J. W. (2015). *Understanding research: A consumer's guide* (2nd ed.). Pearson Education Inc.

Polanyi, M. (1997). The tacit dimension. In L. Prusak (Ed.), *Knowledge in dimensions* (pp. 135–146). Routledge. https://doi.org/10.4324/9780080509822-7

Porras-Hernández, L. H., & Salinas-Amescua, B. (2013). Strengthening tpack: A broader notion of context and the use of teacher's narratives to reveal knowledge construction. *Journal of Educational Computing Research*, *48*(2), 223–244. https://doi.org/10.2190/EC.48.2.f

Punia, P., Sangwan, A., & Sangwan, A. (2022). Determinants of teacher's attitude towards online teaching and learning. *Journal of Curriculum and Teaching*, *11*(8), Article 8. https://doi.org/10.5430/jct.v11n8p134

Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, *29*(1), 4–15. https://doi.org/10.3102/0013189X029001004

Rahimi, M., & Pourshahbaz, S. (2019). Technological pedagogical content knowledge (TPACK): Research agenda. In L. A. Tomei (Ed.), *English as a foreign language teachers' TPACK : Emerging research and opportunities* (pp. 103–114). IGI Global.

Rajagopalan, I. (2019). Concept of teaching. *Shanlax International Journal of Education*, *7*(2), 5–8. https://doi.org/10.34293/ education.v7i2.329

Raygan, A., & Moradkhani, S. (2020). Factors influencing technology integration in an EFL context: Investigating EFL teachers' attitudes, TPACK level, and educational climate. *Computer Assisted Language Learning*, *0*(0), 1–22. https://doi.org/10.1080/09588221.2020.1839106

Richards, J. C., & Schmidt, R. (2010). *Longman dictionary of language teaching and applied linguistics* (4th ed.). Pearson Education Inc. https://doi.org/10.4324/9781315833835

Richardson, V. (1990). The evolution of reflective teaching and teacher education. In R. T. Clift, W. R. Houston, & M. C. Pugach (Eds.), *Encouraging reflective practice in education* (pp. 3–19). Teachers College.

Rosenberg, J. M., & Koehler, M. J. (2015). Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education*, *47*(3), 186–210. https://doi.org/10.1080/15391523.2015.1052663

Şad, S. N., Açıkgül, K., & Delican, K. (2015). Senior pre-service teachers' senses of efficacy on their technological pedagogical content knowledge (TPACK). *Journal of Theoretical Educational Science*, *8*(2), Article 2. https://doi.org/10.5578/keg.9480

Sadeeq, M. N. (2020). *An investigation of technological pedagogical content knowledge (tpack) of pre-service english teachers: A case study* [Master's Thesis, Eastern Mediterranean University]. http://i-rep.emu.edu.tr:8080/jspui/bitstream/11129/5344/1/Sadeeqmohammed.pdf

Sailer, M., Stadler, M., Schultz-Pernice, F., Franke, U., Schöffmann, C., Paniotova, V., Husagic, L., & Fischer, F. (2021). Technology-related teaching skills and attitudes: Validation of a scenario-based self-assessment instrument for teachers. *Computers in Human Behavior*, *115*, 106625. https://doi.org/10.1016/j.chb.2020.106625

Salaberry, M. R. (2001). The use of technology for second language learning and teaching: A retrospective. *The Modern Language Journal*, *85*(1), 39–56. https://doi.org/10.1111/0026-7902.00096

Saritepeci, M., Durak, H., & Seferoğlu, S. S. (2016). Examination of teachers' in-service training needs in the field of instructional technology: An evaluation in light of applications implemented at fatih project. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *7*(3), Article 3. https://doi.org/10.16949/turkbilmat.277873

Sarıçoban, A., Tosuncuoğlu, İ., & Kırmızı, Ö. (2019). A technological pedagogical content knowledge (TPACK) assessment of pre-service EFL teachers learning to teach English as a foreign language. *Journal of Language and Linguistic Studies*, *15*(3), Article 3.

