EXPLORING EARLY CHILDHOOD TEACHERS' TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE AND EXPERIENCES OF TECHNOLOGY INTEGRATED TEACHING

BÜŞRA GÜNDEŞ ORMAN

BOĞAZİÇİ UNIVERSITY

2022

EXPLORING EARLY CHILDHOOD TEACHERS' TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE AND EXPERIENCES OF TECHNOLOGY INTEGRATED TEACHING

Thesis submitted to

the Institute for Graduate Studies in Social Sciences

in partial fulfillment of the requirements for the degree of

Master of Arts

in

Early Childhood Education

by

Büşra Gündeş Orman

Boğaziçi University

2022

DECLARATION OF ORIGINALITY

I, Büşra Gündeş Orman, certify that

- I am the sole author of this thesis and that I have fully acknowledged and documented in my view all sources of ideas and words, including digital resources, which have been produced or published by another person or institution;
- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
- this is a true copy of the thesis approved by my advisor and thesis committee at Boğaziçi University, including the final revisions required by them.

Signature……

Date …….....

ABSTRACT

Exploring Early Childhood Teachers' Technological Pedagogical Content Knowledge and Experiences of Technology Integrated Teaching

The purpose of this mixed-method study is to investigate early childhood education (ECE) teachers' working with children of ages 3 to 6 years technological pedagogical content knowledge (TPACK) and their technology integration in ECE institutions. The first phase, teacher information form, TPACK-Practical Scale and Technology Integration Scale, was used. Interviews focusing on technology-integrated teaching experience and TPACK are held in the second phase to explain and deepen the initial quantitative data set. The scales are analyzed to determine teachers' knowledge levels regarding TPACK and how it relates to their technology integration scores. Thematic analysis is used for interviews. This study revealed the perceived TPACK of in-service ECE teachers, their technology-integrated teaching experiences, and how they relate to their TPACK. The results showed that teachers have a medium to a high level of TPACK. In addition, there is a positive relationship between ECE teachers' technological knowledge and technology integration, and TPACK predicts technology integration at a certain level. In the thematic analyzes, teachers' evaluations that they see technology as a necessity for children's lives and that they blend content, pedagogy and technology knowledge come to the fore. In addition, ECE teachers evaluated TPACK in terms of students, objectives, curriculum, challenges and opportunities, advantages, and disadvantages. At the practical implications level, this study's result suggests that in-service training based on the ECE teachers' needs will help them catch up with the changing technological developments.

ÖZET

Erken Çocukluk Öğretmenlerinin Teknolojik Pedagojik Alan Bilgilerini ve Teknoloji Bütünleşik Öğretim Deneyimlerinin İncelenmesi

Bu karma yöntemli çalışmanın amacı, 3-6 yaş aralığındaki çocuklarla çalışan erken çocukluk eğitimi (EÇE) öğretmenlerinin teknolojik pedagojik alan bilgisi (TPAB) ve EÇE kurumlarında teknoloji bütünleştirmelerini araştırmaktır. Birinci aşamada öğretmen bilgi formu, TPAB-Uygulama Ölçeği ve Teknoloji Entegrasyon Ölçeği kullanılmıştır. İkinci aşamada, başlangıçtaki nicel veri setini açıklamak ve derinleştirmek için teknoloji bütünleştirilmiş öğretim deneyimine ve TPAB'a odaklanan görüşmeler yapılmıştır. Ölçekler, öğretmenlerin TPAB düzeylerini ve bunun teknoloji entegrasyon puanları ile ilişkisini belirlemek için analiz edilmiştir. Görüşmeler için tematik analiz kullanılmıştır. Bu çalışma, hizmet içi EÇE öğretmenlerinin algıladıkları TPAB ve teknolojiyle bütünleştirilmiş öğretimdeki deneyimleri ve bunların TPAB ile ilişkili olduğu bulgular arasındadır. Sonuçlar, öğretmenlerin orta ve yüksek TPAB düzeyleri olduğunu göstermiştir. Ayrıca EÇE öğretmenlerinin TPAB ve teknoloji bütünleştirme puanları arasında pozitif bir ilişki vardır. TPAB teknoloji bütünleştirilme puanlarını belirli bir düzeyde yordamaktadır. Tematik analizlerde öğretmenlerin teknolojiyi çocukların yaşamları için bir gereklilik olarak gördükleri ve içerik, pedagoji ve teknoloji bilgisini harmanladıklarına ilişkin değerlendirmeleri ön plana çıkmaktadır. Ayrıca EÇE öğretmenleri TPAB'ı öğrenciler, hedefler, müfredat, zorluklar, fırsatlar, avantajlar, dezavantajlar açısından değerlendirmiştir. Pratik uygulama düzeyinde, bu çalışmanın sonucu, EÇE öğretmenlerinin ihtiyaçlarına dayalı hizmet içi eğitimin değişen teknolojik gelişmeleri yakalamalarına yardımcı olacağını göstermektedir.

ACKNOWLEDGMENTS

Firstly, I would like to thank my advisor, Assist. Prof. Ersoy Erdemir for his inspiring energy and support. I have special thanks to my committee member Prof. Elif Yeşim Üstün for her limitless support and guidance. I would like to thank Assoc. Prof. Mine Göl- Güven for her nurturing feedback throughout the process, her kindness, and for providing my perspective on teacher training as the starting point of this study. I would also like to thank Prof. Belma Tuğrul for her support. Also, I would like to commemorate and thank Assist. Prof. Aylin Sözer, who motivated me with her excitement, who we heartrendingly lost, and whose smile is endless.

I am truly grateful to my family for always being there for me and supporting me. In particular, thank you to my mother, Feruze Gündeş, for always making things happen, my father, Mustafa Gündeş, for making me believe I could do it, and my sister, Kübra Gündeş, for making everything fun and bearable.

Finally, I would like to thank my spouse, Yunus Emre Orman for his extraordinary support. I couldn't have done it without your love and support. Thank you for being there with me.

Büşra Gündeş Orman

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CK	Content Knowledge
ECE	Early Childhood Education
ICT	Information Communication Technologies
MoNE	Ministry of National Education
NAEYC	National Association for Education of Young Children
STEM	Science, Technology, Engineering, Mathematics
TDC	Teacher Digital Competence
TK	Technological Knowledge
TPACK	Technological Pedagogical Content Knowledge
PK	Pedagogical Knowledge

CHAPTER 1

INTRODUCTION

The study aims to understand early childhood education (ECE) teachers' technological pedagogical content knowledge (TPACK) and their views on technology use working with young children in the classroom. The use of technology in early childhood is ever increasing and becoming a part of daily routines in the home and learning environments such as classrooms (Blackwell, Lauricella, & Wartella, 2014; Plowman, Stephen, & McPake. 2008). The use of technology in early childhood has become inevitable, especially with the compulsory distance learning period due to the COVID-19 pandemic. In this period, while there was an urgent increase in children's use of technology for educational purposes, teachers' acute technology adaptation also took place (Miulescu, 2020). Thus, at this point, it seems possible for teachers to increase their technology exposure and knowledge and transform their relevant practices in the classroom.

Firstly, technology and ICT terms briefly discussed. The effect of technology on the development of children is mentioned and teachers' beliefs and attitudes about the use of technology in education are included. Then, a framework of teacher competencies and knowledge regarding technology was shared. An introduction is provided, along with an overview of all of them.

It would be useful to define technology and information communication technologies (ICT) in education. Technology includes both hardware and devices that provide connectivity, content and assistive technology devices (Tusla, 2018). Information and communications technology (ICT) is the blanket term given to the various ways that information and communication are created, sent, received,

viewed, stored, and experienced through technological tools (Nolan, 2019). For this study, ICT refers to technologies used in educational settings, the hardware forms of digital technologies such as computers, tablets, laptops, smartphones, support devices, and software used for learning management, documentation, creativity, communication, and storage/cloud.

Children are very intertwined with technology at home and school. Although home-based studies intensify in children's use of technology (Stephen & Plowman, 2013), it is possible that these studies can provide important insights into what technology means in children's lives and educational settings. In a study in which the positive and negative effects of technology on children are discussed, the effects are listed as follows: The positive aspects are facilitating children's learning, increasing learning opportunities, keeping up with the times, improving sociality, contributing to visual reasoning, psychomotor and physical skills, and enabling families to monitor development. The downsides are privacy problems, reduced multitasking skills, health issues, and changing social norms (Hatch, 2011).

Currently, there are multiple strands of discussion regarding the relationship of children with technology and the extent to which technology exposure can influence their development and education processes. The concerns that have been central to these discussions mainly focus on the excessive, hence dangerous, amounts of time spent with technological devices, forcing children to use technological devices, exposure to violence, inappropriate contents, as well as exploitative marketing tactics (Simon & Nemeth, 2012). On the other hand, home or school-based technology integration that is in harmony with children's development and learning process positively affects children's academic and social skills in the long

term (Blackwell et al., 2014). Additionally, technology could support children in learning new content and motivate them to learn (Slutsky et al., 2021).

It seems safe to argue that ECE teachers can play a crucial role in providing balanced and appropriate technology integration to help children attain positive outcomes in their learning and development experiences. Teachers could act like scaffolders for technology exposure and experiences with helping children's imagination, problem-solving, curiosity and independence (Rosen & Jaruszewicz, 2009). Teachers' use of technology in accordance with development is affected by various factors. The teacher's pedagogical beliefs, knowledge, experience and the presence of technologies are the main important factors (Blackwell et al., 2014; Casillas Martín, Cabezas González& García Peñalvo, 2019; Schriever, 2018).

Teachers working in the field of ECE become the decision-makers of which information communication technologies (ICT) will be applied, how, when, and why, by considering children's development, individual interests, readiness, and social and cultural contexts in which they live (Christ, Wang & Erdemir, 2018; NAEYC, 2012). Teachers need to carry out pedagogically appropriate planning, implementation, and evaluation process regarding the use of technology to achieve a meaningful technological adaptation in early years classrooms (Laurillard, 2018). The success of this adaptation for effective child outcomes depends primarily on the teacher’s relevant TPACK.

On the other hand, teachers' views on technology use are also important. Different opinions on children's relationship with technology have been influential in teachers' decisions about whether to use technology or not (Blackwell et al., 2014; Thorpe et al., 2015). While studies show that ECE teachers have positive attitudes toward technology use in the early years (Konca, Ozel, & Zelyurt, 2015; Kerckaert,

Vanderlinde, & van Braak, 2015), some indicate that teachers may also think that the use of technology in early childhood classrooms is inappropriate and they may deliberately choose not to use it (Thorpe et al., 2015). Additionally, teaching attitudes/beliefs have a significant positive association with technology use in the classroom (Blackwell et al., 2014). In addition to the use of technology in the school, there is a contribution to children's technological skills. Teachers' positive views on technology use positively affect children's technological skills (Gialamas & Nikolopoulou, 2010). The teacher's attitudes towards technology provide estimates of the teacher's knowledge along with classroom practices. Positive attitudes towards ICT were found to be an important factor predicting TPACK proficiency level (Albayrak Sarı et al., 2016).

There are different definitions and approaches about the technological competence of the teacher. NAEYC (2012) defines the teacher who uses technology suitable as who chooses technology appropriately, believes in the benefits of conscious use, limits the use of technology in children under the age of 2, supports active and interactive use in children aged 2 -5 years, and follows the decisions of health authorities regarding technology and screen time. The concept of digital literacy of teachers stands out as another concept that explains technological competence. Digital literacy is defined as “the ability to use and evaluate digital resources, tools and services properly, and apply it to lifelong learning processes” (1997, p. 220). This ability includes skills as to access the internet, find, manage, and edit digital information, engage with an online information and communication network. The teacher digital competence (TDC) framework is a broader definition. TDC includes curriculum, personal-ethical (awareness, concern, and action) and personal-professional (operational) competencies (Falloon, 2020). The curricular part

of the TDC framework, TPACK, which is also the focus of this study, is based on *what* the teacher uses in the classroom and *why*.

Technological knowledge and competence of the teacher can be considered as the first step toward assessing the suitability/aptness of the technologies that are used for development and learning purposes with young children. Studies indicate that teachers' understanding of using technology to aid children's learning is an essential component to helping them use technology in their classrooms. In this regard, TPACK framework offers a comprehensive perspective to understand teachers' knowledge and practices related to technology use in classrooms (Mishra & Koehler, 2006). TPACK framework presents the teacher's knowledge as a separate type of knowledge characterized by a blend of technology, pedagogy, and content knowledge. TPACK allows us to understand how effectively teachers use their technological competence in the pedagogical sense and how they connect it with the content they deliver to young children.

Technology use seems to be related to teachers' attitudes towards technology (Blackwell et al., 2014; Thorpe et al., 2015; Koç, 2014). However, even if teachers' attitudes are positive, using technology or successfully integrating it may not be possible (Casillas Martín et al., 2019; Konca & Erden Tantekin, 2014). To understand this, analyzing the relationship between teachers' knowledge and technology integration seems to be an important starting point. By looking at the relationship between TPACK and technology integration, it is possible to see the effect of teacher knowledge on technology use in the classroom.

The following section will present the literature on early childhood and technology use, ECE teachers' technology use, and TPACK. Pertinent studies within

this strand of research that focus on teachers' TPACK and technology use in early learning environments will be reviewed.

CHAPTER 2

LITERATURE REVIEW

This chapter illustrates what the literature has to say on TPACK in ECE and the various findings of technology in educational settings. In order to understand the use of technology by teachers, firstly, data on children's relationship with technology will be briefly included. Afterward, the concept of technology integration will be discussed about the technology usage habits of teachers. In addition, a summary of the studies on the theory of teacher knowledge (Shulman, 1986) and, in connection with this, the concept of TPACK (Mishra & Koehler, 2006), which is the focus of this study, and the TPACK of early childhood teachers will be included. In conclusion, what the literature says about the relationship between TPACK, and technology integration will be briefly discussed.

2.1 Children and technology

The use of technology in the early years necessitates a closer look at the relationship between young children and technology. In today's world, children are inevitably involved in technology from an early age, at times even below the age of 2, through the facilitation of their parents, modeling their parents' technology use, or environmental exposure (Chaudron, Di Gioia & Gemo, 2018). The findings of a comparative study conducted with 5-year-old children in England, Estonia, and the United States show that 83% of five-year-olds use a digital device at least once a week, with 42% of them using it daily (OECD, 2020). Relatedly, research documents that children are increasingly more involved in television-, computer- and internet-based activities like games or play and watching videos or engaging with reading,

writing, or drawing apps (Palaiologou, 2016). While parents, siblings or teachers primarily facilitate the use of technological tools at an early age, such devices become gradually autonomous and independent towards 8 (Chaudron et al. 2018). A study with children under six years-old in Turkey shows that 44.8% of children have use smart phones; 43.1%, use tablets, 21.0% of them use computers; and 70.2% of children have watch television (Aral& Doğan Keskin, 2018). Thus, the research findings converge to suggest that children could reach a liberal and subjective use of technology at a very early age.

In a study about children's views on technology use in the classroom, children state positive and enriching experiences with technology (Mourlam, DeCino, Newland and Strouse, 2020). Additionally, they found technology supportive of their learning, and they are willing to have technology-infused learning opportunities in school. In another study conducted directly with children, it was understood that children could integrate technology successfully. It had significant cognitive and social effects when looking at their reflections in their own journals (Ching, Wang, Shih& Kedemi, 2006). Considering these findings, it is seen that children also find it meaningful to include technology in learning and think that it has positive returns for them.

Although children are inevitably interacting with technology, concerns about the extent of children's technology use remain contentious. The moderate use of technology has been suggested to positively impact children’s well-being in fostering cognitive skills, building rapport with peers, and enhancing self-efficacy in employing digital skills (Hooft Graafland, 2018; Gottschalk, 2019). Cross-national studies also suggest that digital tools could benefit children’s language outcomes and creative skills (Christ et al., 2018; Gottschalk, 2019). On the other hand, the

excessive use of technology has been suggested to lead to aggressive and anti-social behaviors, less time spent with conventional reading, decreased verbal literacy and skills germane to the theory of mind, and subsequent attention problems (Blackwell et al., 2014). Overall, the contentious discussion as to whether technology use in early years is beneficial or harmful to children is tied to the amount of time spent with technology, the various types of technologies used by children, and whether or not the use of technology is developmentally appropriate (Plowman & McPake. 2013; Rosen & Jaruszewicz, 2009).

Children's use of technology for educational purposes occurs at home and in school settings. The types of learning related to the use of technologies in early years are suggested to be three-fold: (1) Operational in the sense that children learn how to use and navigate technological devices and tools, (2) curricular knowledge and understanding in the sense that children learn specific content in domains of topic areas, (3) and developing positive learning dispositions in the sense that children learn to acquire habits and behaviors through the use of technology (Stephen & Plowman, 2013). While children's home experiences are likely to support all these types of learning, learning in school settings is more likely to be limited to basic operational skills, learning dispositions such as taking turns, learning about content, and basic early literacy or numeracy skills. In-home and school environments, there are differences and disparities in terms of the types of learning, availability of technologies, ownership and agency of users, the types of support, scaffolding and learning that are encouraged. The home environment may offer multiple kinds of technologies with social support and more proximal supervision in terms of demonstrating, instructing, managing, yet with limited modeling, monitoring, prompting, providing feedback. On the other hand, a limited range of technologies in

schools usually comes with limited encouragement of individual use and help and more distal guidance in terms of monitoring, planning, providing resources, and setting up activities (Plowman et al., 2008).