Saubern, R., Henderson, M., Heinrich, E., & Redmond, P. (2020). TPACK – time to reboot? *Australasian Journal of Educational Technology*, *36*(3), Article 3. https://doi.org/10.14742/ajet.6378

Schmid, M., Brianza, E., & Petko, D. (2021). Self-reported technological pedagogical content knowledge (TPACK) of pre-service teachers in relation to digital technology use in lesson plans. *Computers in Human Behavior*, *115*, 106586. https://doi.org/10.1016/j.chb.2020.106586

Schmid, R. F., Bernard, R. M., Borokhovski, E., Tamim, R. M., Abrami, P. C., Surkes, M. A., Wade, C. A., & Woods, J. (2014). The effects of technology use in postsecondary education: A meta-analysis of classroom applications. *Computers & Education*, *72*, 271–291. https://doi.org/10.1016/j.compedu.2013.11.002

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149.

Schwab, J. J. (1972). Structure of the disciplines: Meaning and significances. In J. M. Rich (Ed.), *Readings in the Philosophy of Education* (pp. 1–30). Belmont, Calif., Wadsworth Pub. Co.

Searle, J. R. (1995). *The construction of social reality*. Allen Lane.

Segall, A. (2004). Revisiting pedagogical content knowledge: The pedagogy of content/the content of pedagogy. *Teaching and Teacher Education*, *20*(5), 489–504. https://doi.org/10.1016/j.tate.2004.04.006

Shavelson, R. J. (2010). On the measurement of competency. *Empirical Research in Vocational Education and Training*, *2*(1), Article 1. https://doi.org/10.1007/BF03546488

Shulman, L. S. (1986a). Paradigms and research programs in the study of teaching: A contemporary perspective. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 3–36). Macmillan.

Shulman, L. S. (1986b). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4–14. https://doi.org/10.3102/0013189X015002004

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–23. https://doi.org/10.17763/HAER.57.1.J463W79R56455411

Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of definitions of online learning (1988-2018). *American Journal of Distance Education*, *33*(4), 289–306. https://doi.org/10.1080/08923647.2019.1663082

Smart, V., Finger, G., & Sim, C. (2016). Developing TPACK: Envisioning technological pedagogical reasoning. In M. C. Herring, M. J. Koehler, & P. Mishra (Eds.), *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators* (Second Edition, pp. 53–62). Routledge.

Solak, E., & Recep, C. (2014). Examining preservice EFL teachers' TPACK competencies in Turkey. *Journal of Educators Online*, *11*(2). https://doi.org/10.9743/JEO.2014.2.2

Su, M., & Foulger, T. (2019). *We aren't there yet: A progression of literature on*

TPACK measures to assess technology integration. 2534–2542. https://www.learntechlib.org/primary/p/208005/

Suharyadi, S., & Wulyani, A. N. (2022). EFL teachers' reasons for selecting instructional materials during the COVID-19 pandemic. *Bahasa Dan Seni: Jurnal Bahasa, Sastra, Seni, Dan Pengajarannya*, *50*(1), Article 1. https://doi.org/10.17977/um015v50i12022p49

Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics* (6th edition). Pearson.

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What Forty Years of Research Says About the Impact of Technology on Learning: A Second-Order Meta-Analysis and Validation Study. *Review of Educational Research*, *81*(1), 4–28. https://doi.org/10.3102/0034654310393361

Tanak, A. (2020). Designing TPACK-based course for preparing student teachers to teach science with technological pedagogical content knowledge. *Kasetsart Journal of Social Sciences*, *41*(1), Article 1.

Tashakkori, A., & Creswell, J. W. (2007). Editorial: The New Era of Mixed Methods. *Journal of Mixed Methods Research*, *1*(1), 3–7. https://doi.org/10.1177/2345678906293042

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences*. SAGE Publications.

Thompson, A. D., & Mishra, P. (2007). Editors' remarks. *Journal of Computing in Teacher Education*, *24*(2), 38–64. https://doi.org/10.1080/10402454.2007.10784583

Tokmak, H. S., Yelken, T. Y., & Konokman, G. Y. (2013). Pre-service teachers' perceptions on development of their IMD competencies through TPACK-based activities. *Journal of Educational Technology & Society*, *16*(2), 243–256.

Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2017). A comprehensive investigation of TPACK within pre-service teachers' ICT profiles: Mind the gap! *Australasian Journal of Educational Technology*, *33*(3), Article 3. https://doi.org/10.14742/ajet.3504

Trif, V. (2022). Basic communication and assessment prerequisites for the new normal of education. In *Https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-7998-8247-3*. IGI Global. https://www.igi-global.com/book/basic-communication-assessment-prerequisites-268793

Tseng, J.-J., Chai, C. S., Tan, L., & Park, M. (2022). A critical review of research on technological pedagogical and content knowledge (TPACK) in language teaching. *Computer Assisted Language Learning*, *35*(4), 948–971. https://doi.org/10.1080/09588221.2020.1868531

Turgut, Y. (2017). Tracing preservice English language teachers' perceived TPACK in sophomore, junior, and senior levels. *Cogent Education*, *4*(1), 1368612. https://doi.org/10.1080/2331186X.2017.1368612

UNESCO. (2022). *COVID-19 Educational Disruption and Response*, *Retrieved from*(https://en.unesco.org/covid19/educationresponse#schoolclosures), (accessed April,30,2022).

Unesco IIEP LearningPortal. (n.d.). *Information and communicaiton technologies (ICT)* [Glossary]. Retrieved January 9, 2023, from https://learningportal.iiep.unesco.org/en/glossary/information-and-communication-technologies-ict

Usluel, Y., Mumcu, F., & Demiraslan, Y. (2007). ICT in the learning-teaching process: Teachers' views on the integration and obstacles. *HACETTEPE UNIVERSITESI EGITIM FAKULTESI DERGISI-HACETTEPE UNIVERSITY JOURNAL OF EDUCATION*, *32*, 164–178.

Uzundurdu, G. (2022). *Technological readiness of pre-servive English language teachers* [Master's Thesis, Akdeniz University]. https://tez.yok.gov.tr/UlusalTezMerkezi

Valtonen, T., Hoang, N., Sointu, E., Näykki, P., Virtanen, A., Pöysä-Tarhonen, J., Häkkinen, P., Järvelä, S., Mäkitalo, K., & Kukkonen, J. (2021). How pre-service teachers perceive their 21st-century skills and dispositions: A longitudinal perspective. *Computers in Human Behavior*, *116*, 106643. https://doi.org/10.1016/j.chb.2020.106643

Valtonen, T., Pontinen, S., Kukkonen, J., Dillon, P., Väisänen, P., & Hacklin, S. (2011). Confronting the technological pedagogical knowledge of Finnish Net Generation student teachers. *Technology, Pedagogy and Education*, *20*(1), 3–18. https://doi.org/10.1080/1475939X.2010.534867

Vereshchahina, T., Liashchenko, O., & Babiy, S. (2018). English language teachers' perceptions of hybrid learning at university level. *Advanced Education*, *5*(10), 88–97. https://doi.org/10.20535/2410-8286.148368

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge – a review of the literature. *Journal of Computer Assisted Learning*, *29*(2), 109–121. https://doi.org/10.1111/j.1365-2729.2012.00487.x

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology in Education*, *36*(3), 231–250. https://doi.org/10.1080/15391523.2004.10782414

Wang, W., Schmidt-Crawford, D., & Jin, Y. (2018). Preservice teachers' TPACK development: A review of literature. *Journal of Digital Learning in Teacher Education*, *34*(4), 234–258. https://doi.org/10.1080/21532974.2018.1498039

Webb, M., & Cox, M. (2007). A review of pedagogy related to information and

communication technology. *Technology, Pedagogy and Education*, *13*(3), 235–286. https://doi.org/10.1080/14759390400200183

Willermark, S. (2018). Technological pedagogical and content knowledge: A review of empirical studies published from 2011 to 2016. *Journal of Educational Computing Research*, *56*(3), 315–343. https://doi.org/10.1177/0735633117713114

Wu, Y.-T. (2013). Research trends in technological pedagogical content knowledge (TPACK) research: A review of empirical studies published in selected journals from 2002 to 2011. *British Journal of Educational Technology*, *44*(3), E73–E76. https://doi.org/10.1111/j.1467-8535.2012.01349.x

Xu, Z., Banerjee, M., Ramirez, G., Zhu, G., & Wijekumar, K. (Kay). (2019). The effectiveness of educational technology applications on adult English language learners' writing quality: A meta-analysis. *Computer Assisted Language Learning*, *32*(1–2), 132–162. https://doi.org/10.1080/09588221.2018.1501069

Yalcin Arslan, F., & Ilin, G. (2018). The effects of teaching practicum on EFL pre-service teachers' concerns. *Journal of Language and Linguistic Studies*, *14*(2), 265–282.