While opinions on children's relationship with technology vary widely, many studies show that a balanced use could benefit children (Blackwell et al. 2014, Rosen & Jaruszewicz, 2009). The role of adults in the use of technology with children is crucial. In the school environment, for what purposes and how the teacher uses technology could determine the effect of technology on children. Although there is a less effective use of technology at school than at home, the role of the teacher might change this.

The next section presents the literature that explains why technology use is comparatively less efficient and effective at school and how it can be enriched and enhanced in early years classroom settings.

2.2 Technology integration in early years learning environments

The Early Childhood Education Curriculum (MoNE, 2013) of the Ministry of National Education (MoNE) carries the main objectives of preparing children for primary school, preparing equal opportunities for children, and contributing to literacy, focusing on physical and cognitive, and emotional development. This program does not offer a specific purpose or framework regarding technology. However, the curriculum emphasizes teachers and teacher competencies. Teachers are encouraged to use different approaches and tools. The program is left flexible to enrich it according to the teacher's purposes.

Technology integration means the process in which technology is used as a tool to enhance the tasks of teaching and learning (Keengwe &Onchwari, 2009). It

also includes different ways of using technology to make learning meaningful. An important point here is that technology should be considered as a part of the curriculum, not separately (Donohue, 2015). Teachers' knowledge and resources play an important role in successful technology integration (NAEYC and Fred Roger Center, 2012). It is also important which technology is used for what purpose, when and why it is used (Ihmeideh & Al-Maadadi, 2018).

Educational technologies used in early childhood years include resources, artifacts, interactive devices, and media tools that draw upon digital, internet-enabled, information-communication, mobile, literacy, and learning technologies. While this list comprises intertwined concepts, it also shows that educational technologies do not solely consist of digital devices but also software and resources (Jack & Higgins, 2019). However, research shows that school provides a limited range of technologies with an exclusive focus on computers, children have no ownership of items, and the individual use and access to these items are time-limited (Plowman et al., 2008).

Steps that provide successful integration could be as follows: 1) integrating technology in different learning opportunities with clear learning objectives, 2) using apps and software to meet curriculum goals for children's learnings, 3) balancing teacher-led activities with child-led activities, 4) putting ICT as an option for free time to deepen their learning (Simon & Nemeth, 2012). For understanding this, looking at which technologies ECE teachers use and for what purposes will provide an important view on technology integration.

In early learning environments, technology is used for such purposes as leisure and entertainment, information and learning, creation, and communication (Chaudron et al., 2018). In classrooms, the purposes are limited to using ICT to

support basic relevant skills and attitudes as well as contents and individual learning needs (Kerckaert et al., 2015). Children's use of ICTs is limited, adult-led, structured and focused on operational skills, turn-taking and close-ended cognitive activities with usually no encouragement of creative use (Jack & Higgins, 2018). In terms of the variety of ICTs and purposes of use, studies suggest that technologically mediated interactions in early education settings are insufficient in comparison with what was available in many domestic environment (Plowman et al., 2008). When we look at the technology usage purposes of ECE teachers, it is seen that the teachers use technology for two main purposes: The first is professional purposes. These are purposes such as preparing materials and using them for course management. The second one is the purposes for the needs of the children. These are purposes such as enriching children's learning opportunities and increasing their skills (Ottenbreit-Leftwich et al., 2010).

The interactive use of technology with children is also an important issue. With the quality of the content used interactively with children, positive effects were found on the language, cognitive and motor development of children (Nobre et al., 2020). However, compared to the use of interactive technology at home, there is a less interactive environment at school (Plowman et al., 2008). Among the purposes of teachers' use of technology, such as showing and presenting sample applications, offers limited interaction. In addition, uses such as games and dance in the title of drill and practice offer more interactive learning environments. Although teachers want to use technology interactively, teachers' use of interactive technology is affected by hardware deficiencies (Cevher-Kalburan, Yurt & Ömeroğlu, 2011). For a qualified technology integration specific to the field of early childhood education, availability of ICT stands out as an important issue with other factors.

Early childhood teachers' use of technology in ECE settings is associated with their personal beliefs and attitudes toward technology (Blackwell et al., 2014; Jack & Higgins, 2019). It has been observed that teachers with positive attitudes towards technology use the ICTs more in their practices. While teachers' positive attitudes increase the effective use of technology, negative attitudes may cause less use (Koç, 2014). However, teachers with relatively higher experience use technology more effectively, even if they use it less (Blackwell et al., 2014). Aligned with this observation, the use of ICT in ECE has been documented to be positively influenced by teachers' competence with navigating ICT (Kerckaert et al., 2015).

Studies also have demonstrated an evident correlation between the ICT knowledge of teachers and better use of technology, irrespective of their attitudes toward technology (Casillas Martín et al., 2019). Although teachers perceive children's access to technology positively and think that children attain benefits, they are often challenged with this in practice between their professional knowledge and pedagogical practices (Dong, 2018). In parallel with this, it was found that teachers' gender, experience, and attitudes did not affect their use of technology. Despite sufficient resources and positive attitudes, their technology usage was limited to limited activities such as presenting content (Konca & Erden Tantekin, 2014).

If teachers know how to integrate technology effectively in educational practice, this knowledge can help change teachers' attitudes and increase their effective use of technology in classrooms (Blackwell et al., 2014). In addition to the teachers' knowledge about technology, it has also been observed that teachers incorporate technology more into the curriculum when they have access to ICT training (Simon & Nemeth, 2012). Moreover, confident and supportive teachers could use technology effectively even if there are insufficient digital resources

(Chaudron et al., 2018). For these reasons, it is crucial to understand the technological knowledge and competence of the ECE teachers when early years are usually the first introduction and exposure for young children to today's increasingly more digital and technological society with which they must navigate in their future lives.

2.3 Teacher's knowledge and technological pedagogical content knowledge framework

The term teachers' knowledge has been conceptualized in three types: (a) pedagogical knowledge, (b) content knowledge, and (c) pedagogical content knowledge (Shulman, 1986). Pedagogical knowledge (PK) refers to concepts such as application, process, and assessment that include knowledge related to pedagogical practices, teaching, and learning methods. Content knowledge (CK) refers to the knowledge of teachers about the fields in which they practice their profession. It can also include subject knowledge, concepts, theories and frameworks in a particular area, good practices, and specific approaches to delivering these practices to students. Pedagogical content knowledge (PCK), on the other hand, is the knowledge of transferring and providing a particular subject with subject-specific and appropriate methods.

In addition to Shulman's theory of teacher's knowledge, Mishra and Koehler (2006) introduced the concept of technological and pedagogical content knowledge (TPACK). TPACK is defined as the knowledge of effective teaching by integrating technology into content-specific pedagogical methods. The TPACK framework aims to explain the links between pedagogy, content, and technology knowledge and how this information interacts and intersects with each other while teachers are designing

and implementing effective teaching processes (Koehler, Mishra, Kereluik, Shin, & Graham, 2014). TPACK can be defined as a type of knowledge that combines technology knowledge with these three types of knowledge (PK, CK and PCK), as a separate form of knowledge. (See Fig. 1).

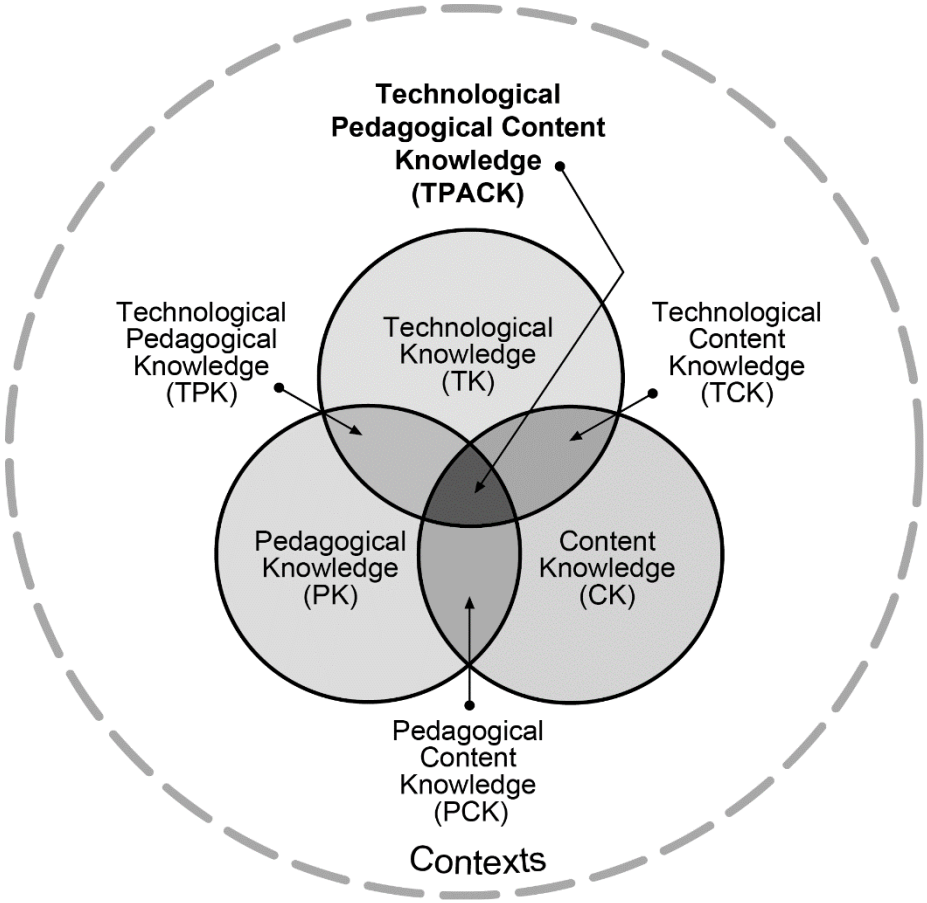

Figure 1. Technological pedagogical content knowledge framework. Reproduced by permission of the publisher, © 2012 by tpack.org

For developmentally appropriate technological use, teachers are expected to be technologically literate, understand the developmental and cultural characteristics of children as well as their needs and interests, be able to make a responsible and informed choice, know scaffolding strategies, and use effective assessment and documentation methods (Rosen & Jaruszewicz, 2009). TPACK framework helps researchers understand the essential and prerequisite knowledge of teachers in technology within the domains of children, subject content, curriculum, application,

and evaluation. Definitions and skills for TPACK and other types of information are set out in Table 1.

Table 1. TPACK Sub-domains and Skills

Knowledge Types	Definitions and Skills
Technology Knowledge (TK)	• Understanding how to use computer software and hardware, presentation equipment, such as presentation documents, and other technologies in the context of education • The ability to adapt and learn new technologies
Content Knowledge (CK)	• Knowledge or specificity of disciplines or subject matter • The specificity of thinking from certain disciplines
Pedagogical Knowledge (PK)	• Understanding classroom management activities, the role of student motivation, lesson plans, and learning assessment • Different teaching methods including knowledge to know how to organize activities in the classroom
Pedagogical Content Knowledge (PCK)	• Understanding of the reciprocal influences between content and pedagogy • Different content will match different teaching methods
Technological Content Knowledge (TCK)	• Understanding the reciprocal relationship between technology and content • Different technologies fit different content
Technological Pedagogical Knowledge (TPK)	• The reciprocal relationship between technology and pedagogy • Understand what technology is appropriate for achieving pedagogical goals • Choose what equipment is most appropriate based on its feasibility for a particular pedagogical approach
Technological Pedagogical Content Knowledge (TPACK)	• How technology can be made specific which is suitable with a pedagogical need to teach the right content in a particular context

Studies of TPACK in early childhood are limited, even if they have proliferated recently. In a study investigating the TPACK levels of teachers from different branches, ECE teachers' TPACK level was found to be high (Albayrak-Sarı, Canbazoğlu-Bilici, Baran& Özbay, 2016). On the contrary, another study reveals that ECE teachers' level of digital competence is not enough to teach digital natives (Casillas Martín et al., 2019).

Although the use of technology by ECE teachers in early years settings is not as intense compared to other school levels, the appropriate use of technological tools in accordance with age and content has become an urgent and important need as a

result of the exponential developments in technology and the distance education conditions propelled by the COVID-19 pandemic. The use of technology in early childhood is linked to teachers' pedagogical beliefs and attitudes toward technology, the support and training that they receive, and their self-confidence (Blackwell et al., 2014, Jack & Higgins, 2019). In a study in which teachers were given a graduate-level course and its impact was measured, an increase was observed in teachers' TPACK levels, excluding PK (Wen & Shinas, 2021).

Similar to teachers at other school levels, ECE teachers' age and experience appear to be important factors and determinants of their TPACK levels. However, there is a discrepancy between the effects of age and experience. While younger teachers' technological knowledge stands out, experienced teachers' pedagogical and pedagogical content knowledge is at a higher level (Chuang & Ho, 2011). Even younger teachers are more technology fluent and eager to use it, experienced teachers use technology better in pedagogical sense. The study conducted with pre-service ECE teachers indicate that TPACK competencies were associated with technology attitudes and use, with other literacy related variables (Altun, 2019). Although the relationship between teachers' attitudes towards technology use and their TPACK levels is clear, there is a dire need for studies on how teachers use knowledge in the relevant literature.

In the context of Turkey, technology use is still questionable (Slutsky et al., 2019). Teachers stated that hardware and software problems and inadequate skills are the problems of technology use in classrooms. When TPACK of teachers teaching in different fields is examined, it is seen that attitudes towards technology are related to their TPACK level. In addition, no difference was found in TPACK of teachers in different subjects (Albayrak et al., 2016). Notably, there is a dearth of TPACK

studies that concentrate on in-service teachers, especially in the field of ECE (Baran & Canbazoğlu Bilici, 2015). For these reasons, research that identifies the TPACK levels of in-service ECE teachers, how they use their knowledge, and the areas they need support can significant contributions to the literature in terms of theory and practice.

2.4 Teachers' knowledge and technology integration

A few studies offer predictions about this relationship, although studies that directly looked at ECE teachers' TPACK levels and technology integration are rare. In a study measuring the effect of an ICT integration training applied to ECE teachers, it was found that the training program affected teachers' perceptions and practices, however, it increased teachers' awareness and helped them understand the importance of ICT tools in education (Ihmeideh & Al-Maadadi, 2018). In this study, it was stated that teachers' practices changed positively, and the quality of the program increased. Another study points out a positive correlation between knowledge and use (Casillas Martín et al., 2019). While teachers' have more knowledge about ICT, they use them better in terms of tools, not the services.

According to a study with pre-service ECE teachers, TPACK levels is related with their technology usage (Altun, 2019). It has been observed that teachers with high TPACK level use technology more. In a study conducted with student teachers, perceived knowledge level is indirectly related to technology use (Luik & Taimalu, 2021). On the other hand, teachers who are confident about their own knowledge about technology use technology effectively to reveal the potential of technology in education (Chaudron et al., 2018).

2.5 Qualitative findings on TPACK and technology integration

It would be helpful to look at what qualitative studies say about ECE teachers' TPACK and technology integrations. Studies with ECE teachers suggest findings that show parallelism with quantitative studies. In a study in which qualitative studies were compiled, teachers' technology integration was found to be related to their beliefs. Teachers' beliefs are also seen as intertwined concepts with education, socialization, and care (Mertala, 2019). In terms of education, he points out teachers' beliefs about technology usage. It has been observed that teachers with positive attitudes see technology as a part of the school. Still, teachers with negative attitudes see technology as a separate content and keep it separate from other experiences. Mertala (2019) indicates that teachers evaluate technology as preparation or assimilation in terms of socialization. Preparation refers to which teachers see technology to prepare children in the digitalized world. On the other hand, assimilation refers to which teachers see technology as a separate part of children's educational live, as a part of their home lives. Another important theme is care. Teachers evaluate themselves as guardians for protecting children from the dangers of technology.

In a study related to TPACK training applied to ECE teachers, teachers stated in their reflections that they found technology important in teaching and evaluation and that education contributed to TPACK levels (Wen & Shinas, 2021). In the study by Jack and Higgins (2016), in which ECE teachers' views on technology and their use of technology were examined, it was stated that teachers saw technology as a way to increase children's learning opportunities. According to the teachers' shares, the use of technology is teacher-centered, teacher-led and child-centered. Teachers

stated that there is a need for activities in which children participate more actively and a technology study in coordination with the family.

In a case study of music teaching with technology in early years, teachers' methods were evaluated. According to these evaluations, it was seen that the teacher's pedagogy was more effective than the presence of technologies (Lee & Jen, 2015). Another case study about discourse on technology and early literacy, findings indicate that teachers' curriculum design could be affected by practical concerns, not only knowledge and beliefs (Boschman, McKenney and Voogt, 2014). The practical concerns are organizational issues and the relationship between children and activity. Organizational issues refer availability of devices, classes, or position of children as they are seated or not. The relationship between children and activity refers that how children participate or react to their activities. When we look closely at the relationship between technology and teachers, it is seen that the decisions made in the classroom have a complex structure.