Yaprak, E., & Tüm, G. (2021). Self-efficacy beliefs and attitudes of EFL teachers towards web 2.0 tools. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *30*(3), 235–250. https://doi.org/10.35379/cusosbil.1031764

Yeh, Y.-F., Hsu, Y.-S., Wu, H.-K., Hwang, F.-K., & Lin, T.-C. (2014). Developing and validating technological pedagogical content knowledge-practical (TPACK-practical) through the Delphi survey technique. *British Journal of Educational Technology*, *45*(4), 707–722. https://doi.org/10.1111/bjet.12078

Zhang, W., & Tang, J. (2021). Teachers' tpack development: A review of literature. *Open Journal of Social Sciences*, *9*(7), Article 7. https://doi.org/10.4236/jss.2021.97027

Zimmer, W. K., McTigue, E. M., & Matsuda, N. (2021). Development and validation of the teachers' digital learning identity survey. *International Journal of Educational Research*, *105*, 101717. https://doi.org/10.1016/j.ijer.2020.101717

APPENDICES

Appendix 1. TPACK-EFL Survey Items

Constructs	Items	1	2	3	4	5	6	7	8	9
Technological Knowledge (TK)	(1) I can use basic technological terms (e.g., operating system, wireless connection, virtual memory, etc.) appropriately.									
	(2) I can adjust computer settings such as installing software and establishing an Internet connection									
	(3) I can use computer peripherals such as a printer, a headphone, and a scanner.									
	(4) I can troubleshoot common computer problems (e.g., printer problems, Internet connection problems, etc.) independently.									
	(5) I can use digital classroom equipment such as projectors and smart boards.									
	(6) I can use Office programs (i.e., Word, PowerPoint, etc.) with a high level of proficiency.									
	(7) I can create multimedia (e.g., video, web pages, etc.) using text, pictures, sound, video, and animation.									
	(8) I can use collaboration tools (wiki, edmodo, 3D virtual environments, etc.) in accordance with my objectives.									
	(9) I can learn software that helps me complete a variety of tasks more efficiently.									
Content Knowledge (CK)	(10) I can express my ideas and feelings by speaking in English.									
	(11) I can express my ideas and feelings by writing in English.									
	(12) I can read texts written in English with the correct pronunciation.									
	(13) I can understand texts written in English.									
	(14) I can understand the speech of a native English speaker easily.									
Pedagogical Knowledge (PK)	(15) I can use teaching methods and techniques that are appropriate for a learning environment.									
	(16) I can design a learning experience that is appropriate for the level of students. (									
	17) I can support students' learning in accordance with their physical, mental, emotional, social, and cultural differences.									
	(18) I can collaborate with school stakeholders (students, parents, teachers, etc.) to support students' learning.									
	(19) I can reflect the experiences that I gain from professional development programs to my teaching process.									
	(20) I can support students' out-of-class work to facilitate their self-regulated learning.									
Pedagogical Content Knowledge (PCK)	(21) I can manage a classroom learning environment.									
	(22) I can evaluate students' learning processes.									
	(23) I can use appropriate teaching methods and techniques to support students in developing their language skills.									
	(24) I can prepare curricular activities that develop students' language skills.									
	(25) I can adapt a lesson plan in accordance with students' language skill levels.									
Technological Content Knowledge (TCK)	(26) I can take advantage of multimedia (e.g., video, slideshow, etc.) to express my ideas about various topics in English.									
	(27) I can benefit from using technology (e.g., web conferencing and discussion forums) to contribute at a distance to multilingual communities.									
	(28) I can use collaboration tools to work collaboratively with foreign persons (e.g., Second Life, wiki, etc.).									
Technological Pedagogical Knowledge (TPK)	(29) I can meet students' individualized needs by using information technologies (35) I can use multimedia such as videos and websites to support students' language learning.									
	(30) I can lead students to use information technologies legally, ethically, safely, and with respect to copyrights.									
	(31) I can support students as they use technology such as virtual discussion platforms to develop their higher order thinking abilities.									
	(32) I can manage the classroom learning environment while using technology in the class.									
	(33) I can decide when technology would benefit my teaching of specific English curricular standards.									
	(34) I can design learning materials by using technology that supports students' language learning.									
	(35) I can use multimedia such as videos and websites to support students' language learning									
Technological Pedagogical Content knowledge (TPACK)	(36) I can use collaboration tools (e.g., wiki, 3D virtual environments, etc.) to support students' language learning.									
	(37) I can support students as they use technology to support their development of language skills in an independent manner.									
	(38) I can use Web 2.0 tools (animation tools, digital story tools, etc.) to develop students' language skills.									
	39) I can support my professional development by using technological tools and resources to continuously improve the language teaching process.									