Parette, Peterson-Karlan and Blum (2013) indicate that when teachers integrated technology into the curriculum, they experience both predicted and unexpected results. According to teachers' comments in the study, technology could both improve the skills of children as well as their enthusiasm for learning. Another statement is that technology could benefit children in providing different participation opportunities. For example, children who feel uncomfortable with verbal communication could contribute to non-verbal communication alternatives. Based on teachers' experiences, Parette et al. (2013) suggest that teachers should understand the importance of using technology for different purposes, feel comfortable and have the expertise for using technology effectively in the classroom.

On the other hand, Lindahl and Folkesson (2012) argue about child place in the technology-infused classroom. Teachers define children as citizens who have the competency to use technology and are active. However, there is a need for space that children could actively benefit from technology. How teachers define children and their pedagogical perspectives can be decisive in using technology.

2.6. Significance of the study

Technology in early childhood is a relatively new and controversial field. Although there is no consensus on how to use technology in accordance with the needs of the age and pedagogical needs, it is known that a balanced use will benefit children. Here, the ECE teacher plays a key role. Understanding the ECE teacher's technological competence and technology use practices can provide an important insight into how and for what purpose technology is used in early childhood classrooms.

The TPACK theoretical framework (Mishra & Koehler, 2006) creates a holistic framework for understanding by integrating the teacher's technological competence with pedagogical and content knowledge. This framework has been studied especially with STEM (Science, Technology, Engineering, Mathematics) group teachers, and studies on early childhood are very few. In technology studies in early childhood, studies on novice teachers and teacher attitudes and use of technology are intense. Although the relationship between teachers' attitudes towards technology and technology use seems to be very clear (Blackwell et al., 2014; Gialamas & Nikolopoulou, 2010), the relationship between teachers' knowledge and views on their use requires a little more attention.

Understanding the relationship between TPACK and technology integration and teachers' experiences in teaching with technology provides us with important insights into the field of instructional design and teacher training. While trying to quantitatively understand the relationship between TPACK and technology integration, it will be possible to deepen and make sense of the insights gained through teachers' experiences.

This study is aimed to investigate ECE teachers' views on their TPACK levels and technology integrations. This study is significant because it examines ECE teachers' TPACK levels with technology integration processes, both quantitative and qualitative findings. Within the context of the literature mentioned above, this thesis research will seek answers to the following research questions:

1. What is the technological pedagogical content knowledge level of the in-service teachers working in the field of early childhood education?

2. Is there a relationship between teachers' TPACK and their technology integration?

3. What are the views of teachers related to their TPACK?

4. How are their experiences with technology integration related to TPACK?

CHAPTER 3

METHOD

3.1 Design of the study

This study adopts a mixed methodology research design. Mixed methodology design includes both quantitative and qualitative inquiry, in which the data from both approaches is combined and integrated (Creswell & Plano Clark, 2017). In the mixed-methodology design, the researcher assumes that the research questions will be better understood within both quantitative and qualitative data (Creswell, 2003). There are different types of designs in mixed-methodology approach according to data collection and analysis procedures. In this study, QUAN-Qual mixed-method research design will be employed (Morse, 1991). In mixed-method QUAN-Qual type design, the process is followed as sequential type, which focuses on primarily attaining quantitative data and following up this data with qualitative data to provide more nuanced explanations (Creswell et al., 2003).

3.2 Sample of the study

The purposive sampling method is used because of the need to reach a certain group of teachers. In purposive sampling, the aim is to get information-rich cases to understand a specific concept (Mertens, 2015). One hundred seven early childhood teachers working in ECE institutions participated in the study. The sample consists of 101 female and 6 male teachers of 3 to 6 years-old children. The age range of teachers is between 21 and 51 (Mean=32.83). The teachers are graduated from Preschool Teaching, Child Development, or other programs as English Teaching, Visual Arts and Psychological Counselling. Teachers are currently working at the

preschool or kindergarten level in kindergartens, primary schools, special education preschool classes or daycare centers in public or private schools. In the second phase, 8 volunteer teachers from the first group has participated the interview sessions.

3.3 Data collection procedure

Teachers working in ECE institutions are reached within the scope of the research. The ethical permission is taken by Boğaziçi University Ethics Committee (INAREK) (APPENDIX A). Data is collected online through Google Forms. Interviews are held remotely via the Zoom application due to the COVID-19 condition. An announcement is made on online platforms to reach the participants. The consent form is shared at the beginning of the online form and is continued after approval (See Appendix B). A separate consent form is used in the video interview, and interviews will be held after consent is obtained (See Appendix C). In addition, teachers who participated in the online survey are asked whether they volunteered for the interview, and online interviews are conducted with the volunteering teachers. Teachers are asked to fill out a questionnaire that includes teacher information form (See Appendix D), Tpack-Practical Scale (Ay, Karadağ & Acat, 2015; see Appendix E), and Technology integration scale (Karaca, Can and Yıldırım, 2013; see Appendix F). Second, in-depth video interviews are held with the volunteer teachers to illuminate the quantitative data better. In the second stage, two groups of teachers are interviewed. Eight teachers working in public or private school participated to study. Two groups were determined according to their working status in public or private schools, as it was seen that the school they work in had an effect on the technology-related experiences of the teachers. Participants are sent a participation mail with information about the Zoom application, and a meeting is held at the scheduled time.

During the sessions, which are planned to last for a maximum of 30 minutes, teachers' opinions on technology use, students, subject content, curriculum, application, and evaluation areas are discussed following the interview protocol (See Appendix G).

3.3. Measures

3.3.1. TPACK-Practical Scale for Teachers

Technological Pedagogical Content Knowledge-Practical Scale (Ay et al., 2015) consists of students, subject content, curriculum, application, and evaluation sub-areas. This scale consists of 22 5-point Likert-type items, including self-report questions (See Appendix E). The scale is an adapted version of the TPACK-Practical Scale by Yeh et al. (2013), consisting of eight knowledge factors from five pedagogic areas. The knowledge dimensions of these areas are defined as using information communication technologies (ICT) to understand students, using ICT to understand the content of the subject, planning the curriculum containing ICT, using ICT representations, using ICT-integrated teaching strategies, to include ICT in teaching management, using ICT to reconcile the teaching contexts and to evaluate students. TPACK-Practical scoring ranges were calculated in 5-point types, with 1 point answering the Likert type questions and low when 5 points were given. The lowest score was 22 and the highest score is 110. This calculation is the calculation method used in the original scale.

3.3.2. Technology Integration Scale

The technology integration scale (Karaca et al., 2013) is a 5-point Likert-type 10-item scale that helps teachers determine how often they use technology for what

purposes. It includes subfields of using technology for planning, presentation, evaluation and communication. The scale measures teachers' technology utilization for a variety of instructional purposes, such as “preparing plans”, “accessing information resources”, “presenting lessons”, and “drill and practice” (See Appendix F).

3.3.3. Interviews

Teachers willing to participate in the interview were contacted via e-mail, and an informed consent form sent (See Appendix B). After the consent form was accepted and sent, the interviews were scheduled to conduct via the Zoom application. Participants were sent a participation mail with information about the Zoom application and a meeting will be held at the scheduled time. During the sessions, which were planned to last for a maximum of 30 minutes, teachers' opinions on technology use, students, subject content, curriculum, application, and evaluation areas will be discussed following the interview protocol (See Appendix G). The interview were transcribed and analyzed thematically. Initial codes related to TPACK (Tzavara, A., Komis, V., & Karsenti, 2018) will be used, and emerging codes were added.

3.4 Variables

Demographic variables of this study are the age of teachers, gender, education level of teachers, field, the age group of children they work with, the type of institutions, class types and income level of children and families in their classroom. In addition to demographics, the variables that whether the teachers have taken a course or training related to technology, the information and communication technologies in the classroom where the teachers work, the software used by the teachers and the

information communication technologies that they personally use are included the study.

Independent variables are Technological Pedagogical Content Knowledge (TPACK) and Technology Integration scores. TPACK presents teachers' knowledge about learners, subject content, curriculum design, practical teaching, assessment subdomains with combination of technology. TPACK is measured by TPACK-Practical Scale (Ay et al., 2015). Technology integration score indicates the view of teachers' uses of technology in specific educational purposes as planning, presenting, evaluating, and communicating. The relevance of variables and research questions are indicated in Table 2.

Table 2. Variables of Quantitative Phase

Research Questions	**Variables**		**Instrument**	**Data Analysis**
What is the technological pedagogical content knowledge (TPACK) level of in-service ECE teachers working with young children?	Technological Pedagogical Content Knowledge	1. Learners 2. Subject content 3. Curriculum Design 4. Practical Teaching 5. Assessment	1.TPACK-Practical Scale	Descriptive Analysis
Is there a relationship between teachers' TPACK and their use of technology in classrooms?	1.Technological Pedagogical Content Knowledge 2. Technology Integration	1. Learners 2. Subject content 3. Curriculum Design 4. Practical Teaching 5. Assessment 1. Planning 2. Presentation 3. Evaluation 4. Communication	1.TPACK-Practical Scale 2.Technology Integration Scale	Correlation Analysis
Is TPACK predicts technology integration in classroom, if it is, how much does it explain the technology integration?	1.Technological Pedagogical Content Knowledge 2. Technology Integration	1. Learners 2. Subject content 3. Curriculum Design 4. Practical Teaching 5. Assessment 1. Planning 2. Presentation 3. Evaluation 4. Communication	1.TPACK-Practical Scale 2.Technology Integration Scale	Regression Analysis

3.5 Data analysis

Data analysis will be performed with the quantitative data obtained from the survey and qualitative data obtained from the interviews with teachers. A structured interview protocol consist of TPACK-related questions will be followed (See Appendix G). IBM SPSS Statistics for MacOS, version 27 is used for statistical analysis. Additionally, MAXQDA is used for qualitative analysis.

The data collected in the first stage is scored in sub-areas of teachers' TPACK as follows: (1) Knowledge of children, (2) subject content, (3) curriculum, (4) application and evaluation. In addition, the study is whether teachers' TPACK is related to their technology integration practices in the effective technology integration domain. In the first stage, the scale scores will be analyzed statistically. Whether knowledge subdomains associated with the technology integration processes as planning, presentation, evaluation and communication are examined (See Table 1.) The correlation between scale domains is calculated within Pearson’s correlation coefficient. Additionally, the TPACK variable is tested to whether predict the technology integration variable.

The interview is transcribed and analyzed thematically. Initial codes related to TPACK (Tzavara et al., 2018) is used, and emerging codes are added. The responses of in-depth interviews are coded, and the common and recurrent themes are identified. The analyses are carried out to explain the quantitative results further.

CHAPTER 4

RESULTS

In this chapter, quantitative and qualitative findings will be presented. Demographic data of teachers and the presence and availability of information communication technologies in educational settings will be exhibited. The relationship between TPACK-Practical scores and technology integration scores of teachers will be further explained. A sample size of 107 is good enough to use parametric tests according to the central limit theorem (Wallnau & Gravetter, 2014). The central limit theorem assumes that 30 or larger samples do not require normal distribution; the sample means approximates a normal distribution. Even if this sample does not show a normal distribution, it is suitable for parametric tests with sample size and skewness and kurtosis measures. The criterion for skewness is ±2 and for kurtosis is ±7 (Hope & Weeks, 1990), which means that the distribution of the dependent variables is in the accepted range.

4.1 Descriptive findings

One hundred seven early childhood teachers participated in the study. The sample consists of 101 female and 6 male teachers, suitable for the general early childhood teacher population ratio (TUIK, 2020). The age range of teachers is between 21 and 51, with a mean of 32,68 (SD= 7.766). Teachers' professional experience ranges from one year to 31 years (SD= 7.296). Most of the teachers in the study have at least a bachelor's degree, and some teachers hold associate and master's degrees. Teachers work in public or private schools, which have preschool or kindergarten classrooms (independent or in primary schools), special education classrooms or

nursery/daycare classes. They teach 3-6 years old children whose families mostly have moderate to high socioeconomic status. Counts and percentages of demographics are shown in Table 3.

Table 3. Demographic Information about Teachers

		Mean	Count
Age		33	
Gender	Female		101
	Male		6
Education Level	Associate		14
	Bachelor		74
	Master		19
Field	Preschool Education		83
	Child Development		20
	Other (Psychological Counselling, Visual Arts, English Teaching		4
Experience (Year)		10	
Income Level of Families of Children	Low		0
	Low-Moderate		12
	Moderate		31
	Moderate-high		26
	High		38
Child Age Group	3-Year-Olds		12
	4-Year-Olds		24
	5-Year-Olds		54
	6-Year-Olds		12
	Mixed Age Group (3 to 5)		5
Institution Type	Public School		67
	Private School		40
Class Type	Preschool/Kindergarten Classroom		46
	Preschool/Kindergarten Classroom (In Primary School)		45
	Nursery/Daycare		7
	Special Education Classroom		9

4.2 Technology and teachers

With the teacher information form, data was collected about the ICT that exist and teachers use in their classrooms, the types of software they use, and the personal ICT they use. Potential ICTs in the classrooms are computers, tablets, smartboards, internet connections, projectors, robot toys and speakers. Additionally, according to the responses of teachers, TV is added. Most teachers report that they have

computers, internet connections and speakers in their classroom. Differences in ICT in the classrooms and used ICT were indicated. Although tablets are reported to be less common in classrooms, it has been reported that they are used more, and projectors are also found in classrooms but not used as much. It is possible to interpret this as the fact that teachers bring their own tablet devices to the classroom and use them even when they are not in the classroom. In addition, the finding that a projector is available but not used can be explained by the fact that smart boards already fulfill the projector's function.

Table 4. ICT Existed and Used in the Classroom

		Count	Layer N %
ICT existed in classroom	Computer	86	81.1%
	Tablet	10	9.4%
	Smartboard	41	38.7%
	Internet Connection	84	79.2%
	Projector	63	59.4%
	Robot Toys	7	6.6%
	Camera	15	14.2%
	Speaker	85	80.2%
	TV	1	0.9%
ICT used in Classroom	Computer	85	80.2%
	Tablet	13	12.3%
	Smartboard	40	37.7%
	Connection	85	80.2%
	Projector	58	54.7%
	Robot Toys	7	6.6%
	Camera	14	13.2%
	Speaker	84	79.2%
	TV	0	0.0%

The reported presence of ICT in classrooms of public and private schools differs. In private schools, the presence of smart boards and tablets are particularly high. In public schools, devices such as computers, projectors, and speakers, older technologies that replace similar functions, are seen. It is possible to say that public and private schools have differences in technological resources. The most important

distinction of these resources is whether children could interact or not. While devices such as smart boards and tablets open more space for children's interaction, tools such as computers offer more limited access. Considering these, it can be said that private schools may have more room for interactive learning opportunities. Detailed information on the technological tools used is given in Table 5.

Table 5. Institution Type and ICT Exist in Classroom Crosstabulation

			ICT exist in classroom[a]									Total
			Computer	Tablet	Smartboard	Internet Connection	Projector	Robot Toys	Camera	Speaker	TV	
Institution Type	Public School	Count	57	4	21	52	45	5	4	55	1	67
		% Within Institution	85.1%	6.0%	31.3%	77.6%	67.2%	7.5%	6.0%	82.1%	1.5%	
	Private School	Count	29	6	20	32	18	2	11	30	0	39
		% Within Institution	74.4%	15.4%	51.3%	82.1%	46.2%	5.1%	28.2%	76.9%	0.0%	
Total		Count	86	10	41	84	63	7	15	85	1	106

Percentages and totals are based on respondents.
a. Dichotomy group tabulated at value 1.

Looking at the teachers' own use of technological devices, it can be seen that they are quite intertwined with technology. The vast majority of teachers have a smartphone or computer. Nearly half of them use tablets or smart televisions. Again, a considerable majority reported that they used assistive technological devices. In summary, 40% of teachers have at least 3 ICT devices, and 60% have at least 5 ICT devices that they personally use. Detailed count and percentages are shown in Table 6.

Table 6. Personal ICT Frequencies

		Responses		
		N	Percent	Percent of Cases
Personal ICT[a]	Smart Phone	106	29.2%	99.1%
	Computer	104	28.7%	97.2%
	Table/Ipad	43	11.8%	40.2%
	Smart TV	46	12.7%	43.0%
	Other Devices	64	17.6%	59.8%
Total		363	100.0%	339.3%

a. Dichotomy group tabulated at value 1.

Technology-related training received by ECE teachers during their education or professional life was asked in the information forms. Most of the ECE teachers have received technology-related training in university programs. In addition, 89,7% of the teachers attended at least one training such as seminars, courses, etc. Training types of teachers and their attendance rates are reported in Table 7. Younger teachers seem more likely to take technology classes in their university programs ($r\,(105) = -.24$, $p < .05$). This can be explained by the recent inclusion of technology courses in university programs.

Table 7. Training Types Frequencies

		Responses		
		N	Percent	Percent of Cases
Training types[a]	Technology Training in Higher Education	64	23.5%	59.8%
	Seminar	62	22.8%	57.9%
	Training Course	38	14.0%	35.5%
	Certification	27	9.9%	25.2%
	Workshop	27	9.9%	25.2%
	Course	39	14.3%	36.4%
	Inservice Training	2	0.7%	1.9%
	Self-paced Learning	2	0.7%	1.9%
	None training	11	4.0%	10.3%
Total		272	100.0%	254.2%

a. Dichotomy group tabulated at value 1.

Teachers stated that they use different types of software. Learning management software are platforms where courses such as Moodle, Google Classroom, Blackboard are managed and shared. Creative software applications such as Canva, Mentimeter, Prezi, Scratch, Padlet, Story Jumper, and Word Wall enrich learning and are open to teachers' creative use. On the other hand, document

management software is applications such as Microsoft Office, Google Documents, which are used for document editing. On the other hand, communication software is software that can be used to communicate and maintain, such as Zoom, Microsoft Teams, Google Meet, and Adobe Connect. Cloud/Storage Software is digital storage software such as Google Drive, iCloud, Dropbox. Most of the teachers stated that they use to document and communication software intensively. Teachers are also indicated that they use cloud software. However, learning management and creative software are used relatively less. Detailed information about the software types of teachers employed is given in Table 8.

Table 8. Software Types Used by Teachers

		Responses		Percent of Cases
		N	Percent	
Software Used	Document Management Software	86	23.7%	81.9%
	Learning Management Software	61	16.8%	58.1%
	Creative Software	58	16.0%	55.2%
	Communication Software	86	23.7%	81.9%
	Cloud/Storage Software	72	19.8%	68.6%
Total		363	100.0%	345.7%

a. Dichotomy group tabulated at value 1.

4.3 TPACK-Practical scores of teachers

The TPACK-Practical score is calculated by the TPACK-Practical Scale by Ay et al. (2015). The scale consists of 22 items of 5-point Likert-type questions in five domains of learners, subject content, curriculum design, practical teaching, and assessment. The scale score was calculated as the sum of the scores obtained from these domains, with a total score of at least 22 and 110 at most. The range, minimum

and maximum points, mean, and standard deviation values of total scores and domain scores are in Table 9.

Table 9. Descriptive Statistics of TPACK-Practical Sub-Domains

	N	Minimum	Maximum	Mean	Std. Deviation
TPACK-Practical Score	107	50	110	92.18	13.754
Learners	107	6	15	12.42	2.282
Subject Content	107	4	10	8.76	1.366
Curriculum Design	107	9	40	33.07	5.787
Practical Teaching	107	16	30	25.83	3.845
Assessment	107	6	15	12.09	2.341
Valid N (listwise)	107				

Early childhood teachers' TPACK-Practical scores are classified as low (0-22 points), low-medium (22 to 44), medium (44-66), high-medium (66-88) and high (88-110). According to reported TPACK-Practical levels of ECE teachers, most of the ECE teachers have a high level of TPACK-Practical score (N= 70, 65.4%). While 30.8% of the teachers have a high-medium level of TPACK-Practical score (N=33), 3.7% of ECE teachers have a medium level of TPACK-Practical score. The score distribution is shown in Figure 2.

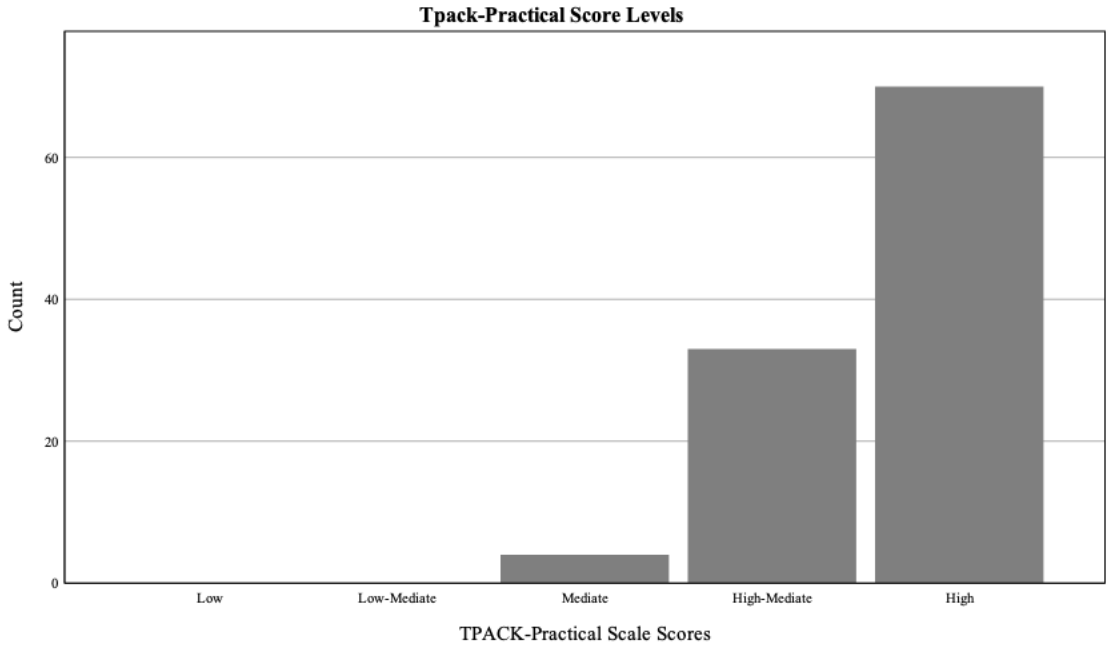

Figure 2. TPACK-Practical score levels

Considering the relationship between teachers' demographic variables and TPACK, age and experience were not found to significantly affect TPACK. On the other hand, there is a positive relationship between the experiences of teachers and the training they receive about technology in their professional life (r (105) = .26, $p < .01$). Additionally, the training received by teachers after graduation shows a correlation with TPACK (r (105) = .28, $p < .01$). Although experience is not directly related to TPACK, teachers' experience, training and TPACK may have an indirect relationship. The reported socio-economic level of the children at schools that teachers work is also related to the TPACK level of the teachers (r (105) = .22, $p < .05$). Teachers with high TPACK levels may work with children from higher socioeconomic levels and vice versa. Correlation table of variables is on APPENDIX I.

4.4 Technology integration

Technology Integration Scale (Karaca et al., 2013) measures technology integration score. The scale consists of 10 items, which includes domains as using technology to prepare plans, to access information resources, to develop instructional materials, to develop assessment strategies, presenting lesson/ instructional activities, demonstrating sample applications, drill and practice, revising lessons, to communicate with students and families, and to communicate with other teachers. Teachers reported that they often use technology to access information sources, plan to prepare, and communicate with colleagues. Using technology for assessment score is the lowest mean compared to other sub-domains. Mean scores of technology integration sub-domains are presented in Table 10.

Table 10. Technology Integration Scale Means

	Mean	N	Std. Deviation
Plan Preparing	4.24	107	.889
Access to Information Source	4.50	107	.732
Material Development	4.20	107	.905
Evaluation Method Development	3.85	107	1.026
Presenting/Instruction	4.01	107	1.005
Demonstrating Sample Practices	4.13	107	.991
Drill and Practice	3.97	107	1.086
Revision of the Class	3.87	107	1.074
Communication with students and families	3.56	107	1.159
Communication with colleagues	4.22	107	.955

The overall technology integration score of the teachers is calculated with all sub-domains. It was seen that most of the teachers scored their technology integration as high or high-medium. The technology integration score distribution of the teachers is shown in Figure 3. Variables of age, education level, department,

institution type, whether to take a technology course or not be not directly related to technology integration.

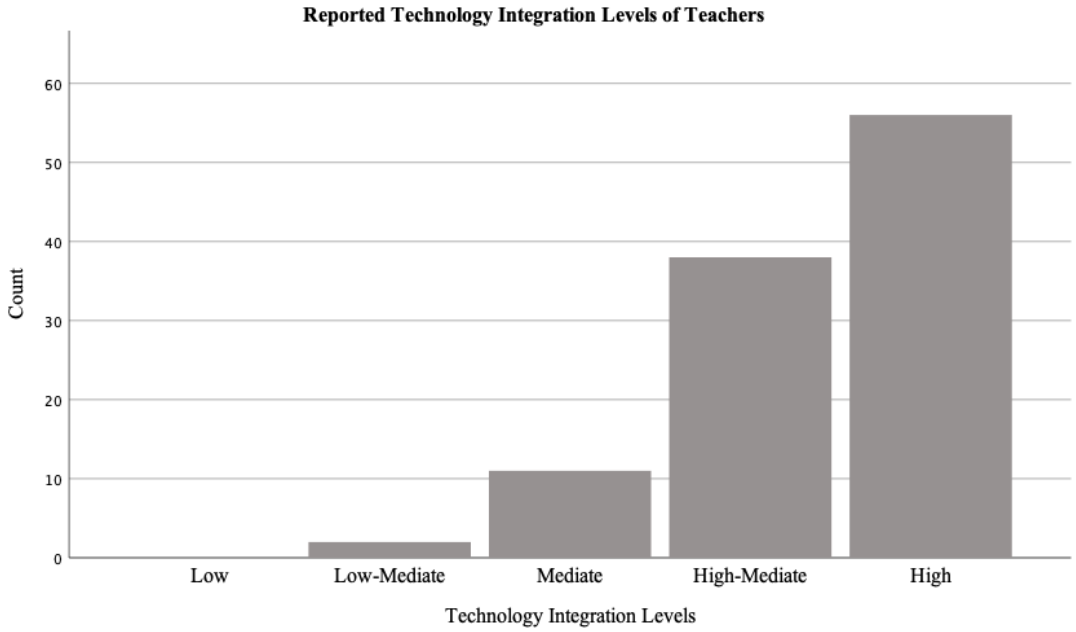

Figure 3. Technology integration score levels

4.5 TPACK and technology integration

First, it would be appropriate to analyze the relationship between TPACK and technology integration. Therefore, the correlation of the two variables was first examined. As a result of this analysis, it was found that TPACK and Technology integration scores were in a positive relationship with each other (r (105) = .42, p<.01). Technology integration is also related to the subdomains of knowledge of learners (r (105) = .37, p<.01), content knowledge (r (105) = .28, p<.01), knowledge of curriculum design (r (105) = .41, p<.01), practical teaching (r (105) = .36, p<.01), and assessment (r (105) = .30, p<.01). Correlation table of subdomains of TPACK and technology integration is in APPENDIX J.

A simple linear regression was calculated to predict technology integration based on TPACK and the other factors. The factors were gender, age, experience,

school type, training during university or professional life, income level of children. Stepwise regression was used to determine the factors that predict the technology integration. Factors other than TPACK were excluded by regression analysis according to their significance level ($p > .05$). A significant regression equation was found ($F(1,105) = 22.522652$, $p < .05$) with an R^2 of .177 of TPACK on technology integration scores. Teachers' technology integration scores increased by .237 points for every point of the TPACK scale. Regression tables are in APPENDIX K.

4.6 Findings from TPACK interviews

The qualitative phase of the study followed the quantitative phase of the study. This method was used to better understand teachers' experiences with TPACK and technology and to deepen the quantitative data. To do this, the interview protocol created by adapting the structured TPACK interview by Harris, Grandgenett and Hofer (2012) was used (APPENDIX G). The main questions in the qualitative phase are (1) what the views of teachers are related to their TPACK, and (2) how their experiences with technology integration are associated with TPACK.

Eight teachers volunteered to participate in the TPACK interview, as in the second phase of the study. After the online survey, volunteer teachers are reached out with an email that explains the online interview process and includes an ethical consent form for the online interviews. Due to the differences between public and private schools in the quantitative stage, the groups in the interview stage were constructed over the school type variable. Teachers' demographic information is in Table 11. With the teachers' answers, an appointment was made for the interviews, and the interviews were held over Zoom for a maximum of 30 minutes. The

recordings of the Zoom meetings were transcribed and subjected to thematic analysis.

Table 11. Teachers' Demographic Information in the Qualitative Phase

	School Type	Age of Children	Socioeconomic Level	Experience (Year)	Education Level
T1	Public School	5	Medium	6	Master
T2	Private School	4	High	2	Bachelor
T3	Private School	5	High	5	Bachelor
T4	Public School	5	Medium	10	Master
T5	Private School	4	High	5	Bachelor
T6	Public School	5	High-Medium	14	Bachelor
T7	Public School	4	Medium	4	Bachelor
T8	Private School	4	High-Medium	7	Bachelor

Themes related to TPACK are as follows: Teachers' idea of technology, learners, content, objectives, curriculum, practice, challenges, opportunities, the fitness of content, methods and technologies, advantages and disadvantages of technology, and teachers' advice about technology use for newer teachers. Here, the codes under all themes will be analyzed, and quotations from the interviews will be shared. Frequencies of themes and codes could be seen in APPENDIX H.

In the interviews, teachers were asked to answer the questions by thinking about their daily learning experiences using technology. In this context, teachers reflect on their daily teaching experiences. When we look at the learning experiences where teachers integrate technology, we see a flow similar to conventional lesson plans. Teachers stated that they started their learning experiences with warm-up and attention-drawing activities, applied the main learning experience that was nourished from various fields for targeting specific learning objectives, and then made an evaluation at the end. According to teachers' reflections, a representative flow of learning experience is shared in Figure 4. The learning experiences that will be mentioned in the themes progress in this flow. Teachers

could use technology at any step in this flow.

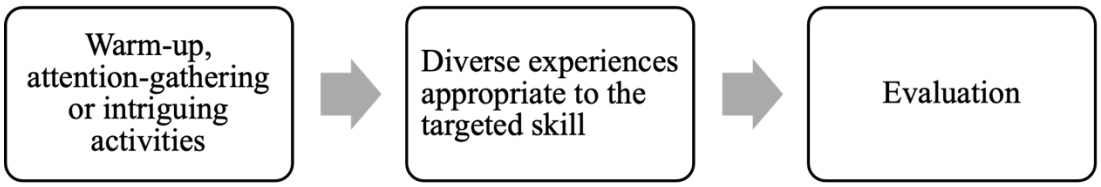

Figure 4. The flow of technology integrated learning experiences

The themes emerged from the interviews are classified into four main themes. Perceived technology, teaching processes, TPACK and evaluation of technology-integrated teaching are the main themes. In perceived technology themes, teachers expressed their opinions about what they perceive when technology is mentioned and their conceptions about ICT that used in classrooms. Teaching processes include curriculum-related subjects such as content, objectives, learners, practice, technology use. In this theme, teachers answered questions about teaching processes by thinking about their own teaching processes. The theme of TPACK includes teachers' opinions on the fitness of learning objectives, methods, and technologies. Evaluation of technology-integrating teaching theme refers to teachers' evaluations about technology use in their classroom in terms of advantages and disadvantages of technology and their advice to new teachers who would use technology in their classrooms. Although these themes consist of the determined themes from structured interviews, the final form was created with the questions added before the interview and the characteristics of answers. Table 12 shows main themes with sub-themes under them.

Table 12. Themes and Subthemes

Main Themes	Subthemes
Perceived Technology	Teachers' conceptions about technology
Teaching Processes	Goals and Objectives
	Content and Curriculum
	Learners
	Practice
	Challenges and Opportunities
TPACK	Technology and Content Fit
	Pedagogy and Technology Fit
	Technology, Pedagogy, Content Fit
Evaluation of Technology Integrated Teaching	Advantages and Disadvantages
	Advice for New Teachers

4.6.1 Perceived technology

Teachers' understanding of technology emerges in two ways. Teachers defined the technologies they use in education in two ways as devices and software. Examples of the devices are computers, speakers, smart boards, and projectors. Examples of software they give are learning applications such as Powerpoint, Wordwall, Canva, Learning Apps. All teachers stated that they use these devices and software together with children. However, whether the devices and software are user-friendly and allow children to use them is important. In particular, teachers who use ICTs to enable interaction, such as smart boards, stated that they could use technology interactively. Some teachers reported the advantage of smartboards:

> T3: …there is a huge difference between the smartboard and the projector. While the projection only adds visuality, you can do one or two things on the computer. Still, the experiences on the smart board are completely different, especially in terms of interaction.

> T5: For example, there was no smartboard in my previous school. There was a projector. At that time, I didn't think of the difference, you know, that the smartboard was that important and functional. I always connected from the computer, but it was very important for children to touch and participate.

In addition, teachers state that they are more intertwined with technology with the pandemic, and their access to technology in their schools has increased and diversified after the pandemic. After a forced transformation, teachers stated that they had difficulties initially, but then adapted easily. Teachers noted that in the early days of the pandemic, they tried software they had never used before and became fluent in this software.

According to the teachers' views, technology should be a part of education, as technology is a part and reality of their children's lives. However, what is important here is how the teacher uses this technology. All teachers refer to the appropriate use of technology in educational settings. They think that technology enriches learning when used appropriately.

4.6.2 Teaching processes

4.6.2.1 Goals and objectives

When the teachers' views on the teaching goals and objectives are examined, it is observed that they especially indicate the objectives in the curriculum. Teachers mentioned about objectives as visual perception development, naming, matching, vocabulary development, naming emotions. These objectives are the learning outcomes already included in the early childhood program. Teachers did not specify any learning outcomes specific to technology. Here, some of their reflections about the goals and objectives during a technology integrated experience:

> T6: If we look at the objectives here, we can say that to develop children's visual perception, to improve their language skills, to provide foreign language support, to develop finger muscles, to develop reading skills.

> T7: It is determined within each theme, at the beginning of the theme, and there are what the school calls the line of inquiry. We have a main idea. In order to reach that main idea, we have 3 lines of inquiry. For example, there was the part about our emotions, what kind of reactions we give in the face of events, and the effect of events on our behavior. We examine them in three stages.

Although the teachers do not state a learning outcome regarding technology, they say that they use technology for the objectives in the curriculum. In addition to these, teachers expressed their views on the purposes of using technology. These stand out as enriching the curriculum, modernizing the curriculum, and making evaluations.

4.6.2.2 Content and curriculum

In the questions about the content and curriculum of the technology-integrated experiences of teachers, teachers made evaluations by comparing the content and curriculum with the experiences they did not use technology. Teachers did not mention a different curriculum target from the conventional teaching methods. However, they emphasized that their content is enriched with technology. Teachers stated that they reached richer content during planning and practice. Teachers stated that they do not carry out a technology-oriented curriculum but integrate technology as appropriate for the subject.

> T3: Even if I include any material related to educational technologies in my experience, it is always interdisciplinary and within the framework of a certain routine. So, if we start with a circle time in the morning, sometimes, of course, educational technologies can be introduced into the circle time.

> T2: According to my objectives and the theme and subject I have worked on. For example, we implement the zero-waste project in the classroom. Within the scope of the zero-waste project, there is a game of finding hidden objects in cooperation with various platforms. I always include them in these processes. I have art activities in different subjects, be it playtime.

Two teachers stated that they also see technology as content. They talked about technology awareness and the correct use of technology in their teaching. In

parallel with the classroom practice, they mentioned that they guide families for the appropriate use of technology.

> T6: The aim here is primarily for the child to use technology correctly. We aim to use it correctly and consciously. Because they can use it unconsciously for different purposes in the future. Therefore, we aim to teach the truth and use it as a solution tool.

4.6.2.3 Learners

Teachers mentioned the age group they work for, their socioeconomic levels, the developmental characteristics of the group they work for, and their learning needs. Teachers especially emphasized the cognitive characteristics of children. Importantly, all teachers talked about the "pandemic effect" regardless of school type and age. Here, public and private school teachers differ in the meaning they give to the impact of the pandemic. The effect of the pandemic, according to teachers working in public schools, the pandemic effect means that children were cognitively lagging behind their peers and had difficulties in following the rules. Teachers describe the impact of the pandemic in their own words:

> T2: This year, I am together with a group with many deficiencies in many points, especially because they have come out of the pandemic. But last year, because I have children who are more ready to gain, because I have children who have never experienced the pandemic, because I work with a more social group, I was able to integrate technology tools into children much more easily.

> T7: This is what I call it: We are removing the debris of the pandemic. This year is my sixth year, but I am facing a group that I found very difficult.

On the other hand, teachers working in private schools consider the effect of the pandemic as an earning. They define the group they are working with this year as a cognitively advanced, active, and social group compared to their previous years. This could be explained by the references made by teachers working in private

schools to the richness of children’s home environment and the relative awareness of their parents. Teachers’ definitions of learners are below:

> T1: Kids this year are better cognitively. Even if included in the 4-year-old class, they can easily continue to the 5-year-old class.

> T8: The profile is perhaps slightly higher than in public school. Children are very interested in technology, very relevant. They have all the facilities at home. Let me tell you; these children are active and conscious, so are their families. I could say a certain segment, a little higher level.

Teachers state that they see technology as a learning need in the education of today's children. Teachers point out that technology attracts children's attention, they are enthusiastic about using technology, and their learning is enriched by technology use. Teachers often called children "today's children". They mean to define children as digital natives who are born in technology and familiar with the technology. Therefore, they see technology as a learning need for today's children.

> T5: I mean because I think that's how children grow up now. They need it. In our time, when I looked, there was no such thing. Just for example, maybe children with higher imaginations. Perhaps we just saw a picture from the book. But now when I say the same thing to the kid there are so many pictures that he sees so much that it's relevant. That's why I think they're really more creative.

> T3: I think it embodies it because of the age group, frankly. Because they really need to see and hear.

However, they also emphasized that some children remained inactive in front of the screen and had difficulty in giving their attention to other activities. Teachers stated that they found solutions such as using fewer screens and producing different alternatives for inactive and unresponsive children in front of the screen.

4.6.2.4 Practice

In terms of practice, two main titles are outshining: Purpose and usage. Teachers pointed out their purposes of using technology in their practice. They use technology

mainly to introduce their class, motivate children, show demonstrations of their content, provide active participation, and present children's products. According to the flow of learning experiences conveyed by teachers, experience flow proceeds as follows: Warm-up, attention-gathering or intriguing activities (such as songs, games, short visual videos), diverse experiences appropriate to the targeted skill, and evaluation. Teachers stated that they generally use technology during the introduction of their learning experience flow. However, they also indicated that they included it at different stages when they saw fit for the target. Teachers state that they integrate technology into various steps of their practice. It would be appropriate to look at teachers' words about their technology integration in the flow of their practices.

> T3: Whether I have included any material related to educational technologies in my activity, it is always interdisciplinary and within the framework of a certain routine. So, if we start with a circle time in the morning, sometimes I could introduce educational technologies into the studies during circle time.

> T1: The flow is not always about technology. First, we do some warm-ups with the kids. It depends on which courses I take. If it's a live lesson, we start by getting their attention with a finger or two. Or if it's something they're more passive about, we begin by dancing a little more, getting them moving, warming them up, and getting them to concentrate. Our goal is; however, we are doing the activity at that point.

According to the teachers' statements, technology is seen as a tool that could be used under the goals in the curriculum rather than being a goal in practice. They integrate technology into their routines when technology is appropriate for their goals. However, they choose to use alternative methods when they are unsuitable for the content and objectives. This stands out as a theme intertwined with another sub-title, usage. Teachers emphasize the appropriate use of technology. Proper use includes both suitability to goals and appropriateness to children's developmental characteristics. In addition to these, teachers stated that they also use technology as a

support or content for their applications. Teachers also indicated that they found ways to use technology as an alternative to their methods in their practices or to create alternatives to the use of technology according to the interests and needs of children. Teachers especially emphasized that technology usage time should be limited. They stated that balanced use is important for the proper use of technology.

4.6.2.5 Challenges and opportunities

In the theme challenges, four main sub-theme emerges Child and family-related factors, teacher-related factors, school or administrative factors and technical difficulties. Regarding child and family-related factors, family attitudes toward technology and guidance of technology use and children's technology habits are the important points. Teachers stated that they are in constant reconciliation with families about technology use. They indicated that they guided families regarding the use of technology at home, provided content and method support, and invited families to work as partners in this regard. They also stated that some families do not set limits on technology and that this affects their children's behavior in the classroom. They also indicated that they gave detailed information to families about the technologies used at school and their benefits because they were hesitant to use technology at school. Teachers point out challenges in their words as:

> T6: Sometimes, some parents say I don't want their children to use it at home; I don't want them to use it at school either. Teacher, we can meet with parents because you wanted to watch this or have this done, and I don't want to do that.

> T5: Parents react a little about this. When I want something technologically, not all of them give feedback unless it is compulsory. They are concerned about how we can take phones from children's hands. That's why I get a reaction when I guide them with technology.

The distance learning period stands out as an important point here as well. Teachers shared their experiences, especially regarding distance learning in the pandemic. They referred to the difficulties created by the reflection of the technology habits at home to the school during this process, that they had difficulties attracting the children's attention, that they had challenges in mediating with the direct involvement of the families in the education with the screen.

In terms of teacher-related factors, teachers' readiness, proper technology use, and content selection were the important points. Teachers mentioned that to integrate technology effectively, the teacher should have the readiness to integrate technology. Teachers said they integrated technology into their practice because they were willing and open to learning. They gave examples of their colleagues being resistant to use technology.

> T3: It's electricity, it's the internet, it's material, it's a teacher's motivation or ability, it's knowledge. These have to be good. I can say that the teacher is also ready. Whether you want to achieve those goals, you have the material, but if the teacher's readiness is not good, they may not be able to realize it.

They also noted that properly integrating technology is also a challenge. They emphasized the importance of choosing the appropriate content and method. They also noted that the choice of content is also important. They stated that the selection of content that is not suitable for children may harm children.

> T5: But you know, there was a content problem that another teacher experienced, not me, but related to Youtube. The children were very scared. There were complaints from the parents or something. The teacher was sent hurriedly.

> T1: You know, because the school doesn't buy YouTube's paid premium, for example, if I don't open the video beforehand, such a ridiculous ad appears. Maybe we should get ahead of it. Ads, content, etc. need attention

In terms of school or administrative factors, teachers in public schools mentioned about lack of infrastructure of schools, lack of training opportunities, unstructured technology integration, unsupportive colleagues, difficulties in finding resource and lack of support. As a solution, teachers do the following: get support from colleagues, use their own personal tools, use existing tools in school alternately, create their own technology integrated plans. The statements of the teachers about the management-related factors are as follows:

> T4: The school administration sometimes says, "Is there really a need for this?" I get a lot of answers. But sometimes they say, okay, we can do this. It can change a little bit depending on what we want. If the school says that I can't afford it, I'm trying to do it myself as much as possible, I'm trying to get myself.

Teachers stated technical difficulties the most when they talked about challenges using technology. Technical difficulties are internet outage, power cut or paid subscriptions to educational software. Teachers stated that internet or power outages directly affect their technology-integrated practices. They stated that such situations are common, and they quickly switched to alternative applications as a solution to these situations.

In terms of opportunities, three important sub-themes emerge: child, teacher, and school opportunities. Teachers see technology as an opportunity for children's interactive learning and participation. They also think that it creates a learning opportunity because it attracts and motivates children.

> T5: very classical methods are boring children somewhere. Because kids are used to it. If we want to see it and use it correctly as a teacher, it's definitely useful.

Teachers define technology as a learning area for themselves as well. They stated that they felt good when they learned and used new tools or applications. In

other words, teachers' openness to learning and their willingness to use technology seem to be an opportunity for technology integration.

> T3: I think it also contributes a lot to the teacher because you feel something, and when you use a different method or technology in your classroom, you feel that you are a different teacher. It happens to me too, for example, my teacher friends at our school do not use such things.

Especially teachers in private schools mentioned that they have collogue support, purchased subscriptions, IT support in the school, and in-service training opportunities. Considering the opinions reported by the teachers, the administrative and infrastructure opportunities of private schools are higher than those of public schools.

4.6.3 Fitness of technology, content and pedagogy

4.6.3.1 Technology and content fit

Teachers found technology and content suitable for early years. However, teachers emphasize that the selection of appropriate technology for various content is a key issue. Here, teachers also stressed the importance of a pedagogical decision-making process. Suitability for development, suitability for content, and suitability for children's learning needs emerged as issues that teachers give importance to in choosing technology. Teachers stated that technology is compatible with the content, providing reasons for enriching learning, providing permanent learning, and technology is a learning need.

> T7: I think it helps children to embody concepts it because of the age group. Because they really need to see and hear. There is also a situation where every child may have a different learning approach. Some can do it by hearing, some by touching, some by seeing. All different. Therefore, I think that these children's learning skills contribute to their different skills.

> T5: Like I said, kids want to see it. In other words, they want to see something flowing, something with a video, rather than showing a flash card to a child and having them do an activity. I believe it is more permanent.

4.6.3.2 Technology and pedagogy fit

Teachers generally see technology and ECE pedagogy suitable in their evaluations. Teachers state that technology helps to encourage active learning and stimulate learning. In the pedagogical sense, teachers mentioned that technology provides learning to be “here and now”. This means that technology could help children to embody the curriculum objectives with the expanded learning opportunities in class. Additionally, according to teachers, technology provides them a selection of teaching methods and diversification of methodology.

> T5: I can say that teaching techniques are getting more diverse. I draw, then I turn off the screen. I want them to do it themselves.

> T2: I think it aligns with the goals. Because we choose methods according to our goals or achievements, it becomes an intermediary way to gain with that goal. As I said, technology is dependent on a few factors since it is a somewhat external situation.

4.6.3.3 Overall fitness of technology, content and pedagogy

Teachers evaluated technology, pedagogy, and content as compatible with each other. They stated that they found technology compatible with pedagogy and content, especially in terms of providing holistic learning, supporting creativity and increasing opportunities for learning.

> T6: This is a controversial topic, but I think it's appropriate. You just have to touch the right place. So you have to integrate the technological tool into our own curriculum or activity at the right time.

> T3: I think it's compatible. Because we choose methods according to our goals or achievements, it becomes an intermediary way to gain with that goal.

4.6.4 General evaluations about technology-integrated teaching

4.6.4.1 Advantages and disadvantages of technology

According to the teachers' opinions, it is possible to classify the advantages of technology into two groups. According to this classification, the advantages of using technology are seen as advantages for the teacher and the children. Teachers mentioned the advantages of technology for teachers as enriched content and method choice, self-development, and ease of use.

> T7: It is easy for me; that is, it is easy to open, easy to touch, easy for children to touch. Now that many books have applications, we need to show them from the board. So, it's easier, of course.

According to teachers, technology provides children active participation and choice, different learning opportunities, creativity, and ease of use.

> T7: I definitely think it improves their creativity, if used correctly, of course... It improves their creativity. I think they can pick and choose things themselves. They go through a filter in their minds, I like this more, I can do this and that, I can change this place.

> T5: It seems a bit like something to me, actually, it feels like seeing abroad. You know, when you see different countries, there is definitely something that adds to you. You know, even if there are not very concrete things, you question more abstractly, you observe better. You know, it could be this here, it could be that here. I think technology offers children this option.

In terms of disadvantages of technology, teachers mentioned two main issues: disadvantages for children and disadvantages of distance learning. Teachers thinks that when technology used inappropriately, children could have developmental problems. In addition, teachers talked about the dangers of privacy and bullying, including children's use of technology at home and at school, and the need for them to develop appropriate media behavior.

> T6: Students who have both physical harm and mental harm in the future may suffer.

> T2: The child only learns from what he reads and watches on the phone. It still needs a small safe. Maybe there is such a negative aspect of technology literacy.

In addition, the distance learning period due to the pandemic was a theme that teachers specifically mentioned. Teachers stated that during the distance learning period, they had a very difficult time guiding children and gathering their attention. In addition, the excessive interference of families in the educational processes during this period emerged as a situation that teachers found difficult.

> T8: Zoom was difficult for me, for example. Distance education was hard because the children are small. I mean, I remember the first Zoom class, so I closed it and cried. I said probably not. I mean, someone is passing in front of the screen with a chair, someone is passing from the other side, you know. So I can't catch the student anyway. Also, the younger age group must stay with the parents. There is an intervention of the parent from there. it was hard for me.

> T3: For example, this happened a lot for me in distance education. We are planning something, but on the one hand, there are connection problems due to the high density. For example, if a child was interrupted while talking, the children were listening without writing to the parents, because I wanted the child to complete the speech by video calling the child, whose speech was left tomorrow, by recording the sound.

4.6.4.2 Advice for new teachers

In the final part of the interviews, teachers asked about what advice they could give to new teachers who wants to use technology in their classroom practice. Answers are twofold: Professional development and in-class suggestions. In terms of professional development, teachers suggest that new teachers should benefit from technology in self- development. They emphasize technology provides limitless learning opportunities and content for teachers' professional developments.

> T2: We graduate as "can be a teacher" and it is imperative that we continue to work and update ourselves. I think they should not be afraid of innovation and new things and should be pioneers.

> T3: I think they should not be afraid and take the time to learn. It's like "inventing". But I think as those inventions come out, the process we spend in the classroom with children actually get more comfortable.

Second one is the suggestions for in-class practice. Teacher points out that screen time should be limited for protecting children from developmental problems. In parallel with that, teacher emphasize the importance of selection of appropriate content. They said that if content is inappropriate, children could be affected negatively. Therefore, teachers state that preparation of the content beforehand is crucial. Other important suggestion is that teachers should include technology in their daily routines, with the usual curriculum aspects.

> T1: Use as little as possible. To have more with the kids. You also need to be prepared. Ads, content need attention. It is necessary to be selective in the content there. It must be seen first.

> T7: First of all, I want them to be aware of the content. I think this is a very important issue. In other words, the teacher should look, see, watch, note, record, how he uses it now. At certain points of the lesson, at intervals, that is, instead of spending half an hour like this and doing half an hour of activity, I say because it is a small age group, you know, it is important to keep the screen part short, the technology part, by watching it for 5 minutes and doing 15 minutes of activity.

Considering the evaluations of the teachers, it is stated that when technology is used appropriately and consciously, it is suitable for content and pedagogy, but that the teacher must blend technology, content and pedagogy skillfully.

CHAPTER 5

DISCUSSION

This study aims to understand ECE teachers' TPACK and their technology integration in early years classrooms. In this section, the findings related to the research questions will be discussed in detail.

TPACK framework was the theoretical background of this study. Mishra and Koehler's (2006) TPACK framework suggests that teacher's technology knowledge is not a simple concept, it is complex and embedded with pedagogy and content. In addition, the knowledge of the teacher plays a key role in successful technology integration (Laulliard, 2018). Teachers' TPACK level and its relationship with technology integration was the most fundamental question of this research. Additionally, teachers' experiences of teaching with TPACK and technology were also used to deepen the initial findings.

In a general overview of the findings, teachers' TPACK levels are medium, medium-high, or high level. TPACK level is related to in-service training that teachers receive. Complementarily, technology integration is positively correlated with TPACK, furthermore, TPACK predicts teachers' technology integration in classrooms. In conjunction with these, teachers' evaluations of their TPACK and technology use are deepening the earlier findings. While teachers generally have a positive view on technology use, they see technology as a need of the child and the program. However, they stated that technology, content, and pedagogy are compatible if the teacher selects and applies the content in accordance with the objectives. They emphasized that teachers play an important role in technology integration with their pedagogical decisions.

5.1 ICT in ECE

Looking at the ICT devices used in early childhood learning environments, it is possible to say that there is at least one device in every classroom. In addition to this, most of the classrooms have a computer, an internet connection, and a speaker. There is an important distinction between public and private schools in terms of ICT tools. Public schools mostly have computers and projectors, while private schools have smart boards. This might reflect the budgetary opportunities in schools. This situation affects the differentiation of learning opportunities as well as having different devices. Smartboards offer more interactive learning opportunities than computers and projectors and allow children to use technology actively. Therefore, I t could be said that there is a significant difference in the situation in public and private schools. The teachers also emphasized that the smartboard increases learning opportunities in the interviews. At the same time, they evaluated that it provides ease of use and allows more children to participate simultaneously. In parallel with the literature, it is seen that the use of interactive technology is highly related to ICT access in the classroom (Cevher-Kalburan, Yurt & Ömeroğlu, 2011).

There is also a difference between the devices found and used by teachers in their classrooms. These differences are twofold. The first is the devices that teachers do not use even though they are in their classrooms, and the second is the devices that teachers use even though they are not in their classrooms. In cases where the functions of some ICT devices are not required, teachers may not use them. For example, if the projector and the smart board exist simultaneously, the projector may no longer need to be used. In the other case, teachers can bring their own devices to school or use existing devices by getting them to their classrooms. This finding is compatible with the finding that teachers produce solutions when resources are

insufficient (Chaudron et al., 2018). In the absence of resources, teachers find different solutions and use resources creatively.

5.2 TPACK of teachers

Teachers gave their views on their TPACK levels along with the TPACK-Practical scale. Findings indicate that teachers' TPACK level is between medium and high level. It is consistent with the results of Albayrak-Sarı et al. (2016). However, it contradicts the findings that teachers have insufficient technology knowledge of today's children (Casillas Martín et al., 2019). As a counter-intuitive finding, teachers' higher TPACK knowledge could be affected by the fact that teachers had to use technology during the Covid-19 period. Their exposure to technology might help to develop their knowledge. On the other hand, the reason for this dichotomy may be related to teachers' self-confidence or whether their skills are measured directly. There is a need for different methods and tools that measure teachers' knowledge levels. When these knowledge and skills are measured directly, it is possible to say that the results may differ. Teachers' TPACK levels are likely to be lower than they reported.

The TPACK level is not affected by the age of the teachers. However, there is a significant relationship between teachers' in-service training and TPACK levels. Experience was not associated with TPACK level. Some studies (Blackwell et al., 2014; Casillas Martín et al. 2019; Schriever, 2018) indicate differences in TPACK, according to experience level of teachers. Higher level of experience is associated with higher TPACK levels. Closing this gap may be the result of compulsory distance education that started with the Covid-19 pandemic. The fact that teachers had to use technology regardless of their experience may have brought their TPACK

levels closer together. In addition, there is an important connection between experience and training received. There might be an indirect link between teachers' experience and TPACK. This finding shows that the TPACK-related training that teachers will receive will contribute to their TPACK levels. It is possible to say that there is a similar result when we look at the studies in the literature that measure the effect of training (Blackwell et al., 2014; Jack & Higgins, 2019; Simon & Nemeth, 2012).

5.3 Technology integration

Technology integration was measured by teachers' views on what purpose and how often they use technology. The aims of technology were listed as using technology to prepare plans, to access information resources, to develop instructional materials, to develop assessment strategies, to present lesson/ instructional activities, to demonstrate sample applications, to drill and practice, to revise lessons, to communicate with students and families, and to communicate with other teachers. Teachers use technology especially for the purposes of accessing information sources, planning to prepare and communicate with colleagues. Secondly, they use technology for material development, presenting/instruction, and demonstrating sample practices. This finding parallels the finding that teachers use technology for professional purposes as preparing materials and learning management (Ottenbreit-Leftwich et al., 2010). Teachers stated that they use technology at least to develop assessment methods. The evaluation methods with the lowest TPACK domain of teachers were also determined along with this finding.

Age, gender, education level, and technology-related education did not affect the teachers' technology integration. Although this finding has similarities to some

studies in the literature, it contradicts others. Konca and Erden Tantekin (2014) indicate that these variables are not effective on teachers' technology integration. However, the experience was an important factor for technology integration (Blackwell et al., 2014). The impact of variables such as age and experience on technology may have changed with the intensive use of technology in the pandemic. With all teachers quickly starting to use technology, it can be expected that there will be no difference between these variables.

5.4 TPACK and technology integration

In the literature, there are many studies that explain the effect of attitudes towards technology, on technology integration. However, studies explaining the relationship between TPACK, and technology integration are scarce. In this study, a positive relationship was found between TPACK and technology integration. Moreover, it was found that TPACK level predicted technology integration scores. This finding shows that besides the attitudes towards technology, teachers' knowledge also makes a significant contribution to technology integration.

All domains of TPACK are positively correlated with technology integration. In the order of the power of correlation, the domains are curriculum design, learners, practical teaching, assessment, and content knowledge. Especially the knowledge of curriculum design is related to technology integration. If teachers know how to design curriculum with technology in terms of planning, using appropriate representations and teaching strategies, they could integrate technology in their practice more. At the same time, the knowledge of learners and practical teaching is also related to technology integration. It means that how much teachers know about the children and their needs, how to manage instruction and how to practice teaching

effectively, they could integrate technology as well. Content and assessment knowledge are also positively correlated with technology integration. These findings show that the level of knowledge that teachers develop in any knowledge sub-domain will contribute to technology integration.

5.5 Teacher interviews

5.5.1 Teachers' conceptions about ICT

The teachers explained the ICTs they used in education by giving examples of hardware and software. All of them stated that they use educational technologies. In addition to the ICT tools that the teachers mentioned and used in the quantitative findings, they talked about some specific applications. Teachers especially stated that they use applications that they can present content to children and that children can use interactively. This finding may indicate that teachers make choices based on children's developmental and learning needs and expand their repertoire while using technology.

Another important finding is the distinction between features of ICT devices. Teachers use smartboards, projectors, computers, and internet connections to present content and show sample applications. Projectors, speakers, and computers serve to present audio-visual media. However, teachers prefer the use of smart boards rather than projectors and computers. This is also in line with the quantitative findings. In the feedback given by the teachers about the devices they use, it was determined that in the classrooms where smartboards, projectors, computers, and speakers are used together, teachers use smart boards, but they use other tools less. It is possible to explain the reason for this with the functions of the smartboard. As the teachers stated, the smart board not only offers audiovisual media, but also an interactive

space. Therefore, it is possible to say that teachers use the smart board more and use this choice for specific pedagogical purposes.

Another important finding is the diversity of device types in schools. In parallel with the quantitative findings, it was stated that there are more smartboards in private schools than in public schools. This may be related to the resources that schools have. It can be said that learning opportunities in private schools may be more qualified than in public schools.

5.5.2 Goals and objectives

Teachers gave examples of general early childhood curriculum achievements in their responses to goals and objectives in their technology integrating experiences. It could mean that their objectives of using technology are the same as their traditional or current curriculum. Teachers see technology as a tool to achieve these goals. Accordingly, it can be said that teachers do not see technology only as content or subject and integrate technology into many aspects of the curriculum.

In terms of curriculum goals, teachers point out that technology could enrich the curriculum by providing opportunities. Additionally, technology could help the modernization of curriculum in catching today's educational trends and the needs of current learners. Similar to the findings of Mertela (2019) teachers see integrating technology as a way to prepare children to the modern world. Teachers also stated that technology creates opportunities for assessment methods. Ease of use and the needs of children, which will be mentioned in the further sections, are seen as an important area here as well.

5.5.3 Content and curriculum

In this part, teachers made more comparisons. They stated that it is like the conventional curriculum's aims and objectives. Similarly, they noted that the content and curriculum are enriched through technology. This means that, as with goals and objectives, technology is not set as a separate content or curriculum objective but is actually integrated into the curriculum content.

5.5.4 Learners

Teachers were asked to describe the children they worked with. Teachers defined children with characteristics such as age, developmental characteristics, and socioeconomic status. Teachers especially talked about the effect of the pandemic. Here, too, there is a difference in public and private schools. While teachers in private schools defined children as cognitively more advanced, teachers in public schools stated that children were cognitively behind. These evaluations of teachers may be due to the learning opportunities of children at home. Children staying at home more during the pandemic may have been more impacted by learning opportunities at home.

5.5.5 Practice

Teachers indicate the purposes and their use of technology in terms of practice. Their purposes are making introductions to class, motivating children, showing demonstrations, and providing active participation of children. These findings revealed different usage purposes of teachers in addition to quantitative findings. In particular, child-based goals suggest an area-specific use of technology. Parette et al. (2013) is also indicated such purposes in line with the usual curriculum aspects.

Teachers also talked about the way they use technology. They integrate the technology into different parts of their daily routines. They stated that sometimes they find the use of technology necessary for the content, and sometimes they limit the use of technology and develop alternative practices. It is possible to associate these with the pedagogical decisions taken by children for their learning needs. Teachers gave examples of children's needs regarding their decisions to use, limit or diversify technology. Examples such as using music for the need for movement, turning off the devices for the need for attention, and doing a teacher-centered warm-up study show that the teachers make these decisions according to the needs of the children.

5.5.6 Challenges and opportunities of technology

Challenges regarding technology use are classified into four factors: Child and family-related factors, teacher-related factors, technical difficulties, and school-administrative challenges. Teachers again mentioned the pandemic effect on children as a challenge. Other than that, family occurs as an important theme. Attitudes of parents toward technology and the necessity of guiding parents were two main points. Teachers see convincing and guiding parents about technology as a part of their job in contrast to the assimilation aspect of technology mentioned by Parette et al. (2013). In their findings, some of the teachers see technology as a concern of the home environment separated from the school. On the contrary, teachers see the family as a partner for technology use and describe themselves as a guide for home use.

In teacher-related factors, teacher readiness emerged as an important theme. It includes teachers' positive attitude toward technology, preparation, and selection of

appropriate content. Teachers point out that they choose to use technology in comparison to their colleagues. They stated that they made a specific preparation and paid attention to choosing content suitable for children. It shows that they are willing to use technology and dedicated themselves to use it in their practice.

In technical difficulties, teachers mentioned power and internet outages and paid subscriptions. Outages are infrastructural problems that teachers do not have many options to solve. However, teachers indicate that they need to be prepared such problems by having alternative plans. Besides, school and administrative challenges are the inadequate infrastructures of schools, lack of training opportunities, unsupportive colleagues, and lack of support. Boschman et al. (2014) indicate that teachers' technology integration could be affected by organizational challenges. This finding supports their results.

Opportunities are about children and school-administrative support. The themes that emerged about children show commonality with the themes in the objectives. Teachers see children's interest and motivation in technology as an opportunity for teaching. Therefore, administrative support also emerges as an opportunity. In this part, administrative processes can be both an opportunity and a challenge. While non-supportive administrations emerged in the opinions of teachers working in public schools, schools that created supportive and technology opportunities were also reported by teachers working in private schools. As a finding that emerges in other titles, the inequality of opportunity between public and private schools is striking here as well.

5.5.7 Advantages and disadvantages of technology

Teacher indicates advantages of technology in two titles: Children and teacher. Advantages for children listed as active participation and choice, different learning opportunities, contributing creativity, and ease of use. The finding about providing different learning opportunities is in line with findings of Jack and Higgins (2016). On the other hand, advantages for teachers are listed as enriched content and teaching methods, self-development, and ease of use. In terms of disadvantages of technology, teachers mainly noted that some developmental problems might occur when technology used inappropriately.

5.5.8 Fitness of technology, content and teaching methods

In this theme, teachers mostly emphasize “proper use of technology”. Appropriate use of technology can be considered as the complete compatibility of content, pedagogy and technology. When these are provided, teachers think that technology is suitable for early childhood pedagogy. According to teachers, technology could provide to enhance learning, encourage, and stimulate active learning, to meet the learning needs of children. With all this, it is possible to say that a fit is achieved with the technology, method and content being appropriate. Perhaps there is a need to conceptually define appropriateness and establish standards. Although teachers indicate that they choose them according to their pedagogical decisions regarding student needs, concrete standards may be more helpful to understand this concept.

5.5.9 Advice for new teachers

To give an opportunity to the teachers and to see their ideal assumptions of a technological teacher, this section was a part of teachers' advice for new teachers

who want to incorporate technology into their teaching. Here, teachers made suggestions under two main headings: professional development and in-class suggestions. Teachers recommend new teachers to use technology for their professional development. They stated that it is a necessity for them to use technology for their development as teachers. On the other hand, teachers suggest including technology in their daily routines, limiting screen time, selection and preparation of content beforehand. Along with the previous title, appropriate content and correct usage come to the fore here as well. It has been stated that teachers' self-development and the use of appropriate technology will contribute to their effective teaching.

5.6 Overall insights of mixed methodology design

Mixed methodology design allows deeper understanding of the investigated concepts. In general, the quantitative phase provides the findings that teachers' TPACK levels predict technology integration and TPACK level is affected by in-service training. Additionally, the type of accessible ICT in teachers' classrooms was found to be related to whether the school is a public or private institution. However, although there is no clear finding that the variety of tools in teachers' classrooms affects their experiences, the qualitative results provide important insights into this. The teachers shared that the types of tools directly affect the interactive processes. In addition to these, teachers also emphasized the importance of their pedagogical decisions. As seen in these findings, the mixed design deepened what the main findings gave.

CHAPTER 6

CONCLUSION

The main scope of this research was investigating the relationship between ECE teachers' TPACK and technology integration with teachers' views. TPACK appears to predict technology integration in classrooms according to teachers' self-reported data. Another aim was specifying the TPACK levels of teachers. The TPACK levels of teachers were found medium to high, which is a remarkable outcome. Although not one of the main objectives, in-service training was prominent as a factor affecting TPACK. However, there is no difference in the effect of teachers' experience on TPACK levels. It may help to speculate that different factors may bridge the earlier gap between TPACK levels caused by teachers' experiences, such as the forced technology exposure resulting from the Covid-19 pandemic. Technology integration levels of reported by teachers shows also good levels. High TPACK and technology integration scores may also be due to teachers' own self-evaluations. Although it is important that teachers make their own evaluations in a positive way compared to previous studies, it is possible that these scores may differ in direct measurements.

Interviews with teachers added significant depth to the study. It has been seen that tools and opportunities are important for teachers and willing teachers play an important role in creating opportunities. It is seen that teachers create opportunities for their own professional development and evaluate learning opportunities that are meaningful to them. Teachers give importance to working in harmony with family and administration. The development of these partnerships seems important. The fact that teachers emphasize that children are under the influence of a pandemic shows that the effect of the pandemic should be investigated, and technology should be evaluated from the perspectives of children and families too.

In addition, the inequality of opportunity in public and private schools, which emerged together in the first and second phases, is an important point. While older, non-interactive tools are used in public schools, there are newer and interactive tools in private schools. Differences between the variety of ICT in schools also cause differences in teaching processes. The differences in the number of ICTs that emerged in the first phase presented findings consistent with the teachers' interviews. The teachers' statement that this difference is reflected in their teaching has been deepening the findings.

6.1 Limitations of the study

The first limitation was experienced in the data collection processes in the study. The research was originally designed to include teachers' experience/activity/lesson plans, but the feedback received from teachers was not sufficient. Due to the pandemic, the data was collected online, and therefore the necessary space for teachers to plan might not have been created. This situation affected the direct skill measurement part of the study. In studies where a process such as an experience/activity/lesson planning would be included, it would be appropriate to work with a more compact group and to have close contact face to face. Due to this situation, the number of participants was less than expected due to the low number of responses. It would be possible to obtain clearer results by reaching more participants.

The second limitation was the inability to observe teachers' technology use. Teachers who volunteered for the interview were asked whether observations could be made in their lessons. Due to the pandemic, a suitable school for observation could not be reached because outside observers were not accepted. Teachers were asked to share their experiences using technology. Although observing this will add

more insight, this shortcoming has been tried to be overcome by transferring the experiences of teachers.

6.2 Implications

This study’s most important field-related finding is the positive effect of teachers' in-service training on TPACK levels. As teachers receive training, their level of knowledge and, therefore their technology integration quality would increase. For this reason, it would be appropriate to prepare and implement qualified technology trainings for teachers and meet the needs of teachers.

From the teachers' point of views, there is a lack of a framework regarding the use of technology. Furthermore, although teachers are strong in harmony with pedagogy and technology, practices change with the teacher's own preferences and skills. These situations create serious differences in practices in different schools. It seems important to at least establish minimum conditions. In this sense, the preparation of national standards suitable for the development of children, their inclusion in the program and their implementation will be a guide for teachers.

Notedly, there is a need for a child-centered technology integration approach. Teachers underline the interactive use of technology and gives opportunities to the children. But at this point, it can be mentioned that they act according to their own pedagogical decisions and there is a lack of a framework. Technology-integrated program preparation, in which children participate, is crucial.

In macro-level, there is a need for increase the quality and accessibility of technological devices and infrastructures. According to teachers, the variety of technological devices are insufficient. More importantly, internet access is

inadequate. The fact that the quality of internet access reaches international standards is a requirement that can form the basis of technology use in educational settings.

6.3 Suggestions for future research

The sample in this study was limited, so a larger sample spread of this study may ensure the precision of the results. Moreover, a study that also incorporates experiences and observations in the school would present a more multidimensional picture. In addition, it is clear that there is a need for studies to be done with methods that directly measure teachers' knowledge, such as lesson plans, lesson practices, diaries, reflections.

There is a need for empowering studies where teachers could receive continuous supervision. Teachers stated that they are open to learning and willing to integrate technology into their programs. Studies in which both they are trained, and their skills are measured would make a significant contribution to the literature. In addition, it would be meaningful to continue studies with a qualitative side, such as this study, so that teacher training could be oriented to the needs of teachers.

In addition, studies involving the perspectives of children and families on the use of technology in schools will also contribute to the field because the teachers made extensive references to the children’s experiences and the views of the families. These findings show that children and families are also important subjects and should be heard.

APPENDIX A

ETHICAL COMMITTEE APPROVAL

Evrak Tarih ve Sayısı: 29.03.2021-9879

T.C.
BOĞAZİÇİ ÜNİVERSİTESİ
SOSYAL VE BEŞERİ BİLİMLER YÜKSEK LİSANS VE DOKTORA TEZLERİ ETİK İNCELEME KOMİSYONU
TOPLANTI TUTANAĞI

Toplantı Sayısı	:	14
Toplantı Tarihi	:	25.03.2021
Toplantı Saati	:	13:00
Toplantı Yeri	:	Zoom Sanal Toplantı
Bulunanlar	:	Dr. Öğr. Üyesi Yasemin Sohtorik İlkmen, Prof. Dr. Ebru Kaya, Prof. Dr. Fatma Nevra Seggie
Bulunmayanlar	:	

Büşra Gündeş

Temel Eğitim

Sayın Araştırmacı,

"Erken Çocukluk Eğitimcilerinin Teknolojik Pedagojik Alan Bilgisi ve Teknoloji ile Öğretim Deneyimleri" başlıklı projeniz ile ilgili olarak yaptığınız SBB-EAK 2021/8 sayılı başvuru komisyonumuz tarafından 25 Mart 2021 tarihli toplantıda incelenmiş ve uygun bulunmuştur.

Bu karar tüm üyelerin toplantıya çevrimiçi olarak katılımı ve oybirliği ile alınmıştır. COVID-19 önlemleri kapsamında kurul üyelerinden ıslak imza alınamadığı için bu onam mektubu üye ve raportör olarak Ebru Kaya tarafından bütün üyeler adına e-imzalanmıştır.

Saygılarımızla, bilgilerinizi rica ederiz.

Prof. Dr. Ebru KAYA
ÜYE

e-imzalıdır
Prof. Dr.Ebru KAYA
Raportör

SOBETİK 14 25.03.2021

Bu belge 5070 sayılı Elektronik İmza Kanununun 5. Maddesi gereğince güvenli elektronik imza ile imzalanmıştır.

APPENDIX B

CONSENT FORM: ONLINE QUESTIONNAIRE

Hi,

I'm Büşra Gündeş Orman. I am a student at Boğaziçi University, Institute of Social Sciences, Early Childhood Education Master's Program. I invite you to participate in my master's thesis in which I aim to examine the technological pedagogical content knowledge of teachers.

If you want to participate in the research, you are expected to complete the personal information section of this form and the survey questions completely. It takes 15-20 minutes to complete the survey. The form consists of three parts. It is very important for the reliability of the research findings that you fill out the form sincerely. In the first part, personal information about you and your profession is asked. Your answers will never be shared with a third party or institution, except for research. In the second part, you will encounter questions about your technological pedagogical content knowledge. You are expected to fill out this questionnaire considering your own teaching experiences. In the last part, you are asked to make a short activity plan. These plans will only be used for data analysis and will not be shared. After completing the survey, you can save and exit. If you do not want to continue the research, you can exit the page. If you do not complete the form, your answers will not be recorded. In addition, phone numbers and e-mail addresses will be requested from our volunteer teachers who want to participate in the second phase of the research. This information will only be obtained from teachers who are volunteers and want to participate in the interview and will be used to communicate with them and will not be shared with third parties or institutions.

The personal information you share throughout the research will be kept confidential and stored in an encrypted cloud system. If you have any questions during the process, you can reach project manager Dr. Ersoy Erdemir ( ) and the project researcher ( ). Approval was obtained from Boğaziçi University Social and Human Sciences Master's and Doctoral Thesis Ethics Review Committee (SOBETIC) to conduct the research. You can consult SOBETİK ( ) about your rights and possible complaints regarding the research. Your consent is required to participate in the study and view the online questionnaire.
Thanks for your contribution and cooperation.

☐ I have read, I agree to participate in the research.

APPENDIX C

CONSENT FORM: ONLINE INTERVIEWS

Hi,

I'm Büşra Gündeş Orman. I am a student at Boğaziçi University, Institute of Social Sciences, Early Childhood Education Master's Program. I invite you to participate in my master's thesis in which I aim to examine the technological pedagogical content knowledge of teachers.

Thank you for participating in the first phase of the research and volunteering for the second phase. At this stage, I would like to make video calls with you and listen to your teaching experiences with technology. In order to carry out this process, we will schedule meetings with you via Zoom and hold meetings for a maximum of 30 minutes. If you accept, I will send you an availability form via e-mail and a Zoom meeting link based on your availability. We will be holding these meetings on the day and time we have planned. During the interviews, a recording will be made and reminder notes will be taken about the interview.

The personal information you share throughout the research will be kept confidential and stored in an encrypted cloud system. If you have any questions during the process, you can reach project manager Dr. Ersoy Erdemir ( ) and the project researcher ( ). Approval was obtained from Boğaziçi University Social and Human Sciences Master's and Doctoral Thesis Ethics Review Committee (SOBETIC) to conduct the research. You can consult SOBETİK ( ) about your rights and possible complaints regarding the research. Your consent is required to participate in the study and view the online questionnaire.
Thanks for your contribution and cooperation.

☐ I have read, I agree to participate in the research
☐ I agree to audio and video recordings during the call.

APPENDIX D

TEACHER INFORMATION FORM

1. Age
2. Gender

3. Graduation Status
o High School
o Associate degree
o License
o MSc
o Ph.D.

4. Field
o Child Development
o Pre-School Teaching
o Other

5. Age Group You Work With

6. Type of Institution You Work for
o State Institution
o Private Institution

7. The type of class you are working in
o Nursery/Day Nursing Home
o Independent Kindergarten Classroom
o Kindergarten Classroom
o Special Education Classroom

8. Year of Working …..

9. How would you describe the income status of the children you work with and their families?
Families find it difficult to meet their basic needs. 1 2 3 4 5 Families can easily meet their basic needs.

10. Did you take a course on educational technologies in your university program?
Yes No

11. Apart from university courses, have you received training on the use of technology and digital tools in education? *
Yes No

12. Please tick that you have participated in the following types of activities related to the use of technology and digital tools. (Check all that apply.)
o Seminar
o Workshop
o Lesson
o Course

o Certificate Program

13. If you have received training on technology and digital tool use (other than university courses), how long do they last?

o 1-3 Hours
o 3-5 Hours
o 1 Day
o 1 Week
o 1 Semester
o Other:

14. Did you do online courses during the distance education process?

Yes No

15. Please ick the information and communication technologies available in your classroom. *

Computer Tablet Smart Board Internet Connection Projector Robot Toys Digital Camera Speaker Other

16. Please tick the information and communication technologies you use in your classroom.

Computer Tablet Smart Board Internet Connection Projector Robot Toys Digital Camera Speaker Other

17. Please tick the software you use in the education and training processes.

Course Management Software (Moodle, Google Classroom, Blackboard)
Creative Writing (Canva, Mentimeter, Prezi, Scratch, Padlet, Story Jumper)
Document Management Software (Microsoft Office, Google Documents)
Communication Software (Zoom, Microsoft Teams, Google Meet, Adobe Connect)
Cloud/Storage Software (Google Drive, iCloud, Drop)

18. Please tick the information and communication technologies that you personally use.

Smart phone
Tablet
Computer
Smart Television
Assistive Devices (Smart Watch, Wireless Headset etc.)

APPENDIX E

TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE-PRACTICAL SCALE

Learners

A. Using ICT to understand students
A-1. Know how to use ICT to know more about students
A-2. Know how to use ICT to identify students' learning difficulties
A-3. Be able to use different technology-infused instruction to assist students with different learning characteristics

Subject Content
B. Using ICT to understand subject content
B-1. Be able to use ICT to better understand the subject content
B-2. Be able to identify the subject topics that can be better presented with ICT

Curriculum Design
C. Planning curriculum –> Planning ICT-infused curriculum
C-1. Be able to evaluate factors which influence the planning of ICT-infused curriculum
C-2. Be able to design technology-infused lessons or curriculum
C-3. Be able to identify what types of technology-infused curriculum designs can be used to solve teaching objectives difficult to achieve
D. Representations –> Using ICT representations to present instructional representations
D-1. Select appropriate ICT representations
D-2. Use appropriate ICT representations to present instructional content
D-3. Be able to use appropriate ICT representations to present instructional content
E. Teaching strategies –> Employing ICT-integrated teaching strategies
E-1. Be able to indicate the strategies which are appropriate to be used with ICT-integrated instruction
E-2. Be able to apply appropriate teaching strategies in technology-integrated instruction

Practical Teaching
F. Instructional management –> Applying ICT to instructional management
F-1. Be able to indicate the advantages and disadvantages of ICT on instructional management
F-2. Be able to use ICT to facilitate instructional management
G. Teaching practices –> Infusing ICT into teaching contexts
G-1. Be able to indicate the differences between the contexts of ICT-infused teaching to the contexts of traditional teaching
G-2. Be able to use ICT to facilitate the achievement of teaching objectives
G-3. Be able to indicate the influences of different ICT to instruction
G-4. Be able to indicate substitute plans for technology-infused instruction

Assessment
H. Assessments –> Using ICT to assess students
H-1. Know the types of technology-infused assessment approaches
H-2. Be able to identify the differences between technology-integrated assessments to traditional assessments
H-3. Be able to use ICT to assess students' learning progress

APPENDIX F

TECHNOLOGY INTEGRATION SCALE

Q: How often do you use technologies for the following purposes? (1 = Never to 5 = Always)
1. Prepare lesson plan
2. Access information resources
3. Develop instructional materials
4. Develop assessment strategies
5. Present lesson
6. Demonstrate sample applications
7. Drill and practice
8. Revise lesson
9. Communicate with students
10. Communicate with other teachers

APPENDIX G

ONLINE INTERVIEW PROTOCOL

Perceived Technology

1. Please give examples of educational technology that you used in the classrooms.
2. Answer the next questions by considering the examples you have given and the experiences you have used.

Teaching Processes

1. Can you give information about the subjects and processes you have covered in your lessons/activities?
2. Can you describe the learning objectives/objectives that you addressed in your lessons/activities? (These do not have to be national standards. Participants should explain in their own words.)
3. Can you describe your students? (For example, grade level, age group and special learning needs/preferences).
4. How is your course/activity process going? Can you explain?
5. Which educational technologies (digital and non-digital) did you use in your lessons and how did you and/or your students use them?
6. What are the circumstances that affect the design or implementation of your lessons/activities? (any contextual information (e.g. access to a computer lab, available materials and resources; specific department/school-wide initiatives))
7. What were your solutions and initiatives for the situations you encountered?

TPACK-Specific Questions

1. How and why do the particular technologies you use in your lesson or activity "fit" with content/process objectives?
2. How and why do the particular technologies you use in your lesson/activities "fit" with the teaching methods you use?
3. When you consider all of the learning objectives, teaching methods and technologies used in your lessons or activities, how and why do they fit together?

General Evaluation

1. What do you think are the advantages of using educational technologies?
2. What do you think are the disadvantages of using educational technologies?
3. What difficulties did you encounter while using educational technologies?
4. What advice would you give to new teachers who want to use educational technologies?

APPENDIX H

THEMES AND CODES FROM INTERVIEWS

Themes	Sub-themes	Codes	Frequency
Teachers' Ideas of Educational ICT	Devices/Artifacts	Camera	2
		Computer	5
		Smart Board	4
		Smart Phone	2
		Speaker	2
		Internet Connection	2
	Software	EBA	3
		Learning Apps	5
		PowerPoint	1
Goal & Objectives	Curriculum Objectives	Visual perception	3
		Matching	2
		Naming	2
		Games	4
		Vocabulary	2
		Emotions	1
	Curriculum Goals	Assessment	3
		Modernization	3
		Enriching the curriculum	3
Content & Curriculum	Comparisons	Same with the conventional curriculum	10
		Enriched Content	5
Learners	Definitional characteristics of children	Affected by pandemic	8
		4-Year-Olds	4
		5-Year-Olds	4
		High SES	4
		Low SES	2
		Good Cognitive Development Level	3
		Physically Active	1
		Negative effects of pandemic	5
Practice	Purpose	Introduction	4
		Motivating Children	6
		Demonstrations	7
		Active Participation of Children	5
		Result-Oriented	2
	Usage	Technology integration	3
		Technology as a Content	2
		Supportive use of technology	3
		Alternative Activities to Technology	3
		Necessity of Using Technology	5
		Limited Technology Time	5
		Lack of one-to-one Interaction	2
		Proper Use	7
Challenges	School-Administrative Challenges	Infrastructure of schools	2
		Lack of training opportunities	1
		Unstructured technology integration	1
		Unsupportive Colleagues	2
		Difficulties in finding resources	3
		Lack of support	2
	Technical Difficulties	Internet Outage	5
		Paid subscription	3
		Power Cut	4
	Teacher-related Factors	Teachers' readiness	3
		Preparation of Content	5
		Selection of Content	3
	Child and Family related Factors	Attitudes of Parents	4
		Negative Pandemic Effect	4
		Guiding Parents to Proper Use of Technology	7
Opportunities	School & Administrative Support	Collogue Support	2
		Purchasing Subscriptions	2
		IT Support	3

		Inservice Training	2
	Children	Active Participation of Children	5
		Attractive for learners	7
		Motivating Children	6
Advantages of Technology	Teachers	Enriched Content and Method Choice	6
		Self-Development	3
		Ease of Use	6
	Children	Active Participation and Choice	4
		Different Learning Opportunities	3
		Creativity	5
		Ease of Use	4
Fitness of Technology, Content and Teaching Methods	Technology and Content	Content-Appropriate Use	6
		Enhance the learning	6
		Permanent Learning	3
		Technology as a Learning Need	3
	Technology and Teaching Methods	Encouraging and stimulating active learning	4
		Here and now	2
		Selection of Appropriate Methods	6
		Diversification of Methods	5
	Overall Fitness	Whole Learning	4
		Open to Learn	4
		Creativity	3
		Needs of Learners	5
Disadvantages of Technology	Children	Developmental problems	2
		Proper Media Behavior	1
		Child Protection	3
	Distance Learning	Parent Interference	4
		Difficulties in Guiding Children	2
Advice for New Teachers	Professional Development	Self-development	3
		Benefiting from Technology	5
	In-Class	Including technology in daily routines	3
		Limiting Screen Time	2
		Selection of Appropriate Content	3
		Preparation of Content	6

APPENDIX I

CORRELATION TABLE OF VARIABLES ON TPACK

		Age	Experience (Year)	Gender	Education Level	Field	Technology Course	Inservice Traning	Child Age Group	Institution Type	Income Level	TPACK-Practical Score
Age	Pearson Correlation	--										
	N	107										
Experience(Year)	Pearson Correlation	.876**	--									
	Sig. (2-tailed)	.000										
	N	107	107									
Gender	Pearson Correlation	-.116	-.131	--								
	Sig. (2-tailed)	.236	.179									
	N	107	107	107								
Education Level	Pearson Correlation	.133	.105	.053	--							
	Sig. (2-tailed)	.172	.282	.589								
	N	107	107	107	107							
Field	Pearson Correlation	.034	.003	-.123	-.304**	--						
	Sig. (2-tailed)	.725	.979	.206	.001							
	N	107	107	107	107	107						
Technology Course	Pearson Correlation	-.247*	-.135	-.049	.000	.046	--					
	Sig. (2-tailed)	.010	.165	.618	.997	.637						
	N	107	107	107	107	107	107					
Inservice Traning	Pearson Correlation	.165	.265**	.092	.239*	.026	.085	--				
	Sig. (2-tailed)	.090	.006	.347	.013	.791	.382					
	N	107	107	107	107	107	107	107				
Child Age Group	Pearson Correlation	-.047	.003	.334**	-.013	.143	-.084	.080	--			
	Sig. (2-tailed)	.629	.978	.000	.895	.143	.391	.413				
	N	107	107	107	107	107	107	107	107			
Institution Type	Pearson Correlation	-.108	-.117	-.104	-.170	.132	.082	-.047	.090	--		
	Sig. (2-tailed)	.268	.232	.285	.080	.176	.403	.627	.357			
	N	107	107	107	107	107	107	107	107	107		
Income Level	Pearson Correlation	.192*	.132	-.120	-.052	.060	.022	.116	-.138	.474**	--	
	Sig. (2-tailed)	.048	.177	.219	.592	.538	.826	.233	.157	.000		
	N	107	107	107	107	107	107	107	107	107	107	
TPACK-Practical Score	Pearson Correlation	-.006	.054	-.071	.052	.008	.083	.278**	-.064	.039	.224*	--
	Sig. (2-tailed)	.948	.580	.465	.595	.935	.395	.004	.512	.687	.020	
	N	107	107	107	107	107	107	107	107	107	107	107

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

*. Correlation is significant at the 0.05 level (2-tailed).

APPENDIX J

CORRELATION TABLES OF TPACK AND TECHNOLOGY INTEGRATION

Correlations

		TPACK-Practical Score	Learners	Subject Content	Curriculum Design	Practical Teaching	Assessment
Learners	Pearson Correlation	.789**					
	Sig. (2-tailed)	.000					
	N	107					
Subject Content	Pearson Correlation	.790**	.596**				
	Sig. (2-tailed)	.000	.000				
	N	107	107				
Curriculum Design	Pearson Correlation	.944**	.649**	.779**			
	Sig. (2-tailed)	.000	.000	.000			
	N	107	107	107			
Practical Teaching	Pearson Correlation	.913**	.636**	.616**	.814**		
	Sig. (2-tailed)	.000	.000	.000	.000		
	N	107	107	107	107		
Assessment	Pearson Correlation	.812**	.662**	.538**	.652**	.729**	
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	107	107	107	107	107	
Technology Integration	Pearson Correlation	.420**	.375**	.288**	.414**	.367**	.309**
	Sig. (2-tailed)	.000	.000	.003	.000	.000	.001
	N	107	107	107	107	107	107

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

APPENDIX K

REGRESSION TABLES OF TPACK AND TECHNOLOGY INTEGRATION

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TPACK-Practical Score	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Technology Integration

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.420[a]	.177	.169	7.067

a. Predictors: (Constant), TPACK-Practical Score

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1124.964	1	1124.964	22.523	.000[b]
	Residual	5244.550	105	49.948		
	Total	6369.514	106			

a. Dependent Variable: Technology Integration
b. Predictors: (Constant), TPACK-Practical Score

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	8.774	4.651		1.887	.062
	TPACK-Practical Score	.237	.050	.420	4.746	.000

a. Dependent Variable: Technology Integration

Excluded Variables[a]

						Collinearity Statistics
Model		Beta In	t	Sig.	Partial Correlation	Tolerance
1	Age	-.021[b]	-.236	.814	-.023	1.000
	Education Level	.147[b]	1.672	.097	.162	.997
	Field	.107[b]	1.207	.230	.117	1.000
	Institution Type	-.025[b]	-.279	.781	-.027	.998
	Experience(Year)	.026[b]	.289	.773	.028	.997
	Income Level of Families of Children	.047[b]	.515	.608	.050	.950
	Technology Training in Teaching Degree	.050[b]	.558	.578	.055	.993
	Inservice Traning	-.084[b]	-.909	.366	-.089	.923

a. Dependent Variable: Technology Integration
b. Predictors in the Model: (Constant), TPACK-Practical Score

REFERENCES

Albayrak-Sarı, A., Canbazoğlu-Bilici, S., Baran, E., & Özbay, U. (2016). Farklı branşlardaki öğretmenlerin teknolojik pedagojik alan bilgisi (TPAB) yeterlikleri ile bilgi ve iletişim teknolojilerine yönelik tutumları arasındaki ilişkinin incelenmesi. *Eğitim Teknolojisi Kuram ve Uygulama, 6*(1), 1-21.

Aral, N., & Doğan Keskin, A. (2018). Examining 0-6 year olds' use of technological devices from parents' points of view. *Addicta: The Turkish Journal on Addiction, 5,* 177–208. http://dx.doi.org/10.15805/addicta.2018.5.2.0054

Ay, Y., Karadağ, E. & Acat, M. Y. (2015). The technological pedagogical content knowledge-practical (TPACK-Practical) model: Examination of validity in the Turkish culture via structural equation modeling. *Computers & Education, 88,* 97-108.

Altun, D. (2019). Investigating pre-service early childhood education teachers' technological pedagogical content knowledge (TPACK) competencies regarding digital literacy skills and their technology attitudes and usage. *Journal of Education and Learning, 8*(1). 249-263.

Baran, E., & Canbazoğlu Bilici S. (2015). Teknolojik pedagojik alan bilgisi (TPAB) üzerine alanyazın incelemesi: Türkiye örneği. [in Turkish]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi [Hacettepe University Journal of Education], 30*(1), 15-32.

Belo,N. McKenney, S. Voogt, J. and Bradley, B. (2016). Teacher knowledge for using technology to foster early literacy: A literature review. C*omputers in Human Behavior, 60,* (372-383)

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education, 77,* 82-90.

Boschman, F., McKenney, S., & Voogt, J. (2014). Understanding decision making in teachers' curriculum design approaches. *Educational Technology Research and Development, 62*(4), 393–416. https://doi.org/10.1007/S11423-014-9341-X

Casillas Martín, S., Cabezas González, M., & García Peñalvo, F. J. (2019). Digital competence of early childhood education teachers: attitude, knowledge and use of ICT. *European Journal of Teacher Education, 1–14.*doi:10.1080/02619768.2019.1681393

Cevher-Kalburan, N., Yurt, Ö., & Ömeroğlu, E. (2011). The use of interactive CD-ROM in early childhood education: Teachers' thoughts and practices. *Procedia Computer Science, 3*, 1555–1561.doi.org/10.1016/J.PROCS.2011.01.049

Chaudron S., Di Gioia R., Gemo M. (2018). Young children (0-8) and digital technology, a qualitative study across Europe; EUR 29070; doi:10.2760/294383

Ching, C.C., Wang, X.C., Shih, M.L. & Kedem, Y. (2006). Digital photography and journals in a kindergarten-first-grade classroom: Toward meaningful technology integration in early childhood education. *Early Education and Development, 17*(3), 347-371. Retrieved December 14, 2021 from https://www.learntechlib.org/p/99584/.

Christ, T., Wang, X. C., & Erdemir, E. (2018). Young children's buddy reading with multimodal app books: Reading patterns and characteristics of readers, texts, and contexts, *Early Child Development and Care, 188*(8), 1012-1030.

Chuang, H., & Ho, C. (2011). An investigation of early childhood teachers' technological pedagogical content knowledge TPACK in Taiwan. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 12*(2), 99-117.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, California: Sage Publications.

Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

Donohue, C. (2015). Technology and digital media as tools for teaching and learning in the digital age. In C. Donohue (Ed.), *Technology and digital media in the early years: Tools for teaching and learning* (pp. 21–35). New York/Washington, DC: Routledge/NAEYC.

Dong, C. (2018) 'Young children nowadays are very smart in ICT' – preschool teachers' perceptions of ICT use, *International Journal of Early Years Education*, DOI: 10.1080/09669760.2018.1506318

Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Education Tech Research Dev, 68***,** 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Gialamas, V., & Nikolopoulou, K. (2010). In-service and pre-service early childhood teachers' views and intentions about ICT use in early childhood settings: A comparative study. *Computers & Education, 55(1), 333–341*.doi:10.1016/j.compedu.2010.01.019

Gilster, P. (1997). *Digital literacy*. New York: Wiley.

Gottschalk, F. (2019), "Impacts of technology use on children: Exploring literature on the brain, cognition and well-being", *OECD Education Working Papers*, No. 195, OECD Publishing, Paris, https://dx.doi.org/10.1787/8296464e-en.

Harris, J. B., Grandgenett, N., & Hofer, M. (2012). Testing an instrument using structured interviews to assess experienced teachers' TPACK. *Teacher Education Faculty Proceedings & Presentations, 15*.

Hatch, K. E. (2011). Determining the Effects of Technology on Children. *Senior Honors Projects*. Paper 260

Hooft Graafland, J. (2018), "New technologies and 21st century children: Recent trends and outcomes", *OECD Education Working Papers*, No. 179, OECD Publishing, Paris, https://doi.org/10.1787/e071a505-en.

Hopkins, K. and Weeks, D. (1990). Tests for Normality and Measures of Skewness and Kurtosis: Their Place in Research Reporting. *Educational and Psychological Measurement, 50(4).*

Jack, C. & Higgins, S. (2019) What is educational technology and how is it being used to support teaching and learning in the early years? *International Journal of Early Years Education*, *27*(3), 222 237, DOI: 10.1080/09669760.2018.1504754

Ihmeideh, F., Al-Maadadi, F. (2018). Towards improving kindergarten teachers' practices regarding the integration of ICT into early years settings. *Asia-Pacific Edu Res*, 27**,** 65–78 https://doi.org/10.1007/s40299-017-0366-x

Karaca, F., Can, G., & Yildirim, S. (2013). A path model for technology integration into elementary school settings in Turkey. *Computers & Education*, *68*, 353-365.

Keengwe, J. & Onchwari, G. (2009). Technology and early childhood education: a technology integration professional development model for practicing teachers. *Early Childhood Educ J* 37**,** 209-218. https://doi.org/10.1007/s10643-009-0341-0

Kerckaert, S., Vanderlinde, R. and van Braak. J. (2015). The role of ICT in early childhood education: Scale development and research on ICT use and influencing factors. *European Early Childhood Education Research Journal 23* (2): 183–199. Doi: 10.1080/1350293X.2015. 1016804

Lee, A. and Jen, Y. H. (2015). Interactive whiteboard integration into music teaching and learning: preschool children as a case study. Procedia - *Social and Behavioral Sciences*, *177*, 449-458.

Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). The technological pedagogical content knowledge framework. In Spector, J. M., Merrill, M. D., Elen, J. ve Bishop, M.J. (Eds). *Handbook of research on educational communications and technology* kitabında (p. 101-111). New York: Springer.

Konca, A. S. and Erden Tantekin, F. (2014). Digital technology (DT) usage of preschool teachers in early childhood classrooms. *Journal of Education and Future, 0*(19), 1-12.

Konca, A., Ozel, E. & Zelyurt, H. (2015). Attitudes of preschool teachers towards using information and communication technologies (ICT). *International Journal of Research in Education and Science. 2*(10). 10.21890/ijres.21816.

Laurillard, D. (2018). Teaching as a design science: Teachers building, testing and sharing pedagogic ideas. In J. Voogt, G. Knezek, R. Christensen & Kwok-Wing L. (Eds), *Springer International Handbooks of Education: Handbook of Information Technology in Primary and Secondary Education* (p. 557-566). Springer, New York.

Lindahl, M. G., & Folkesson, A. M. (2012). ICT in preschool: Friend or foe? The significance of norms in a changing practice. *International Journal of Early Years Education*, *20*(4), 422–436. https://doi.org/10.1080/09669760.2012.743876

Luik, P. and Taimalu, M. (2021). Predicting the intention to use technology in education among student teachers: A path analysis. *Education Sciences, 11,* 564-578.. https:// doi.org/10.3390/educsci11090564

Mertala, P. (2019). Teachers' beliefs about technology integration in early childhood education: A meta-ethnographical synthesis of qualitative research. *Computers in Human Behavior*,101,334-349, https://doi.org/10.1016/j.chb.2019.08.003.

Mertens, D. M. (2015). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods (Fourth Edition).* Thousand Oaks, California: Sage Publications.

Milli Eğitim Bakanlığı [Ministry of National Education]. (2013). *Okul Öncesi Eğitim Programı [Early Childhood Education Curriculum]*. Ankara, Turkey: MEB Talim Terbiye Kurulu.

Milli Eğitim Bakanlığı [Ministry of National Education]. (2016). *2016 Yılı Hizmetiçi Eğitim Planı [Inservice Training Programme-2016]*. Ankara, Turkey: Milli Eğitim Bakanlığı. Retrieved from: http://personel.meb.gov.tr/www/icerik_goruntule.php?KNO=108.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054. doi: 10.1111/j.1467-9620.2006.00684.x

Mourlam, D., DeCino D, Newland, L., and Strouse, G., (2020). "It's fun!" using students' voices to understand the impact of school digital technology integration on their well-being *Computers & Education, 104003, 159*

National Association for the Education of Young Children (2019). Position statement: Technology and young children. Washington, DC.

National Association for the Education of Young Children & Fred Rogers Center for Early Learning and Children's Media. (2012). Technology and interactive media as tools in early childhood programs serving children from birth through age 8. Joint Position Statement. Washington, DC: NAEYC. www.naeyc. org/content/technology-and-young-children.

Nobre, J.N.P., Vinolas Prat, B., Santos, J. N., Santos L.R., Pereira, L., Guedes, S. C., Ribeiro, R. F., Morais, R.L. S. (2020). Quality of interactive media use in early childhood and child development: a multicriteria analysis. *Jornal de Pediatria*. *96*(3). 310-317

Nolan, D. (2019). *Social media and technology use by early childhood educators*. Barnardo's, Ireland

OECD (2020). Early learning and child well-being: a study of five-year-olds in England, Estonia, and the United States, OECD Publishing, Paris, https://dx.doi.org/10.1787/3990407f-en.

Ottenbreit-Leftwich, A. T., Glazewski, K. D., Newby, T. J., Ertmer, P. A. (2010). Teacher value beliefs associated with using technology: Addressing professional and student needs. *Computers & Education*, *55*(3), 1321–1335. https://doi.org/10.1016/j.compedu.2010.06.002

Palaiologou, I. (2016). Children under five and digital technologies: implications for early years pedagogy. *European Early Childhood Education Research Journal, 24* (1), 5–24. doi:10.1080/ 1350293X.2014.929876.

Parette, H. P., Peterson-Karlan, G. R. and Blum, C. (2013). Integrating technology in early childhood classrooms. In H. P. Parette & C.Blum (Eds.), *Instructional technology in early childhood: Teaching in the digital age* (pp. 29–50). Baltimore, MD:Brookes

Plowman, L., Stephen, C. and McPake. J. (2008). Supporting Young Children's Learning with Technology at Home and in Preschool. *Research Papers in Education, 25* (1), 93–113. doi:10. 1080/02671520802584061.

Plowman, L., and McPake, J. (2013). Seven myths about young children and technology. *Childhood Education* 89 (1), 27–33.

Rosen, D. B. & Jaruszewicz, C. (2009) Developmentally appropriate technology use and early childhood teacher education, *Journal of Early Childhood Teacher Education*, *30*(2), 162-71, DOI: 10.1080/10901020902886511

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Simon, F., & Nemeth, K. N. (2012). *Digital Decisions: Choosing the Right Technology Tools for Early Childhood Education.* Gryphon House Inc.

Slutsky, R., Kragh-Müller, G., Rentzou, K., Tuul,M., Gol Guven, M., Foerch, D. & Paz-Albo, J. (2021) A cross-cultural study on technology use in preschool classrooms: early childhood teacher's preferences, time-use, impact and association with children's play, *Early Child Development and Care*, 191:5, 713-725, DOI: 10.1080/03004430.2019.1645135

Stephen, C., and Plowman, L. (2013). Digital technologies play and learning. *Early Childhood Folio, 17* (2), 3–8.

Türkiye İstatistik Kurumu (TÜİK), 2020. Toplumsal Cinsiyet İstatistikleri. Ankara, Türkiye İstatistik Kurumu.

Tzavara, A., Komis, V., & Karsenti, T. (2018). A methodological framework for investigating TPACK integration in educational activities using ICT by prospective early childhood teachers. *Italian Journal of Educational Technology*, *26*(1), 71-89. doi: 10.17471/2499-4324/976

Wallnau, L. and Gravetter, F, (2014). *Essentials of statistics for the behavioral sciences*, (8th Edition). Wadsworth Cengage Learning, Belmont.

Wen, B. & Shinas, V. H. (2021) Using a multidimensional approach to examine TPACK among teacher candidates, *Journal of Digital Learning in Teacher Education, 37*(1), 30-47, DOI: 10.1080/21532974.2020.1804493.