Appendix 2. Technology Integration Assessment Rubric

Criteria	4	3	2	1
Curriculum Goals & Technologies (Curriculum-based technology use)	Technologies selected for use in the instructional plan are strongly aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are partially aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are not aligned with any curriculum goals.
Instructional Strategies & Technologies (Using technology in teaching/ learning)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Compatibility with curriculum goals & instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Content, pedagogy and technology together)	Content, instructional strategies and technology fit together strongly within the instructional plan.	Content, instructional strategies and technology fit together within the instructional plan.	Content, instructional strategies and technology fit together somewhat within the instructional plan.	Content, instructional strategies and technology do not fit together within the instructional plan.

[1] Harris, J., Grandgenett, N., & Hofer, M. (2010). Testing a TPACK-based technology integration assessment instrument. In C. D. Maddux, D. Gibson, & B. Dodge (Eds.). *Research highlights in technology and teacher education 2010* (pp. 323-331). Chesapeake, VA: Society for Information Technology and Teacher Education (SITE).

[2] Adapted from: Britten, J. S., & Cassady, J. C. (2005). The Technology Integration Assessment Instrument: Understanding planned use of technology by classroom teachers. *Computers in the Schools, 22*(3), 49-61.

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Appendix 3. Technology Integration Observation Instrument

	4	3	2	1
Curriculum Goals & Technologies (Matching technology to curriculum)	Technologies used in the lesson are strongly aligned with one or more curriculum goals.	Technologies used in the lesson are aligned with one or more curriculum goals.	Technologies used in the lesson are partially aligned with one or more curriculum goals.	Technologies used in the lesson are not aligned with one or more curriculum goals.
Instructional Strategies & Technologies (Matching technology to instructional strategies)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Matching technology to both curriculum and instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Considering curriculum, pedagogy and technology all together)	Curriculum, instructional strategies and technology fit together strongly within the lesson.	Curriculum, instructional strategies and technology fit together within the lesson.	Curriculum, instructional strategies and technology fit together somewhat within the lesson.	Curriculum, instructional strategies and technology do not fit together within the lesson.

	4	3	2	1
Instructional Use (Using technologies effectively for instruction)	Instructional use of technologies is maximally effective in the observed lesson.	Instructional use of technologies is effective in the observed lesson.	Instructional use of technologies is minimally effective in the observed lesson.	Instructional use of technologies is ineffective in the observed lesson.
Technology Logistics (Operating technologies effectively)	Teachers and/or students operate technologies very well in the observed lesson.	Teachers and/or students operate technologies well in the observed lesson.	Teachers and/or students operate technologies adequately in the observed lesson.	Teachers and/or students operate technologies inadequately in the observed lesson.

Comments:

Appendix 4. Informed Consent Form

Dear participant,

This form aims to inform you about the research you are asked to participate in and to obtain your consent for your participation.

The study aims to investigate English Language Teacher candidates' Technological Pedagogical Content Knowledge (TPACK) levels. In this context, the research titled "The Effect of Technological Pedagogical Content Knowledge (TPACK-EFL) Levels of English Teacher Candidates" is conducted with voluntary participants. This survey is designed as a part of the dissertation study by Belkıs Benlioğlu under the supervision of Asst.Prof.Semin Kazazoğlu.

As a participant, you are required to fill out a questionnaire containing two-stage self-assessment questions. The estimated time to complete the questionnaire is approximately 15 minutes.

Participation in this research is at your sole discretion. You can refuse to participate in the study or stop it once it has started. The results of this research will be used for scientific purposes. If you withdraw from the study, we will not use data about you. However, you cannot withdraw from the research once the data has been anonymized. All information obtained from you will be kept confidential, and the confidentiality of your identity, if any, will be protected even when the research is published. In addition, you can contact the researcher, whose contact information is below, for any questions, opinions, and suggestions regarding the research.

If you want to contribute to this research project with follow-up tasks, please share your e-mail address (This option is up to you; however, your willingness to participate would be appreciated).

If you approve this form, it will be considered that you have given your consent to participate in the research.

Thank you for your participation.

Researcher contact information:
