INVESTIGATING THE RELATIONSHIP BETWEEN 21ST-CENTURY SKILLS AND TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) OF IN-SERVICE EARLY CHILDHOOD EDUCATORS

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submitted by **HİLAL ASENA CANGÜL** in partial fulfillment of the requirements for the degree of **Master of Science in Elementary and Early Childhood Education, Early Childhood Education, the Graduate School of Social Sciences of Middle East Technical University** by,

Prof. Dr. Yaşar KONDAKÇI
Dean
Graduate School of Social Sciences _____

Prof. Dr. Feyza TANTEKİN-ERDEN
Middle East Technical University
Department of Elementary and Early Childhood Education _____

Assoc. Prof. Dr. Hasibe Özlen DEMİRCAN
Supervisor
Department of Elementary and Early Childhood Education _____

Examining Committee Members:

Assoc. Prof. Dr. Selda ARAS (Head of the Examining Committee)
Hacettepe University
Department of Elementary and Early Childhood Education _____

Assoc. Prof. Dr. Hasibe Özlen DEMİRCAN (Supervisor)
Middle East Technical University
Department of Elementary and Early Childhood Education _____

Assist. Prof. Dr. Volkan ŞAHİN
Middle East Technical University
Department of Elementary and Early Childhood Education _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last Name: Hilal Asena CANGÜL

Signature :

ABSTRACT

INVESTIGATING THE RELATIONSHIP BETWEEN 21ST-CENTURY SKILLS AND TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) OF IN-SERVICE EARLY CHILDHOOD EDUCATORS

CANGÜL, Hilal Asena
M.S., The Department of Elementary and Early Childhood Education, Early Childhood Education
Supervisor: Assoc. Prof. Dr. Hasibe Özlen DEMİRCAN

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This research was designed as a quantitative study to investigate the 21st-century skills and technological pedagogical content knowledge (TPACK) of in-service early childhood educators and to examine the association between 21st-century skills (Learning and Innovation Skills, Life and Career Skills, Information, Media and Technology Skills) and TPACK. 382 in-service early childhood educators, who worked in Ankara, İzmir, and İstanbul in the 2021-2022 academic year, participated in the study. Data were collected via three instruments. These instruments were the Demographic Information Form, the 21st-Century Skills Scale (Anagün, Atalay, Kılıç & Yaşar, 2016), and the Technological Pedagogical Content Knowledge Scale (Horzum, Akgün & Öztürk, 2014). In the beginning, a pilot study was conducted to test the validity and reliability of scales for in-service early childhood educators. After some changes were made to the 21st-Century Skills Scale, it was confirmed that the scales were valid and reliable. Therefore, the main research was conducted. Two-way ANOVA, and correlational method were used to analyze research data. The study findings showed no statistically significant difference in the 21st-century skills

regarding age, years of experience, and education level. The only statistically significant difference was detected in training attendance on 21st-century skills. Additionally, there was no statistically significant difference in the total TPACK score regarding independent variables. Moreover, sub-factors of 21st-century skills (Learning and Innovation Skills; Information, Media and Technology Skills; and Life and Career Skills) had a significantly positive correlation with the total TPACK.

Keywords: 21st-century skills, Technological Pedagogical Content Knowledge, TPACK, Early Childhood Educators, In-service educators

ÖZ

OKUL ÖNCESİ ÖĞRETMENLERİNİN 21. YÜZYIL BECERİLERİ İLE TEKNOLOJİK PEDAGOJİK ALAN BİLGİLERİ (TPAB) ARASINDAKİ İLİŞKİNİN İNCELENMESİ

CANGÜL, Hilal Asena
Yüksek Lisans, Temel Eğitim, Okul Öncesi Eğitimi Bölümü
Tez Yöneticisi: Doç. Dr. Hasibe Özlen DEMİRCAN

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Bu araştırma, okul öncesi öğretmenlerinin 21. yüzyıl becerileri ile teknolojik pedagojik alan bilgilerini (TPAB) incelemek ve 21. yüzyıl becerileri (Öğrenme ve Yenilenme Becerileri, Yaşam ve Kariyer Becerileri, Bilgi, Medya ve Teknoloji Becerileri) ile TPAB arasındaki ilişkiyi araştırmak için tasarlanmış nicel bir çalışmadır. Araştırmaya 2021-2022 eğitim öğretim yılında Ankara, İzmir ve İstanbul'da görev yapan 382 okul öncesi öğretmeni katılmıştır. Üç farklı veri toplama aracı kullanılarak çalışma verileri toplanmıştır. Bu veri toplama araçları Demografik Bilgi Formu, 21. Yüzyıl Becerileri Ölçeği (Anagün, Atalay, Kılıç ve Yaşar, 2016) ve Teknolojik Pedagojik Alan Bilgisi Ölçeği'dir (Horzum, Akgün ve Öztürk, 2014). İlk olarak, okul öncesi öğretmenleri ile ölçeklerin geçerlik güvenirliğini test etmek için bir pilot çalışma yapılmıştır. 21. Yüzyıl Becerileri Ölçeği üzerinde bazı değişiklikler yapıldıktan sonra ölçeklerin geçerli ve güvenilir olduğu teyit edilmiş ve ana araştırmaya geçilmiştir. Araştırma verilerinin analizinde iki yönlü ANOVA ve korelasyon yöntemleri kullanılmıştır. Katılımcıların yaş, deneyim ve eğitim düzeyleri incelendiğinde 21. yüzyıl becerilerinde istatistiksel olarak anlamlı bir farklılık görülmemiştir. İstatistiksel olarak anlamlı tek fark, 21. yüzyıl becerilerine yönelik

eğitime katılımda tespit edilmiştir. Bağımsız değişkenlere göre toplam TPAB puanında da istatistiksel olarak anlamlı bir fark bulunmamıştır. 21. yüzyıl becerilerinin alt faktörleri (Öğrenme ve Yenilik Becerileri; Bilgi, Medya ve Teknoloji Becerileri ve Yaşam ve Kariyer Becerileri) ile toplam TPAB arasında anlamlı düzeyde pozitif bir korelasyon bulunmuştur.

Anahtar Kelimeler: 21. Yüzyıl Becerileri, Teknolojik Pedagojik Alan Bilgisi, TPAB, Okul Öncesi Öğretmenleri

To my parents,
Hatice and Mehmet CANGÜL

&

To the lights of my life,
Merve Altınışık, Elif Altınışık,
Enes Altınışık and Oğuz Kağan Altınışık

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LIST OF ABBREVIATIONS

PK Pedagogical Knowledge

CK Content Knowledge

TK Technological Knowledge

PCK Pedagogical Content Knowledge

TPK Technological Pedagogical Knowledge

TCK Technological Content Knowledge

TPCK Technological Pedagogical Content Knowledge

TPACK Technological Pedagogical Content Knowledge

ICT Information and Communication Technologies

P21 Partnership for 21st-Century Skills

OECD Organization for Economic Co-operation and Development

ATCS Assessment and Teaching of 21st Century Skills

ISTE International Society for Technology in Education

WEF World Economic Forum

IR Industrial Revolution

MoNE Ministry of National Education

EFA Exploratory Factor Analysis

CFA Confirmatory Factor Analysis

CHAPTER 1

INTRODUCTION

Throughout history, industry and technology have influenced the direction of people's lives (Younes & Al-Zoubi, 2015). Technological developments are taking hold faster than in previous times and directs individuals to have united, advanced, and interdisciplinary qualifications. Known as the Industrial Revolution (IR) 4.0, this era involves the development of technology in all parts of life, and it affects all individuals by increasing the complexity, speed, and quality of technology (Marope, 2017).

With these advances many developed countries have transitioned to function as knowledge-based economies, and developing countries are following suite. In such economy, the production of services and goods is based mainly on professional knowledge, unlike the industry-based economy. Consequently, people's thinking, living, and working ways need to change to adapt to the world's new requirements (Organization for Economic Cooperation and Development [OECD], 2005; Griffin, Care & McGaw, 2012). Our lives have already been changed significantly over the last 50 years, and it seems they will change even more rapidly in the next. We've witnessed industry-based economies supplant agricultural ones in importance and the emergence of even more influential, knowledge-based ones that will continue to affect social life and the labor market (Griffin, Care & McGaw, 2012). The World Economic Forum (WEF) predicted that 65 percent of children, who begin primary school these days, will work in a job that does not exist yet (2016).

The challenge of preparing children for such a future will likely impact all levels of the education system, necessarily making it more children-centered as in the Ecological System Approach, which encompasses the need to increase educators' knowledge and capabilities, prepare political and educational policies, support

technological infrastructure in schools, and so on (Herselman, Botha, Mayindi & Reid, 2018).

Education is seen to have a vital role in people's lives and has a key role in preparing children for a complex and challenging world since children need various competencies to fulfill the demands of the modern world of the 21st century (OECD, 2005; OECD, 2018a). For this reason, an adaptation of the education system to current global conditions is crucial (OECD, 2005; Wang, 2012; Marope, 2017). Educators are central to this effort as they strive to support children's acquisition of new skills by applying their current knowledge and experience in innovative ways (Lee & Reigeluth, 1994; OECD, 2018b). Clearly, it is essential to ensure that educators possess 21st-century knowledge, skills, and technological pedagogical content knowledge (TPACK). Thus, they can be ready to encourage their students to gain 21st-century skills and digital competencies to adapt to a currently improving world (American Association of Colleges for Teacher Education [AACTE] & Partnership for 21st Century Skills [P21], 2010). In this way, children can be responsible, beneficial, and active citizens in their social life and competent individuals, especially for business life in the future (OECD, 2018a). 21st-century skills like life skills, innovation skills, and information and technology skills are competencies that both young and old learners need to gain to adapt to the rapidly shifting requirements of the world now and in the future (OECD, 2005; Griffin, Care & McGaw, 2012; Wang, 2012; Marope, 2017).

Early childhood years are the critical period to support the necessary competencies of children to prepare them to fulfill the demands of the world in the future since their early experiences have a great influence on the development of their brain (Ministry of National Education [MoNE], 2013; Tuncer, 2015; BattelleForKids, 2019d). Considering that the early ages are precious times for individuals (MoNE, 2013; Tuncer, 2015), supporting young children to gain necessary skills in their early years is the responsibility of their families, teachers, schools, and policymakers (MoNE, 2013; BattelleForKids, 2019d).

To keep pace with these demands, the Turkish government began to give importance to the 21st-century skills and technological knowledge of both teachers and students. The eleventh development plan of the Presidency of The Republic of Turkey (2019) mentions the aim to have qualified people who are productive and capable of using technology by increasing the quality of all levels of education between 2019 and 2023. Its other purpose is to provide lifelong learning opportunities by increasing children's perception, problem-solving skills, entrepreneurship, innovation, communication, productivity and technological skills, and a sense of self-confidence and responsibility. Moreover, it aims to increase the technological competencies of educators and technological equipment in schools. Additionally, in the Strategic Plan of the Ministry of National Education (MoNE) for 2019-2023, it is pointed out that it will be ensured that students acquire knowledge, skills, attitudes, and behaviors suitable for the era's requirements. For this purpose, digital skills and digital content will be supported for both students and teachers (MoNE, 2019).

In addition to these publications made by the Turkish government, the early childhood curriculum also emphasizes some 21st-century skills to be acquired by children, and that early childhood educators are vital to encouraging them to gain these skills (MoNE, 2013). Ata-Aktürk, Demircan, Şenyurt, and Çetin (2017) pointed out that early childhood education in Turkey supports some basic 21st-century skills of young children like creativity, critical thinking, problem-solving, self-expression, and taking the initiative.

There are various frameworks on 21st-century skills. However, in this research, the Partnership for 21st Century Learning (P21) Framework for 21st Century Learning is used as a primary framework because of its special emphasis on early childhood education (BattelleForKids, 2019c). P21 has created a 21st-century learning framework with an integrated and collective structure. It includes knowledge and skills needed for successful daily and business life (BattelleForKids, 2019b). While AACTE & P21 stated that educators should have 21st-century skills (2010), P21 also emphasized that teachers who work with young children should integrate 21st-century skills into children's learning programs (BattelleForKids, 2019c; BattelleForKids, 2019d). In the P21 framework, essential competencies for the 21st century are divided

into sub-factors: Learning and Innovation Skills; Life and Career Skills; Information, Media and Technology Skills (BattelleForKids, 2019a; BattelleForKids, 2019b; Trilling and Fadel, 2009).

- Learning and Innovation Skills help people keep up with their complicated life in the 21st century. These are creativity, critical thinking, problem-solving, communication and collaboration, and innovation skills.

- Life and Career Skills contain self-management skills, leadership, social and cross-cultural skills, flexibility, liability, adaptability, and also being innovative and productive. They are significant for people to adapt to their work and social environment.

- Information, Media and Technology Skills contain information literacy, media literacy, and ICT (Information and Communication Technology) literacy.

Information, media, and technology skills have a significant place in the P21 Framework for 21st-century learning (BattelleForKids, 2019a). In recent years, educators have begun to utilize technology frequently because they need it to keep up with their changing environment and to support their students in adapting to the demands of a rapidly improving world (Mishra & Koehler, 2006; Blackwell, Lauricella & Wartella, 2016; Shafie, Majid & Ismail, 2019; Altun, 2019). That is why instead of focusing on whether educators use technology or not, focusing on the way they use technology is more critical (Mishra & Koehler, 2006; Blackwell, Lauricella & Wartella, 2016). Voogt and McKenney (2017) and Altun (2019) claim that integrating technology into education can lead teaching to have a more complex and multidimensional structure. By taking this complexity into account, Mishra and Koehler (2006) evolved the framework of Technological Pedagogical Content Knowledge (TPACK) to integrate technology into education. As supported, teaching is a complicated cognitive skill that primarily requires teachers' pedagogical and content knowledge (Mishra & Koehler, 2006). TPACK is a theoretical framework related to teachers' combined skills, competencies, and roles in incorporating technology into the educational process (Koehler & Mishra, 2009).

TPACK helps educators to understand how educational technologies interact with Pedagogical Content Knowledge (PCK) to teach effectively by supporting their professional development (Mishra and Koehler, 2006). TPACK occurs with the interactions of three core components, which are pedagogy, content, and technology knowledge. It is the knowledge of using technologies in the educational environment to create meaningful learning and teaching processes in terms of content, students' development levels and interests, and the teaching environment. In the TPACK framework, a general definition was used to define technology due to rapidly improving technology (Koehler & Mishra, 2009). In the current study, it will be used similarly to be inclusive.

When the literature was examined on these topics, the researcher realized that there already had been a few amounts of studies exist on in-service early childhood educators' 21st-century skills and TPACK, but the studies focused on examining them regarding various variables like educators' age, years of experience, education level, and training attendance were also not much. To illustrate, Çoban and İnan (2020) researched in-service early childhood educators' creativity, which is a sub-skill under Learning and Innovation skills, based on educators' self-assessment regarding gender, age, year of experience, type of graduated high school, hometown, education status of parents, parents' occupation and reading habits of educators. Nevertheless, they did not investigate the educators' 21st-century skills altogether. Furthermore, Özdurak Sıngın and Gökbulut (2020) investigated whether the educators' techno-pedagogical competencies differ regarding their education level (undergraduate or graduate) and their professional seniority. However, it would be optimal to conduct more studies with in-service early childhood educators regarding these variables.

Additionally, although there were more studies than other variables related to the influence of training on educators' 21st-century skills and TPACK, most of them were qualitative studies. Therefore, they were not examining the effects of pre-service or in-service training on educators' skills and knowledge. Pre-service and in-service training for improving 21st-century skills and TPACK of educators is essential. Teo, Unwin, Scherer and Gardiner (2021) pointed out that technological enhancements affect the educational system as much as other systems, and it means that professional

development programs should be adapted to this enhancement so that educators can fulfill changing academic demands. Bozkurt (2020) stated that when the literature was reviewed, there was no comprehensive research or project on how to support the 21st-century skills of educators. Moreover, Teo et al. (2021) remarked a similar point by stating there is little information about how training programs in the universities support pre-service educators in increasing their 21st-century skills, although it is a highly critical topic for the current century.

In addition to training for 21st-century skills, the significance of training on TPACK of educators was emphasized to have qualified educators. However, this topic is needed to be discussed in detail to improve appropriate professional training programs, such as pre-service training programs (Kaya & Yılayaz, 2013). Bayrak and Bayrak (2021) supported this point by remarking that the content of in-service training programs is needed to be developed since they are insufficient.

All in all, these two topics are vital for the development of educators, but they need more research and emphasis to improve educators' skills and knowledge. In this era, when the importance of having educators who have 21st-century skills and know how to integrate technology into education is considered, this study was conducted as a preliminary study.

1.1. Purpose of the Study

This study aims to examine the general characteristics of early childhood educators regarding their 21st-century skills and technological pedagogical content knowledge (TPACK) level as a preliminary study since there were a few studies in this area, the purpose of this study was to investigate whether these two areas should be explored in detail or not and to investigate the potential association between the 21st-century skills and TPACK of in-service early childhood educators. In this regard, the present study explores the following research questions:

R.Q.1. What are the 21st-century skills of in-service early childhood educators?
1.1. Is there a difference in 21st-century skills of in-service educators regarding age?

1.2. Is there a difference in 21st-century skills of in-service educators regarding years of experience?

1.3. Is there a difference in 21st-century skills of in-service educators regarding education level?

1.4. Is there a difference in 21st-century skills of in-service educators regarding training attendance on 21st-century skills?

R.Q.2. What is the TPACK levels of in-service early childhood educators?

2.1. Is there a difference in TPACK levels of in-service educators regarding age?

2.2. Is there a difference in TPACK levels of in-service educators regarding years of experience?

2.3. Is there a difference in TPACK levels of in-service educators regarding education level?

2.4. Is there a difference in TPACK levels of in-service educators regarding training attendance on technology usage in education?

R.Q.3. Is there any relationship between 21st-century skills (Learning and Innovation Skills; Life and Career Skills; Information, Media and Technology Skills) and TPACK of in-service early childhood educators?

3.1. Is there any relationship between the 21st-century skills and TPACK of in-service early childhood educators?

3.2. Is there any relationship between the sub-factors of 21st-century skills and TPACK of in-service early childhood educators?

3.2.1. Is there any relationship between Learning and Innovation Skills and TPACK of in-service early childhood educators?

3.2.2. Is there any relationship between Life and Career Skills and TPACK of in-service early childhood educators?

3.2.3. Is there any relationship between Information, Media and Technology Skills and TPACK of in-service early childhood educators?

1.2. Significance of the Study

In the recent era, technology has improved faster than in previous times (Marope, 2017). Individuals have to be competent to fulfill the demands of the rapidly changing world. Considering these circumstances, educators' capabilities are critical because they will prepare students for the complex world and the unknown future (WEF, 2016; Shafie, Majid & Ismail, 2019). Only after children are supported with essential skills and knowledge in line with the conditions of the era, can they be irreplaceable and skilled enough when there will be more advanced technological inventions that do most of the work instead of people (Shafie, Majid & Ismail, 2019).

Teachers are seen as leaders in educational changes by having various roles like being guidance, facilitator, advisor, instructor and also technology manager (Lee & Reigeluth, 1994). If teachers do not have sufficient 21st-century knowledge and skills themselves, they cannot support their students' improvement for the 21st century (Subramaniam, 2013; Voogt & McKenney, 2017; Valtonen, Sointu, Kukkonen, Kontkanen, Lambert & Mäkitalo-Siegl, 2017; Shafie, Majid & Ismail, 2019). Consequently, we should examine the gap between the current capabilities of educators and which skills educators need to have so that they can support children to be ready for the future (Lee & Reigeluth, 1994).

With the help of this study's results, the general state of the 21st-century skills of early childhood educators is detected. Besides, the difference in the 21st-century skills of educators regarding age, years of experience, education level, and training attendance is discovered. There are few previous studies about this topic, therefore, this study conducted as a preliminary study to provide an initial step for more detailed research on educators' 21st-century skills. If educators' 21st-century skills are focused, and educators are encouraged to develop their competencies, we can have more capable educators to prepare children for the unknown future. As Benner and Hatch (2010) point out, educators should gain these skills themselves, and then we can expect them to support their students' 21st-century skills by beginning from the early years.

As the new generation grows up with the technology and will depend on it throughout their lives, so educators need to integrate technology into education instead of only using traditional methods (Ferrari, Punie & Redecker, 2012). Previous research studies indicate that educators could use technology in their daily lives. However, due to its complexity, they can have some difficulties while integrating technology into the educational process (Koehler & Mishra, 2009; Altun, 2019; Voogt, Tilya, & van den Akker, 2009; Liang, Chai, Koh, Yang & Tsai, 2013; Voogt & McKenney, 2017). Thus, how teachers integrate technology into education gains more importance than what teachers know about technology. Jones and Moreland (2004) stated that there is a positive correlation between educators' TPK and students' success. Thus, when broadening out the concept a bit, this leads us to teachers' TPACK (Koehler & Mishra, 2009; Blackwell, Lauricella & Wartella, 2016).

By investigating how early childhood educators evaluate their TPACK in this study, an opportunity is provided to see whether educators believe they are good at integrating technology into education or not. Moreover, differences in the TPACK of educators regarding age, years of experience, education level, and training attendance are examined. Therefore, the study can be used to increase the technology usage in the educational process by supporting educators according to the analysis results. Additionally, the scarcity of studies on 21st-century skills and the TPACK of in-service early childhood educators draws attention when literature is examined. This study contributes to the literature related to in-service early childhood educators with data collected from 382 early childhood educators in Ankara, İstanbul, and İzmir.

Moreover, when the scales are examined to assess educators' 21st-century skills, it is seen that although there are some scales for evaluating pre-service educators' 21st-century skills, there is no comprehensive scale developed to investigate the 21st-century skills of in-service educators. The adaption of the 21st-Century Skills Scale (Anagün, Atalay, Kılıç & Yaşar, 2016) from pre-service educators to in-service early childhood educators is provided with the help of the current study.

Both 21st-century skills and the TPACK of educators are crucial for preparing children to cope with complex life situations in the future (AACTE & P21, 2010; Valtonen et

al., 2017; Mtebe & Raphael, 2018). However, a handful of studies highlighted the relationship between 21st-century skills and technological pedagogical content knowledge (TPACK). Some studies imply that there is a kind of relation between them. Valtonen et al. (2017), Mtebe and Raphael (2018), and Başaran (2020) focused on 21st-century skills by combining them with TPACK. They point out that educators should learn how to integrate 21st-century skills into TPACK because technology usage in education can support children to gain 21st-century skills, and the pedagogical component of TPACK is connected with 21st-century skills. Moreover, WEF (2015) states that educational technology might be an excellent helper in supporting children to gain 21st-century skills. Smith, Burrow, Fite, and Guerra (2016) support that view by remarking that technology integration into early childhood education is crucial for encouraging the enhancement of the children's 21st-century skills in the technology-oriented era. Besides, generally, studies highlight that technology-related skills are the core of 21st-century skills and essential for children's education (Ferrari, Punie & Redecker, 2012; Karakoyun & Lindberg, 2020).

On the other hand, these studies do not indicate how the various 21st-century skills of educators and TPACK are connected. The current study investigates whether there is any relationship between the 21st-century skills and the TPACK of in-service early childhood educators. They are two significant subjects to support educators in preparing children for the future. The connection between the 21st-century skills and the TPACK of in-service educators can help us to notice the nature of the mutual relationship between 21st-century skills and TPACK. Therefore, educators' professional development can be directed according to their connection in further studies. Moreover, this study can inspire people to focus on their association in future research studies to create different scales for better integration of educators' 21st-century skills and TPACK.

1.3. Definition of Terms

21st-Century Skills: These skills contain three sub-groups. They are Learning and Innovation Skills (learning to learn, thinking critically and problem-solving, communication and collaboration skills, creativity and innovation), Life and Career

Skills (self-management skills, leadership skills, social and cross-cultural skills, flexibility, liability, adaptability, and also being innovative and productive) and Digital Literacy Skills (ICT literacy, information literacy and media literacy) (Trilling & Fadel, 2009).

Technological Pedagogical Content Knowledge (TPACK): Emerges from the interactions of three core components: pedagogy, content, and technology knowledge. It is the knowledge of using technologies in the educational environment to create meaningful learning and teaching processes in terms of content, students' development levels and interests, and the teaching environment (Koehler & Mishra, 2009).

CHAPTER 2

LITERATURE REVIEW

The literature review provided information about the theoretical structure of the study, 21st-century skills, and TPACK. After the theoretical structure was shared, different frameworks for 21st-century skills and previous studies on 21st-century skills were discussed. Later, the historical development of TPACK and prior studies related to TPACK was presented.

2.1. Theoretical Background of the Study

Technology leads to rapid changes in people's thinking, living, and working to adapt to the world's new requirements (Griffin, Care & McGaw, 2012). By thinking that point, preparing children for the future is highly related to Ecological System Theory. All ecological system layers should be prepared for the change when we place children in the center of this system to help them adapt to the world of the 21st century (Herselman, Botha, Mayindi & Reid, 2018).

Ecological System Theory was developed by Urie Bronfenbrenner. The theory supports that individuals live in a complex system affected by different factors that have a mutual relationship, so people's development cannot be identified only by looking at one factor. Various factors like family, neighbors, school, political and economic factors, and the interaction of these factors should be taken into consideration (Bronfenbrenner, 1979; Conkbayir & Pascal, 2014; Buchanan, 2020).

The theory consists of five system layers: microsystem, mesosystem, exosystem, macrosystem, and chronosystem. The first system layer is the microsystem, which includes the smallest and the immediate environment of a person. For instance, family,

friends, school, and neighborhood take place in this system (Bronfenbrenner, 1979; Conkbayir & Pascal, 2014; Lerner, 2005). Navarro and Tudge (2022) pointed out that Bronfenbrenner's ecological theory emphasized only the physical environment. On the other hand, virtual environment also should be added to the microsystem layer because the complexity of technology usage is added into the system. Both of them have its own unique features. To illustrate, virtual microsystem has features like permanency, synchronous and asynchronous communication, replicability and availability. Therefore, these characteristics influence the relationship between two different microsystems. The mesosystem is the second layer. In this one, there is the interaction between different microsystems. The third system is the exosystem, in which there are people and places that influence individuals indirectly (Conkbayir & Pascal, 2014; Lerner, 2005). In the digital era, many conditions can influence young children indirectly and lead them to virtual microsystems (Navarro & Tudge, 2022). The fourth layer is the macrosystem. It is the largest surrounding, including beliefs, cultural values, educational, political, and economic contexts. The final system is the chronosystem, which indicates the passage of time and life-changing events (Bronfenbrenner, 1979; Conkbayir & Pascal, 2014; Lerner, 2005).

People affect their environment as much as different systems affect people (Conkbayir & Pascal, 2014). Mutual relations of people with various system structures lead individuals to develop themselves (Lerner, 2005). When we look at the chronosystem, time is changing, and technological developments affect the required competencies of children for the future. Therefore, this change impacts the children-educators connection and usage of technology in education (Herselman, Botha, Mayindi & Reid, 2018).

By considering the influence of the interactions, we can point out that the enhancement of early childhood educator's 21st-century skills and technological pedagogical content knowledge is essential for supporting children effectively because if educators do not have sufficient 21st-century knowledge and skills, they cannot support their students' improvement for the 21st century (Voogt & McKenney, 2017; Valtonen, et al., 2017; Mtebe & Raphael, 2018; Shafie, Majid & Ismail, 2019).

2.2. 21st Century Skills

Along with the developing technology, the requirements of the world have been changing rapidly, which has influenced especially the job market. Thus, many jobs are at risk of disappearing in the future. This situation leads people to identify essential skills and competencies to be more active and effective in the knowledge-based economy. Identified skills were used before the 21st-century, but they have gained more importance in the last decades than in previous times (Karoly, 2004; OECD 2005; Voogt & Roblin, 2012) because requisite capabilities for personal life, academic life and workplaces in the 21st-century are different than emphasized skills in the 20th-century (Dede,2010). That is why these skills were named 21st-century skills, especially in the USA (Karoly, 2004; OECD 2005; Voogt & Roblin, 2012). However, they also have other names in various resources, like "lifelong learning competencies" and "key competencies" in OECD and European Union countries (Voogt & Roblin, 2012).

2.2.1. Different Frameworks for 21st Century Skills

When 21st-century skills are mentioned, the characteristics of the period can be listed as general and not connected with specifically one area, being multidimensional by including various knowledge and skills, and also being linked with higher-order thinking skills- which help people to deal with complex and unpredictable situations (Voogt & Roblin, 2012). For these reasons the term 21st-century skills remains an umbrella definition. There are many frameworks related to these that slightly change from one organization to another (Dede, 2009; Binkley, Erstad, Herman, Raizen, Ripley, Miller-Ricci & Rumble, 2012; Voogt & Roblin, 2012). These different frameworks can be listed as the Organization for Economic Cooperation and Development, En Gauge, the American Association of Colleges and Universities, Assessment and Teaching of 21st Century Skills (ATCS), International Society for Technology in Education (ISTE), and the Partnership for 21st-Century Skills (Dede, 2009; Voogt & Roblin, 2012).

The Organization for Economic Cooperation and Development (OECD) started to evaluate the effectiveness of education via the Program for International Student Assessment (PISA) in 1997. According to the report published in 2005, OECD recognized that lifelong learning has begun to be more significant with the changing demands of the era. By considering this, OECD extended PISA with the OECD's Definition and Selection of Competencies (DeSeCo) Project to examine students' knowledge, skills and new competencies in addition to their self-concept, attitude, motivation to learn, and learning tactics (OECD, 2005). This shift indicates that the capabilities of individuals gained more value with the information age to provide for their adaptation to complex demands (Griffin, Care & McGaw, 2012). Therefore, the DeSeCo Project created a framework to classify key competencies into three different categories for individuals to be successful in today's world (OECD, 2005). These are about Using Tools Interactively, Interacting in Heterogeneous Groups, and Acting Autonomously (OECD, 2005; Dede, 2009).

Although all these categories have a different and specific focus, they are correlated with each other at individual and social levels. At the same time, they are valuable for both economic and social aims. Firstly, "Using Tools Interactively" contains the abilities of interactive and practical usage of socio-cultural and technology tools. While socio-cultural tools are related to literacies, mathematical skills, and critical thinking; technological tools include more than fundamental technical abilities such as efficient usage of hardware, software, and the Internet. Secondly, "Interacting in Heterogeneous Groups" is associated with soft skills or social skills, and it refers to good communication, cooperation, collaboration, problem-solving, and management skills. Finally, "Acting Autonomously" is related to being aware of the environment around oneself and managing their life responsively and meaningfully. It includes understanding the system in which people live, carrying out personal plans or projects, and also defining and defending one's own interests, necessities, and rights (OECD, 2005).

In 2002, the North Central Regional Educational Laboratory (NCREL) prepared the EnGauge framework related to 21st-century skills for education, business, and all other

people who live in the digital age. Eight different national sets of capabilities and feedback on education were collected via surveys and focus groups and then examined to decide on 21st-century skills in the EnGauge framework (Lemke, 2002). After this examination, the EnGauge framework on 21st-century skills was created by grouping critical capabilities into four sections: Digital-Age Literacy, Inventive Thinking, Effective Communication, and High Productivity (Lemke, 2002; Dede, 2009).

The first section is "Digital-Age Literacy". It includes fundamental literacy skills, like speaking, listening, reading and writing, but also advanced literacy skills such as scientific, digital, visual, and information literacy to find, analyze and understand complicated information, images and new technological developments. Additionally, it is related to cultural awareness and literacy since technological advances increase multicultural communication at the global level. The second section is "Inventive Thinking", which means being curious, creative, open to taking risks, and adaptive; having good management skills, critical thinking, and problem-solving abilities in complicated situations. The third section is "Effective Communication". It refers to capabilities related to interactive communication, cooperative and collaborative working, being responsible, and behaving ethically. The final section is "High Productivity," which is generally associated with workplaces instead of schools. It is about being able to decide priorities, plan and manage projects by focusing on the primary purpose, selecting the most appropriate tools to solve real-life problems and creating good quality products (Lemke, 2002).

According to the report published by Schneider in 2015, the American Association of Colleges and Universities defined necessary 21st-century skills for higher school graduates in four categories. These are Knowledge of Human Cultures and the Physical and Natural World, Intellectual and Practical Skills, Personal and Social Responsibility, and Integrative and Applied Learning. The first category is "Knowledge of Human Cultures and the Physical and Natural World", which is related to having good knowledge of natural, social and applied sciences, respecting various cultures and values, and having intercultural skills. The second one is "Intellectual and Practical Skills". It contains written and verbal communication, group working, critical thinking and problem solving, creativity, research and technological skills, and

information literacy. Another one is “Personal and Social Responsibility”, which refers to decision making, conflict solving, community, ethical and democratic knowledge. The final category is “Integrative and Applied Learning”, which composes of using gained knowledge and skills in various settings (Schneider, 2015).

The Assessment and Teaching of 21st Century Skills (ATCS) project produced a list of necessary skills for 21st-century living that was developed by examining different frameworks from various counties that can use this list of skills while deciding on new educational standards. These skills are arranged under four groups which are Ways of Thinking, Ways of Working, Tools for Working, and Living in the World (Binkley et al., 2012). “Ways of Thinking”, which is about creativity, problem-solving, critical thinking, making decisions, metacognition, and learning how to learn. “Ways of Working” includes social skills like communication and cooperation, “Tools for Working”, refers to information and digital literacy, and “Living in the World” concerns personal and career life, citizenship at both local and global levels, and people’s responsibilities (Binkley et al., 2012).

The International Society for Technology in Education (ISTE) created an ICT-focused framework for 21st-century in 2007. This framework includes six main categories: Creativity and Innovation; Communication and Collaboration; Research and Information Fluency; Critical Thinking, Problem Solving and Decision Making; Digital Citizenship; and finally, Technology Operations and Concepts (ISTE, 2007). The first category is “Creativity and Innovation”, which is about using existing knowledge and skills in various situations and creating original ideas and products. The second one is “Communication and Collaboration”. It is related to having an excellent digital communication and collaboration environment at an individual and global level. Another category is “Research and Information Fluency”, which consists of the practical usage of digital tools for collecting, planning, analyzing, evaluating, and benefiting from the information. The fourth category is “Critical Thinking, Problem Solving and Decision Making”. It is related to detecting and investigating problems, gathering and examining data about issues, creating a plan, and making decisions to solve them. The fifth category is “Digital Citizenship”. This refers to understanding secure, legal, and liable usage of digital devices and being responsible

for lifelong learning. The final one is “Technology Operations and Concepts”, which means understanding technology-related concepts and using technological devices and digital tools/systems effectively (ISTE,2007; Dede, 2009).

Partnership for 21st Century Learning (P21) has formed the 21st-century learning framework with an integrated and collective structure. The P21 Framework for 21st-century learning was created with the support of various educators, experts, and business people to specify necessary knowledge and skills according to students’ needs to succeed in their daily and business lives. It includes core subjects, 21st-century themes, and skills. While core subjects refer to traditional matters such as writing, reading, language, math, science, and so on, 21st-century themes mean topics like ecological literacy, global awareness, and monetary literacy. In addition to these, the essential skills in the 21st-century are divided into three sub-groups: Learning and Innovation Skills; Information, Media and Technology Skills; Life and Career Skills (Trilling & Fadel, 2009; BattelleForKids, 2019a; BattelleForKids, 2019b).

- Learning and Innovation Skills include mostly referred skills among other 21st-century skills. These are learning to learn, creativity and invention, critical thinking and problem-solving skills, and communication and collaboration skills.

- Life and Career Skills are required for people to adapt to their work and social environment. They contain self-management skills, leadership, social and cross-cultural skills, flexibility, liability, adaptability, and also being innovative and productive.

- Information, Media, and Technology Skills contain information literacy, which is about reaching, assessing, using, and operating information appropriately and efficiently. Besides, media literacy is related to analyzing written or visual messages correctly and creating media tools; while ICT literacy is regarding using digital/ technological tools effectively and ethically to research, access, organize, communicate and evaluate.

In this research, the P21 Framework for 21st Century Learning is used as a primary framework after examining the compatibility of all frameworks mentioned above on 21st-century skills for early childhood education. The P21 team emphasized that educators who work with young children should also integrate 21st-century skills into children's learning programs by stating that their brain's capacity for learning is around twice that of adults and early experiences have a high effect on their brain development (BattelleForKids, 2019d). Therefore, experiences in using 21st-century skills will be helpful for young children both in their daily lives, academic lives (BattelleForKids, 2019c), and later years to adapt to the changing world efficiently (WEF, 2016). As a result, the P21 Framework for 21st Century Learning seems the most appropriate one for using in this research with early childhood educators.

2.2.2. Previous Studies on 21st Century Skills and Education

In this part, education-related studies on 21st-century skills were shared. Firstly, research studies related to early childhood education (ECE) were given. Then, studies related to other educational contexts were mentioned.

2.2.2.1. Previous Studies on 21st Century Skills in Early Childhood Education

While examining studies related to early childhood education, it was noticed that there are fewer studies on this topic than in other educational contexts. Among the previous studies, some studies investigated whether 21st-century skills differed in regard to some independent variables, like age and education level, as it was aimed in the current study.

Eğmir and Çengelli (2020) conducted a study to examine the prediction power of educators' 21st-century skills to use reflective thinking. Data collection was done with two scales: the "21st Century Teaching Skills Scale" and the "Teachers' Skills of Using Reflective Thinking in Learning and Teaching Process Scale". 308 teachers working in early childhood education, primary, middle and high school in Afyonkarahisar have attended the study. The study findings indicated that teachers

evaluated their own 21st-century teaching skills and reflective thinking ability high. Additionally, it was founded that there was a significant positive correlation between educators' 21st-century teaching skills and using reflective thinking. While both of them did not change significantly according to the gender of teachers, some significant changes were detected according to working experience, branch, and education level in which teachers work. It was noticed that early childhood educators have higher 21st-century teaching skills than other teachers. Besides, the research results showed that five sub-groups of teachers' 21st-century teaching skills all together explained 66% of the change in their ability to use reflective thinking. However, it was apparent that management skill was the primary variable in predicting teachers' ability to use reflective thinking.

Çoban and İnan (2020) researched in-service early childhood educators' creativity levels based on self-assessment and differences in their creativity regarding characteristics of individuals (gender, age, type of graduated high school, hometown, education status of parents, parents' occupation, reading habits of teachers and year of experience), preferred educational methods, used assessment types for children, and preferred activities. Quantitative data were collected from 85 in-service early childhood educators who worked in public schools in Uşak. The analysis results showed that in-service teachers believed that they were creative. Moreover, activity preferences affected the creativity level. It was noticed that teachers who stated their creativity higher preferred drama more. Other than this difference, significant differences could not be found regarding various factors.

Karaca, Akyol, Karaca and Can Yaşar (2016) designed research to explore the changes in the pre-service early childhood educators' problem-solving skills and self-respect regarding gender, grade level, the graduated high school, and education level of their parents. Data were collected from 313 pre-service teachers via Demographic Information Form, Problem Solving Skill Scale, and Self Respect Scale. The study findings demonstrated that female pre-service teachers had better self-respect than males. However, any investigated factors (gender, grade level, type of the graduated high school and education level of their parents) did not lead to differences in their

problem-solving skills. Additionally, a positive correlation was found between problem-solving skills and self-respect of pre-service early childhood educators.

Ghani, Lah, Mat, Rahman, Sulaiman and Mustafa (2020) conducted a study to test pre-service early childhood educators' ability to be multimedia program builders. Data were collected from 14 participants during digital program creation workshops in a limited time. Analysis of pre-service teachers' ability development progress was made in three different stages. In the first stage, unstructured interviews were conducted with pre-service early childhood teachers before workshops. In the second one, the researchers interviewed participants about basic technology design like using image programs after the workshop. Finally, after another workshop, the last interview was done with pre-service teachers about advanced technology design, such as designing interactive programs. The researchers investigated how workshops influenced creativity and critical thinking, among other 21st-century skills. The study findings represented that pre-service early childhood teachers were capable of creating multimedia programs and using their imagination and critical thinking skills if the opportunity was given.

Akcanca (2020) investigated pre-service early childhood educators' attitudes respecting Problem-Based Learning (PBL), and how STEM Education affected the prediction of their mastery perception of the 21st-century skills. 284 pre-service early childhood educators attended this research, and the researcher used three different scales which were the "21st-Century Skills and Competencies Scale", the "STEM Education Attitude Scale" and the "Problem-Based Learning Attitude Scale". The collected data were analyzed by applying multiple linear regression analysis. Based on the results, pre-service teachers' attitudes about PBL and STEM Education had a reasonable and worthwhile correlation with mastery perception of 21st-century skills. Besides, 20 percent of mastery perception of 21st-century skills could be explained by pre-service teachers' attitudes about PBL and STEM Education. Moreover, it was recommended that both pre-service and in-service teachers could be engaged with various and innovative educational approaches such as Problem-Based Learning and STEM Education, which focus on the development of 21st-century skills so that they can create better learning settings.

Other than the mentioned quantitative studies in early childhood education, generally, qualitative studies or studies with young children were conducted at the early childhood level. Kardeş (2020) carried out a case study to explore the pre-school teachers' points of view related to young children and digital literacy, which is one of the critical 21st-century skills. The researcher interviewed 20 early childhood educators who pointed out that improving children's digital literacy provides an advantage for children and makes a contribution to their development. Aside from giving education about digital literacy appropriate pre-school settings should be provided for children so that they can use technological devices safely, play games, and engage with books.

Rentzou (2021) investigated how in-service teachers in Cyprus evaluated their pre-school class environment to support 21st-century learning, fulfill young children's needs, and improve 21st-century skills. Data were collected from 34 participants in 2017 via an online questionnaire created by the researcher. Teachers reported that the quality of pre-school classroom settings was at the medium level as they were more like a traditional learning environment that did not encourage children to feel like they belonged there and nor did it provide a sense of privacy, integrity, and an organized setting. Considering these shortfalls, the researcher emphasized that further studies should be conducted.

Sylva, Sammons, Melhuish, Siraj and Taggart (2020) investigated whether the quality of pre-school activities affects children's 21st-century skills or not. More than 2,800 children in England attended the study as participants, and the researchers followed them from the approximate age of 3 until they were 16 or 18 years old. Two environmental rating scales were used to assess the quality of the educational process in 141 pre-school centers. The results showed that quality education contributed, especially to the children's self-regulation and pro-social behavior, which are seen as vital 21st-century skills.

Zviel-Girshin, Luria and Shaham (2020) examined how providing robotics education in early childhood and elementary education influenced children's self-esteem about

technology usage, technological thinking ability and crucial 21st-century skills. Their own teachers gave robotics education to children. 84 pre-school children and 113 children from first grade attended the program. The researchers collected data via observation at the beginning, survey, and interview. The study findings indicated that the program encouraged both girls and boys to continue robotics in later years by reducing the gap between girls and boys in technology, engineering and science areas because it helped children to increase their self-sufficiency and self-confidence, to enhance their positive attitude towards technology, engineering and science, to improve their ability of group-working and to create innovative things.

Cekić-Jovanovic, Stepıć, and Miletić (2020) carried out a study to examine Serbian pre-service pre-school teachers' attitudes about using digital technologies in education and whether saw possibilities for using digital technologies. 57 of the participants were undertaking a three-year program of vocational studies at teacher education colleges, while a further 68 pre-service teachers were attending a four-year program of academic studies at a faculty of education. The "Digital Competence of Educators" scale was used as a self-assessment tool. Participants attending the academic program were found to have more positive attitudes towards using digital technologies. Overall, the majority of students thought it possible to deploy digital technology in the educational process in early childhood.

Woods-Groves and Choi (2017) carried out research to examine the early childhood educators' evaluation of their students' 21st-century skills by measuring their academic and behavioral performance in the classroom. These 21st-century skills included persistence, curiosity, social-emotional behaviors, and critical thinking abilities. The researchers worked with 31 pre-school teachers and 579 students, whose ages were between 5 and 7, by collecting data during the first six months of school for two years. Data were collected each year via the Human Behavior Rating Scale (HBRS): Brief, behavioral assessments, student office discipline referrals (ODRs), educational performances, and records of students' absences. According to analysis with the Hierarchical linear model, persistence and problem-solving behaviors of kindergarteners were highly connected with educational performances. Besides, Teachers' evaluations of children's perseverance, inquisitiveness, and interpersonal

skills were predictive of their annually recorded behavioral assessments. At the same time, teachers' interpersonal skills evaluation was also highly correlated with ODRs. Moreover, the findings of this study supported the effectiveness of examining the point of view of teachers about the 21st-century skills of pre-school students.

2.2.2.2. Previous Studies on 21st Century Skills in Educational Contexts Other than Early Childhood

Some previous studies were conducted in other educational contexts in addition to early childhood education. Some of these studies also examined whether 21st-century skills differed regarding independent variables, like education level, and taken education, as it was aimed in the current study with in-service early childhood educators.

Haviz, Maris, Adripen, Lufri, David, and Fudholi (2020) applied a survey to pre-service teachers in the department of mathematics, physics, biology, and chemistry so that they could examine their perceptions about thinking, acting, and living (TAL) of 21st-century skills. 321 participants attended this study by filling out a questionnaire that included 16 indicators and 78 statements related to TAL of 21st-century skills. After various comparisons were made, the research findings indicated that 21st-century skills of pre-service teachers in Indonesia were at level 2 while they should be around level 6-7. Besides, the appearance of 21st-century skills was not correlated with either department or gender of pre-service teachers. The research results represented that pre-service teachers' TAL level in mathematics was correlated with pre-service teachers in physics. In contrast, the TAL level of pre-service teachers in biology was associated with pre-service teachers in chemistry. After conducting this research study, the researchers recommended that suitable curriculums and methods should be used to increase the 21st-century skills of pre-service teachers in each department.

Cemaloğlu, Arslangilay, Üstündağ and Bilasa (2019) aimed to investigate the 21st-century skills perception of vocational high school teachers and examine their 21st-century skills in terms of various variables. The researchers collected data from 38 vocational high school teachers from 11 different fields in Ankara, Turkey, after

implementing 30 hours of training by using a 21st-century skills scale to conduct a one-shot case study. The study findings showed that teachers perceived their 21st-century skills at a high level. Furthermore, their perception of their 21st-century skills did not vary by gender, education level, or working experience. However, it was noticed that younger teachers assessed their "Learning and Innovation Skills" higher than other teachers.

Ciğerci (2020) investigated how digital storytelling influences the 21st-century skills of pre-service primary school teachers. The researcher decided to work on this research question because digital storytelling includes many 21st-century skills, from the preparation of stories to reading digital stories, like Learning and Innovation Skills, and Information, Media and Technology Skills. The "21st Century Skills and Competencies Scale", a rubric for digital storytelling, and structured individual interviews were used during the data collection process. In this mixed-methods study, quantitative data were collected from 42 pre-service teachers as pre-test and post-test and qualitative data were collected from 15 pre-service teachers. Post-test scores of pre-service teachers were higher than their pre-test scores. Moreover, when the three rubric scores of teacher candidates were compared, it was seen that the scores taken from rubrics increased over time. Therefore, the results of both scale and rubric supported each other. The rubric scores were a predictor of teacher candidates' 21st-century skills, and rubric scores explained variability in scale scores around 40%. Furthermore, the participants remarked that digital storytelling contributed to developing their 21st-century skills during the interview.

Atalay, Anagün, and Kumtepe (2016) conducted research to investigate how pre-service elementary school teachers use 21st-century skills in the slow-motion development process according to some particular criteria. 100 junior students from a university in Turkey attended the study (16 males, 84 females). The embedded single-case design was used in the research by creating slow-motion animations in four phases: the planning stage, storytelling stage, creation stage, and regeneration stage. Data was collected via open-ended questionnaires and student products. According to the study results, pre-service elementary school teachers mostly used their 21st-century skills in the planning process of slow-motion animations other than "Creativity

and Innovation" and "Entrepreneurship and Self-Direction". Moreover, when examining the Physical Events-related slow-motion animations of students according to some criteria, the researchers noticed that pre-service teachers used their 21st-century skills at different levels at each phase of the production process of slow-motion animations.

İsmail, Razali, Hashim, Abiddin, Masek, and Abd Samad (2021) aimed to examine educators' points of view about Problem Based Learning (PBL) and how this educational approach can increase 21st-century skills (Communication, Collaboration, Critical Thinking, and Creativity) of students. The researchers collected quantitative data from 60 educators using an online questionnaire in line with this purpose. The research findings indicated that students were more interested in the PBL method than the traditional educational method that improved their 21st-century skills. Besides, a strong association was detected between PBL and 21st-century skills. It meant that PBL could be helpful to have more capable graduates in the future. For this reason, the researchers hoped that further studies would be conducted to take students' attention to topics that will prepare them for the globalized world after graduation.

In addition to these previous studies, there were other studies that focused on some specific 21st-century skills, most of them concentrated on technology-related skills. Hung and Sitthiworachart (2020) conducted a study with 89 in-service teachers who worked in various levels (pre-school, primary school and high school) to explore teachers' points of view about creativity and its relation with technology. It was seen that there were both progressive teachers and teachers who had some difficulties in understanding the concept of creativity. The researchers declared that teachers believed that technology might be a good supporter of children's creativity even though it is not compulsory to be creative.

Akgül and Şahin-İzmirli (2021) carried out a study with 262 pre-service teachers on the association between their critical thinking and ICT-decoding skills, which was about comprehending an ICT experience based on past experiences. ICT-decoding skills included basic digital skills, advanced technical skills, security and social skills

in the digital environment, and coding skills. The researchers found that there was a moderate and positive relationship between them.

Valtonen, Hoang, Sointu, Naykki, Virtanen, Poysa-Tarhonen, Hakkinen, Jarvela, Makitalo and Kukkonen (2021) conducted longitudinal research by collecting data from pre-service teachers via questionnaire for three years (2014, 2015 and 2016) at three different universities in Finland. This research aimed to provide information about pre-service teachers' perceptions and dispositions related to 21st-century skills by focusing on three main areas: learning abilities, collaboration tendencies, and capabilities of ICT usage. According to findings, all these three areas of 21st-century skills showed different signs of progress. While learning abilities and collaboration tendencies indicated minor differences in annual assessments, capabilities of ICT usage showed a noticeable change in years. It was noticed that pre-service teachers began their university education with confidence in their learning abilities and a prominent tendency to collaborate. On the other hand, their confidence in ICT usage capabilities was lower than other two areas at the beginning of the university. The results demonstrated that learning abilities changed annually, but there were minimal differences in years. Moreover, collaboration tendencies did not highly alter in years, and it had negative change surprisingly, although there was a high emphasis on the significance of collaborative work. However, preparation courses in university became beneficial for developing capabilities about ICT usage in education, and pre-service teachers' responses altered positively and more than other two areas within years.

Bedir (2019) examined the thoughts and perceptions of pre-service English language (ELT) teachers on 21st-century learning and innovation skills, which were specially referred to as 4C skills (creativity, communication, cooperation, and critical thinking). The researcher worked with 124 pre-service teachers to collect quantitative data using customized surveys and 12 pre-service teachers to collect qualitative data using focus group interviews. It was found that most ELT teacher candidates perceived 21st-century learning as technology integration into the teaching environment. Additionally, their awareness and involvement in 4Cs were within limits, although their perception was high and positive. They described 4Cs in terms of educational perspective even though they could have diverse definitions in various contexts.

Moreover, they believed that the current curriculum did not emphasize 21st-century skills enough, but they had positive beliefs about the benefit of supporting the professional development of pre-service teachers on 4Cs.

Gürsoy (2020) aimed to detect the influence of digital storytelling on the point of view of pre-service science teachers by offering them an opportunity to create digital stories in the "instructional technologies and material development" course. This research was a mixed-method study and 50 pre-service teachers took place in this study by filling out a survey while 16 pre-service teachers attended the interview. Both quantitative and qualitative data indicated that digital storytelling positively impacted pre-service science teachers' 21st-century skills. The pre-service teachers believed that creating digital stories provided various advantages for them, such as meaningful and lifelong learning and increased motivation, but also had some disadvantages like spending long hours on the creation of stories and needing technological knowledge. Moreover, although digital storytelling posed some difficulties, pre-service teachers pointed out that most science-related subjects can be used to create digital stories. It was concluded that digital storytelling should be included in various courses to help pre-service teachers to improve their 21st-century skills and gain experience in the preparation of digital stories.

Nurhayati, Rizaldi and Fatimah (2020) conducted a qualitative study and reviewed the literature related to digital literacy and 21st-century skills to answer two questions. The first question was how the 21st-century skills of both teachers and students could be increased. The second one was whether digital literacy and STEM education affect the improvement of 21st-century skills of teachers and students. According to the study findings, it was noticed that digital skills were not exact factors that influenced students' advancement of 21st-century skills. However, they were supporting components for developing these skills which should have been introduced during school life. Multidisciplinary STEM education should be optimized in Indonesian schools to expect students to gain objectives related to 21st-century skills.

Moreover, some studies could be beneficial to see how to support the 21st-century skills of teachers. Karakoyun and Lindberg (2020) conducted research to discover the

pre-service teachers' views about 21st-century skills in Turkey and Sweden. Open-ended questions were asked to 116 pre-service teachers in Turkey and 81 pre-service teachers in Sweden. The study's findings indicated that pre-service teachers from both countries believed that 21st-century skills were generally connected with communication, technology, digital citizenship, and information literacy. Other than these mostly referred skills, pre-service teachers in Turkey gave importance to critical thinking and problem-solving skills, while pre-service teachers in Sweden emphasize information literacy and communication skills, among other 21st-century skills.

Smith, Burrow, Fite and Guerra (2016) investigated the knowledge and perception of pre-service teachers about integrating technology into early childhood education settings by designing this mixed-method study since technological support is highly significant to increasing students' 21st-century skills. The researchers collected data using a self-developed survey, which included close and open-ended questions and semi-structured focus group interviews. 88 pre-service early childhood teachers from a university in the southwestern United States attended the research in 2014. The study findings indicated that although pre-service teachers benefitted from technology in their daily lives and had a positive attitude about technology integration, they had many misconceptions about integrating technology into young children's education. Both qualitative and quantitative data analysis showed that the levels of misconceptions were changing. Also, most of them have already integrated technology into educational settings with unoriginal and teacher-directed instructions. That is why the research team suggested that teacher education programs should offer diverse examples related to technology integration into the academic environment of young children.

Kim, Raza and Seidman (2019) supported the significance of measuring the quality of teaching activities in a context-based manner to improve 21st-century skills. For this reason, the researchers focused on evaluating teachers' classroom activities by developing the Teacher Instructional Practices and Processes System (TIPPS), an instrument for class observation. They carried out this study in three different countries and school levels to have various contexts. The first validity and reliability study of TIPPS was conducted in Uganda with 197 secondary schools. TIPPS included 18

indicators, and these indicators were developed according to the contextual and cultural concept of Uganda. The second study was conducted in India with 256 primary classes. In this one, all the indicators of TIPPS for secondary school level were used in TIPPS for primary school, but some concrete examples were added to the indicators in addition to cultural adaptation of the instrument. To adapt TIPPS to the early childhood level, the researchers chose 317 pre-school classrooms in Ghana. More adaptation was made for the early childhood level. In addition to contextual changes for the pre-school level, they made some cultural changes. The researchers pointed out that if we want to have 21st-century learners, we should focus on teachers' 21st-century skills and their applications in the classroom. It is essential because school is an appropriate environment for students to observe the usage of these skills. Besides, if teachers are not aware of how to develop practical teaching activities which promote 21st-century skills, they cannot create appropriate models for their students.

Yılmaz (2020) carried out a study to investigate how technology integration influenced the pre-service teachers' multidimensional 21st-century skills, critical thinking, creativity, and academic achievements. Quantitative and qualitative data were collected from 144 pre-service teachers in early childhood education, elementary school education, and science education. The research was conducted in three phases. In the first phase, there was not any technology integration. In the second one, technology was integrated into education at a basic and medium level. However, technology was integrated at an advanced level in the third phase. To collect quantitative data, the researcher used five tools. The researcher developed the Academic Achievement Test and the Critical and Creative Thinking Test along with the Critical Thinking Standards Scale for the Teacher Candidates. The Multidimensional 21st-Century Skills Scale, Student's Perception Scale about Instructors Technology Integration Competence Scale were taken from other researchers. Additionally, semi-structured interviews, field notes, observations, the examination of pre-service teachers' assignments and projects, and their exam grades were used to collect qualitative data. The study findings represented that integrating technology made a positive change from the first phase to the third phase of the research in pre-service teachers' multidimensional 21st-century skills, critical thinking, creativity, and academic achievements.

Liesa-Orús, Latorre-Cosculluela, Vázquez-Toledo and Sierra-Sánchez (2020) examined the points of view of 345 professors from various departments in a university of Spain about using Information and Communication Technologies (ICTs) to make a contribution to the improvement of students' 21st-century skills. For this reason, the quantitative method was used by collecting data via an online survey for this descriptive study. The study's findings indicated that the university professors were aware of the significance of ICTs usage and took the positive impact of ICTs usage on the development of 21st-century skills into consideration while answering questions in the online survey, such as improvement of communication, cooperation, and problem-solving skills and so on. Moreover, it showed that professors' teaching experience and gender were affective on their perceptions and attitudes, unlike some other research. Briefly, the authors emphasized the importance of preparing appropriate lessons for a technological learning culture to encourage students to be ready for the 21st-century.

Sural (2017) aimed to represent the level of 21st-century skills of pre-service teachers and how much a faculty of education supported the development of pre-service teachers' 21st-century skills. Data collection was done by using a 5-Point Likert Survey, in which there were 50 items about the importance and ownership of three sub-groups of 21st-century skills. 293 pre-service teachers from the Counselling and Guidance Department, Special Education, English Language Teaching, and Computer Education participated in this quantitative study. Their education level ranged from 1st-grade to 4th-grade. The study findings indicated that pre-service teachers' awareness of the significance of 21st-century skills was high, but they believed that their 21st-century skills were insufficient. Besides, the researchers found out that the scores of 2nd-grade pre-service teachers related to the significance of 21st-century skills were significantly higher than 1st-grade pre-service teachers' scores, even though there were no differences in the scores of ownerships of 21st-century skills according to class levels. These results implied that education in the faculty of education was not sufficient to support pre-service teachers to increase their 21st-century skills. For them, the education system should be improved to holistically support pre-service teachers by integrating them into the educational environment.

Sherouk and Raad (2020) carried out a study to see how teacher educators in universities think and behave when they encounter six of the usual learning problems, especially in e-learning during the Covid 19 pandemic, since thinking and behaving successfully in unforeseen and complex conditions is one of the 21st-century skills. Data were collected from 75 teacher educators from universities in Iraq, Jordan, and Lebanon via an online survey. When the research findings were examined, it was recognized that teacher educators had some problems with needed skills to cope with learning problems. The results represented that Information and Communication Technology (ICT) can positively affect students' learning process if their teachers have improved digital literacy and know how to combine ICT with educational content. For this reason, the researchers recommended that teacher educators should be supported to enhance their 21st-century skills.

When the literature about 21st-century skills was reviewed, emphasis on technological skills could be realized quickly. However, when it comes to technology and its relation to education, it is a more complicated topic that needs to be explored on its own. For that reason, Technological Pedagogical Content Knowledge (TPACK) was explained in detail in the following part.

2.3. Technological Pedagogical Content Knowledge (TPACK)

In this part of the study, the historical development of the TPACK and the findings of previous studies related to early childhood education and other areas was mentioned in detail. Firstly, historical development of the Technological Pedagogical Content Knowledge (TPACK) was explained.

2.3.1. Historical development of TPACK

Throughout history, researchers have been attempting to answer questions about teaching, such as how educators manage the classroom, how they decide on topics, how they present issues to their students, and so on (Shulman, 1986). After Shulman

recognized that educators need complex knowledge and skills to teach effectively, he searched what kind of knowledge and skills are required. He noticed that both Content knowledge and Pedagogical knowledge are significant for the teaching process (Shulman, 1987). However, Shulman believed that only focusing on content or pedagogy is useless. Thus, he developed a conceptual framework for Pedagogical Content Knowledge (PCK) (Shulman, 1986). Shulman did not pay so much attention to integrating technology into PCK because the technology used in education was seen as commonplace at that time. However, since new digital technologies began to be used, educators started to struggle to integrate technology into the teaching process (Mishra & Koehler, 2006; Mishra & Koehler, 2009).

Mishra and Koehler (2006) broadened out the PCK of Shulman by adding technological knowledge (TK) to help educators to understand how educational technologies interact with PCK to teach effectively. Over five years of study on this issue, Technological Pedagogical Content Knowledge (TPACK) was developed. Mishra and Koehler (2006, 2009) stated that it includes three fundamental knowledge categories: pedagogy knowledge, content knowledge, and technological knowledge. Moreover, TPACK emphasizes the relations and interactions among them. Although content knowledge, pedagogical knowledge, and technology knowledge are the core of the framework, it also represents PCK, TPK (technological pedagogical knowledge), TCK (technological content knowledge), and TPACK.

Content knowledge (CK): It is the knowledge related to what educators need to know as topics for teaching (Mishra & Koehler, 2009). Shulman (1986) pointed out that educators' knowledge about thoughts, concepts, facts, frameworks, and theories takes place in CK. It is significant for educators since incorrect information can lead to misconceptions among students. That is why it is notable for educators to understand subjects correctly not to give inaccurate information to students (Mishra & Koehler, 2009).

Pedagogical knowledge (PK): Relates to the process, methods, practices, educational goals, and values of teaching and learning. Moreover, it includes how individuals learn knowledge and skills, how activity/lesson plans are developed, how classroom

management can be provided, how the learning environment can be designed, and how assessment and evaluation can be conducted (Koehler & Mishra, 2006).

Technology knowledge (TK): Due to rapidly developing technology, any definition of TK soon becomes outdated. For this reason, a meaningful explanation is to consider TK a way of thinking about technology and working with it as tools and resources (Mishra & Koehler, 2009).

Pedagogical content knowledge (PCK): Similar to Shulman's PCK, it arises from the integration of CK and PK. It helps people understand how specific subjects can be prepared, organized, presented and adapted to different learners' prior knowledge, abilities, and interests for better teaching (Mishra & Koehler, 2006). PCK is essential for the learning and teaching process since it is the core of the curriculum, assessment, pedagogy, and their combination (Koehler & Mishra, 2009).

Technological content knowledge (TCK): Emerges from the union of technological knowledge and content knowledge so that both are in a mutual relationship. While technology affects how we can present subjects by increasing the variability of presentation, content affects what kind of technology educators can use to transmit topics (Mishra & Koehler, 2009).

Technological pedagogical knowledge (TPK): With the integration of TK and PK, educators can use technology in the learning and teaching process. Moreover, it is crucial to see how the educational process can change with technology usage. It also includes which technological tools can be appropriate to use for pedagogical designs and strategies (Mishra & Koehler, 2006).

Technological Pedagogical Content Knowledge (TPACK): Emerges from the interactions of three core components: pedagogy, content, and technology knowledge. It is the knowledge of using technologies in the educational environment to create meaningful learning and teaching processes in terms of content, students' development levels and interests, and the teaching environment. It is based on teaching effectively with the support of technology by comprehending how to represent subjects with

technology; how to benefit from pedagogic methods to teach different contents; how to help students to face problems; how to strengthen already existing knowledge of students and build new concepts on them (Koehler & Mishra, 2009).

2.3.2. Previous Studies related to TPACK

In this part, the results of previous studies related to both early childhood education and other educational contexts were mentioned. First of all, early childhood education related studies were given.

2.3.2.1.Previous Studies on TPACK in Early Childhood Education

Among the previous studies, some studies investigated whether TPACK of early childhood educators differed with regard to some independent variables like age and years of experience, as it was aimed in the present study. These studies are mentioned below.

Sancar-Tokmak, Yavuz-Konokman and Yanpar-Yelken (2013) focused on the self-confidence of pre-service early childhood educators on TPACK. Besides, they examined whether the grade level or genders of the educator candidates have any influence on TPACK or not. 154 educator candidates who are sophomore, junior and senior at Mersin University participated in this quantitative research. The study findings revealed that pre-service educators had a high self-confidence on TPACK. Their TPACK level was not influenced by grade level or gender. However, it was noticed that only TK was different in terms of grade level and gender. Surprisingly, it was seen that females had higher TK scores than males. Additionally, senior educator candidates had higher TK confidence than sophomore and junior educator candidates. Lavidas, Katsidima, Theodoratou, Komis and Nikolopoulou (2021) investigated in-service early childhood educators' self-perception related to TPACK by carrying out a quantitative study. The researchers collected data from 147 Greek educators via a 5-Likert scale, which included 7 factors and 28 items. The study results indicated that educators evaluated each factor of the TPACK scale as neutral or more than 3 points.

It was seen that they considered their PK, CK and TCK a little higher than other factors. Besides, it was noticed that educators who took technology integration-related training improved their knowledge and abilities about TK and all interrelated factors. Moreover, younger educators perceived their TK higher than older educators, and it can be related to participating in pre-service or in-service ICT courses.

Liang, Chai, Koh, Yang and Tsai (2013) conducted a study named "Surveying in-service pre-school educators' technological pedagogical content knowledge". In this research, the TPACK survey was used to collect data after exploratory factor analyses for the validity and reliability of the survey. 366 Taiwanese early childhood educators participated in the research, and the results of the correlational study indicated that more experienced pre-school educators might be more resistant to technology usage in the educational process than others. Additionally, there was a positive relationship between the educational qualification of educators and the tendency to have knowledge related to technology integration into education.

Özdurak Sıngın and Gökbulut (2020) conducted a study by collecting data from 1,169 pre-school educators in Ankara. It was investigated whether the educators' techno-pedagogical competencies differ regarding their education level (undergraduate or graduate) and their professional seniority. The relational survey showed that early childhood educators had high techno-pedagogical competencies, and these were not related to their education level or professional seniority.

A recent research study about the TPACK of pre-service pre-school educators was conducted by Altun in 2019. 481 pre-service early childhood educators completed a cross-sectional survey used to investigate the contribution of digital literacy skills, technology attitudes and usage, and online reading comprehension strategies to TPACK. The study findings indicate that TPACK is associated with them, and all these variables explain 38% of the variance. While digital literacy skills were strongly associated with TPACK, online reading comprehension ability had a moderate association with TPACK. Moreover, the time of technology usage was a weak predictor of TPACK when we compared it with other variables. On the other hand,

pre-service educators' GPA and grade level did not associate with pre-service educators' self-reported TPACK scores (Altun, 2019).

In 2011, Chuang and Ho investigated the TPACK of 335 Taiwanese pre-school educators by collecting quantitative data via a translated and adapted instrument which was developed by Schmidt, Baran, Thompson, Mishra, Koehler and Shin in 2009. According to the findings, early childhood educators' three sub-domains (PK, CK and PCK) were better than other sub-domains of TPACK. Besides, the pre-school educators, who had more than ten years of working experience, assessed themselves better in the sub-domains of PK, CK and PCK. Additionally, the pre-school educators, who were older than others, had better PK and PCK; meanwhile, they did not have good TK according to their self-assessment. Therefore, results showed that while senior educators assessed their PK better than younger ones, younger pre-school educators assessed their TK better than older educators. Finally, the findings of this study indicated that educators who used ICT more frequently (more than 20 hours) considered their TK and TCK higher than educators who used ICT less regularly (less than 5 hours) (Chuang & Ho, 2011).

Blackwell, Lauricella and Wartella (2016) executed a study with 411 in-service early childhood educators who worked with children between the ages of 3 and 5 in various pre-school programs. The researchers collected data via an online survey to examine how TPACK contextual elements affected educator or child-centered tablet and computer usage of early childhood educators. These contextual elements were at the student level (student's income), the educator level (educator's attitude, beliefs, confidence and pedagogy) and the school level (support of the school). The findings indicated that elements of TPACK at the educator level, like the positive attitude of educators towards the use of technology, were the most influential factors for integrating technology into education other than the student's income or the school support. All in all, it was emphasized that focusing on contextual factors of TPACK is significant for both teachers, teacher educators and education policymakers to increase student-centered education and professional improvement models.

Other studies have also pointed out the importance of TPACK and the influence of different types of training on the TPACK of teachers. These include a recent study by Luo, Berson, and Berson (2020) that explored pre-service early childhood teachers' technology usage and technological self-efficacy during the teaching process. They conducted a case study in the central universities of China by collecting data from 55 pre-service teachers via an online survey which included five parts: demographic information, attitude towards working with young children, courses in university, final internship experiences, technological self-efficacy of pre-school teachers. The findings revealed that pre-service teachers had positive attitudes towards technology usage. However, they did not use technology in the teaching settings frequently because of some issues, which were having no course in their teacher preparation program that indicated how to use TPK effectively with young children, mostly focusing on teacher-centered technology usage. The researchers stated that if pre-service teachers had been supported, they would be able to use technology with greater self-confidence. The researchers therefore recommended that teacher preparation programs should be improved, and more opportunities should be offered to pre-service teachers to practice field-based technology usage.

Oakley (2020) carried out research to examine the points of view of 67 pre-service educators from the Primary and Early Childhood Department about using digital storybooks to teach literacy in early childhood education and investigate how using digital storybooks supports them in improving their TPACK. This mixed-method study ran from 2011 to 2015. The researchers collected data via an online quantitative survey, focus group meetings and reflections of pre-service educators, created digital stories and lesson plans. However, the primary source of information was a survey that included both open-ended questions and a Likert-scale. At the end of the study, the findings represented that the pre-service educators believed that creating digital storybooks and utilizing them in the teaching process is beneficial for educators to improve their TPACK while teaching literacy in early childhood education in addition to knowledge of educators related to students.

Kildan and Incikabi (2015) carried out research to explore how preparing digital stories influences the TPACK self-perception of the pre-service early childhood

educators. It was a quasi-experimental study. 13 pre-service early childhood educators took help to use digital tools for preparing digital stories. The data were collected via four instruments: demographic information form, open-ended questions before and after story creation process, and a TPACK diagram. The study findings revealed that preparing digital stories enhanced pre-service educators' TPACK. Additionally, it was seen that their focus changed from TPK, TCK, and PCK to TPACK after the study.

Sancar-Tokmak (2014) examined the perception of pre-service educators about their TPACK after they attended the "Instructional Technology and Material Design" course in which educative digital games were designed for young children. The data for this qualitative study were collected from 21 pre-service early childhood educators via observations, journals, and focus group meetings. The study findings demonstrated that designing digital games enhanced the perceived TPACK of pre-service educators. They pointed out that they had difficulties at the beginning while designing games due to limited experience, TK, and design knowledge. On the other hand, after they developed digital games, it was noticed that all TPACK sub-factors improved in addition to knowledge of design and creativity.

Masoumi (2020) aimed to broaden and enhance the knowledge in the literature about how pre-service pre-school educators meet with digital technologies during their professional education and how they are supported to use ICT in their future careers. Data were collected through semi-structured focus group discussions with 25 pre-service educators who are in their last year in the educator education program and interviews with 5 educator educators in Sweden. According to the results of this study, both educator educators and pre-service early childhood educators believed in the significance of the digital competencies of educators. However, many pre-service educators pointed out that they did not take sufficient education about using technology in education, and they were not confident about using technology during the teaching process. On the other hand, educator educators stated that they give enough attention to preparing pre-service educators to use ICT in their future teaching experiences. Although educator educators suggested they were teaching how to use ICT in early childhood education, they also remarked that there was no mandatory course specifically related to technology usage in the early years. This situation

represents that both the TPACK of pre-service educators and educator educators should be supported, and their knowledge should be increased about technology usage in the early years.

Sheffielda, Dobozya, Gibsonb, Mullaneyb and Campbell (2015) investigated the TPACK of pre-service primary and early childhood educators in terms of science content and pedagogy (information literacy and inquiry). Moreover, they explored whether a science development course was successful in supporting pre-service educators and the limitations and affordances of information technologies for pre-service educators. 219 (187 on-campus and 32 online) freshman pre-service educators participated in this case study. While on-campus students attended workshops, online students participated in weekly workshops and online meetings. The data for the study was collected using mixed method techniques which were pre-test and post-tests via an online questionnaire and open-ended questions related to their perception of ICT, science knowledge, and science pedagogy via an online platform. The findings showed that most pre-service educators could fulfill the required complicated tasks. Moreover, while 25% of them were not confident during the inquiry process, 2% were confident according to pre-test results. However, after the workshops, it changed positively. While 72% of them stated that they had confidence, only 2% of pre-service educators pointed out that they still did not have confidence during the inquiry process in the post-test. Additionally, they remarked that their confidence in using technology in the educational process for science content increased. It was noticed that using the TPACK framework to create courses helped to support pre-service educators' understanding by blending TK, PK, and CK (science).

2.3.2.2. Previous Studies on TPACK in Educational Contexts Other than Early Childhood

In this part, firstly, some previous research studies which connected TPACK with 21st-century skills in some ways were examined. Then, studies related to self-evaluation of TPACK, how TPACK differ regarding various independent variables and importance of TPACK were mentioned.

Mtebe and Raphael (2018) conducted a study to adapt TPACK combining with the 21st-century skills to explore the 21st-century skills of teachers by using class observation and self-report questionnaires. After the adaptation, the researchers collected data from 132 in-service teachers who were English language teachers, mathematics, chemistry, and information and computer science teachers. The findings were represented that most teachers had moderate confidence in all sub-factors related to Technological knowledge. Additionally, teachers had high confidence in PK, CK and PCK. It was emphasized that technology usage in education prepares children for the 21st century. For that reason, professional development programs should be prepared to help teachers to use technology efficiently to support children's 21st-century skills.

Başaran (2020) investigated the association between sub-factors of TPACK-21, which was developed by Valtonen et al. (2017), by highlighting the pedagogical methods used by teachers and technology usage in education are crucial for the improvement of children's 21st-century skills. 254 pre-service teachers from the science and math departments were included in the study. The study findings represented that there was a direct positive impact of TCK, TPK21 and PCK21 on TPACK-21. They explained 74 percent of change in TPACK-21. However, the most effective sub-factor on TPACK-21 was TCK. Besides, it was seen that the direct and positive effect of CK was more than TK and PK21 on TCK and PCK21. According to these results, it was suggested that while professional teacher programs are developed, supporting teachers' CK and PCK21 can be emphasized more instead of only focusing on TK for the enhancement of teachers' 21st-century skills.

Chen and Jang (2019) investigated the correlation between TPACK and Self-Regulation (SR) of 386 in-service teachers who worked in a secondary school as science teachers in Taiwan. TPACK included CK, TK, PCK in context and TPACK in context, while Self-Regulation consisted of ICT, monitoring and controlling capability (MC/CC), planning capability (PC) and reflecting capability (RC). The data collection process was completed by collecting data with scales. After analyzing the results of the study, the findings were presented. According to the SR scale, MC/CC had the greatest score, and ICT had the lowest score among other SR components.

Additionally, the TPACK scale indicated that CK had the highest and TK and TPACK in context had the lowest scores among other TPACK components. When correlation was examined, it was detected that the components of TPACK and SR had a positive correlation. It was found that RC and MC/CC had a higher association with CK and PCK; however, a lower correlation with TK and TPACK. On the other hand, ICT had a highly significant correlation with TK and TPACK, but it had a less substantial correlation with CK and PCK in context.

Hannaway and Steyn (2016) conducted a case study to investigate teachers' experiences with technology-based teaching and learning (TbTL) with children who were older than nine. The researchers collected qualitative data from two schools that had high technology usage. Moreover, they used the TPACK framework for evaluation. The findings of the study represented that TbTL was correlated with TK, CK, PK, 21st-century skills and technological tools. Technology usage has a positive influence on educational and administrative aspects. Additionally, although technology integration is helpful for the teaching process, it should not be the core of the teaching. Because of the inevitable digitalization in education, the researchers suggested that the technological infrastructures of schools and the policy framework of TbTL should be supported, and teachers should be educated during pre-service education about how to use technology in education. Also, there should be teacher training for improving pedagogical and technological abilities and 21st-century skills. Finally, teachers should be supported in finding appropriate toolkits for children older than nine.

Moreover, some studies demonstrated how educators evaluated their TPACK levels. Sumba-Nacipucha, Cueva-Estrada, Conde-Lorenzo and Mármol-Castillo (2021) reviewed the college educators' skills and knowledge by benefitting from the TPACK framework after the Covid 19 Pandemic. Especially, their TK and TPK were examined since they were the most needed knowledge with the transformation of the education from face-to-face to online. The researchers collected data from 381 college educators in Ecuador via an online survey. The study findings represented that the college educators had a high TPACK level, including TK and TPK specifically. The reason for this can be that both TK and integration of TK and PK were vital for adapting to

online education. Since the professors needed to adjust to the new online educational arrangement immediately, this situation might have led them to enhance their knowledge and skills.

Destiani and Purnawarman (2020) worked on the TPACK level of in-service English teachers and its influence on their assessment implementations. This quantitative study collected data from 30 teachers via semi-structured interviews and an online survey. More than half of the participants were found to have high TPACK levels, while others had average or low TPACK levels. Each teacher had some strong and weak knowledge among 7 factors of TPACK. However, it was seen that teachers with high TPACK levels were more confident while assessing students, and they used more efficient assessment methods during the assessment process by choosing more appropriate and motivating methods for students. It was recommended that English teachers should be supported with training to increase their TPACK and develop their assessment methods.

In addition to these studies, some previous studies investigated whether the TPACK of teachers differed with regard to some independent variables like age and years of experience, as it was aimed in the current study. Details of these studies are given below.

Schmid, Brianza, and Petko (2020) looked at whether there is any correlation between self-evaluation of TPACK and integration of technology in the lesson plans of 173 pre-service upper secondary school teachers, whose subject areas are STEM, social sciences and languages by controlling for age, gender and the subject areas of pre-service teachers. Data was collected via the TPACK survey and lesson plans of pre-service teachers. The study findings indicated that when all pre-service teachers were evaluated altogether, the CK component of TPACK has the highest score and TCK has the lowest score. Moreover, when the lesson plans were examined, it was noticed that 37 lesson plans did not contain technology usage. In comparison, 90 lesson plans included technology usage solely for teachers, and 46 of them had technology usage for students. The research showed that the self-evaluation results of TPACK might not be a reliable indicator of technology integration into education. On the other hand, it

generates useful information about the self-efficacy and self-confidence of pre-service teachers about TPACK. That is why only using the TPACK scale is not enough to determine levels of technology integration. Additionally, no differences can be accounted for in terms of the age or gender of pre-service teachers. However, subject areas led to differences. Pre-service teachers in STEM areas evaluated their TK and TCK higher than other pre-service teachers. Moreover, pre-service teachers in STEM areas with high TPACK scores integrated technology into education more in their lesson plans than pre-service STEM teachers who evaluated their TPACK level as low. Nevertheless, a similar relation between pre-service social science and language teachers could not be found. Additionally, the results indicated that pre-service social science and language teachers integrated technology more frequently in their lesson plans than pre-service STEM teachers. However, these plans were primarily teacher-centered, while pre-service STEM teachers generally planned for student-centered integration of technology.

Cheung and Tse (2021) examined in-service science teachers' behavioral intention about STEM education and their TPACK level by collecting data from 30 teachers in Hong Kong via two online questionnaires. The research results indicated that teachers had a positive attitude toward STEM education, and their TPACK level was high. Besides, it was noticed that teachers' TK had an indirect impact on intention about STEM education. In contrast, both CK and PK did not have any indirect effect on their intention about STEM education. However, CK and PK had an impact on how many difficulties teachers had during the adaptation period to use STEM education. Additionally, it was revealed that the TPACK level and behavioral intention of in-service teachers did not alter according to their gender, the year of teaching experience, and the subjects they taught. In line with this result, it can be stated that similar professional teacher training programs can be designed for all science teachers regardless of their profiles.

Lin, Tsai, Chai and Lee (2012) carried out research to investigate what the perceptions of science teachers were about TPACK to recognize their point of view about the usability of technology in instruction. During the data collection process, the researchers surveyed 222 pre-service and in-service teachers in Singapore using the

TPACK scale as an online instrument. Seven components of TPACK were examined. The study findings indicated that a TPACK model with seven components, which are PK, CK, TK, PCK, TPK, TCK and TPACK, was acceptable. Moreover, science teachers comprehended the importance of TPACK and the positive correlation between all components and TPACK. Besides, this research represented the correlation between teachers' TPACK perception and their demographic attributes, like age, gender, and teaching years. It was revealed that the self-confidence of female in-service science teachers is higher in PK, however, lower in TK than male teachers, although there were no differences between the TPACK perceptions of female and male pre-service teachers. Additionally, the perception of female in-service science teachers on technology-related components (TK, TPK, TCK and TPACK) is significantly but adversely correlated with their age.

Koh, Chai and Tsait (2010) investigated the TPACK of pre-service elementary and secondary school teachers in Singapore. Data were collected from 1185 pre-service teachers by using the TPACK questionnaire, which included 5 factors: TK, CK, PK, teaching with technology knowledge and knowledge from critical expressions. Teachers' perceptions of their TPACK were found to have varied in terms of gender but not age and educational level. It was seen that males' TK was higher than females' TK.

Altun (2012) researched the connection between some independent variables and the TPACK of 322 primary school teachers in Trabzon, Turkey. Quantitative data were collected by using an adapted TPACK scale. The study results represented that gender influenced the TPACK of teachers. Female teachers' PK, CK-science, CK-literacy and TCK were higher than male teachers, although other sub-components did not differ. While the existence of computers without an Internet connection both at home and school was not correlated with the TPACK of teachers, there was a positive correlation between some sub-components of the TPACK of primary school teachers and using the Internet in the classroom or at home, Information Technology (IT) lab at school and Instructional software. The researchers recommended that primary school teachers should be supported with professional development programs to recognize the pedagogical advantages of technology usage in primary education.

Li, Chen, Chen, Zhang and Sallam (2021) carried out a study in which the TPACK level of college teachers in Zhejiang University was examined during the Covid 19 Pandemic. The researchers collected data from 91 college teachers from one of the best Chinese universities via an online demographic information form and the TPACK scale. After the analysis, it was found that most teachers had limited or no online teaching experience prior to the pandemic. Moreover, PK, CK, and PCK of teachers had a higher score than technology-related knowledge (TK, TCK, TPK, and TPCK). While teachers had the highest score in CK, they had the lowest score in TK. It was seen that PK and CK increased with the year of experience. Given limited online teaching experience, the teachers did not have good scores in any technology-related knowledge. For this reason, they needed time to adapt to online education and use technology effectively by integrating it into the teaching process. Finally, the analysis indicated that the gender or age of teachers was not influential on any factor of the TPACK of teachers.

Apart from these studies, many others have found that teachers should be supported by pre-service or in-service training. Also, they emphasized the impotence of training for TPACK.

Köse (2012) conducted research to enhance the TPACK level of in-service primary school teachers by designing and applying in-service training as a single-group pretest-posttest experimental study. The researcher collected data from 5 primary school teachers via demographic information form, interview and questionnaire by using it as pre-test and post-test. In line with the data analysis, the findings demonstrated that the TPACK level of teachers increased after the training. Moreover, while they did not have sufficient knowledge about technology integration before the training, they had experience in integrating technology into education. By attending the training, they noticed that only using technology in education did not mean the integration of technology. Therefore, they learned about various ways of technology integration and stated that they would join other training about TPACK.

Tanak (2018) aimed to establish whether a TPACK-based course had any influence on the TPACK of 15 pre-service science teachers. Data was collected data via a questionnaire that included four components (TK, TCK, TPK, and TPACK) of TPACK and pre-service teachers' lesson plans. The findings indicated that pre-service science teachers generally had TK other than TPACK. Besides, the PK of pre-service teachers was more effective on their TPACK. To clarify that, it was pointed out that if pre-service teachers lacked PK but had good TK, they remained unable to connect technology with pedagogy. Additionally, their TCK and TPK were better than TPACK. When teachers' lesson plans were examined, it was noticed that they generally used technology to motivate learners and not to help them to apply technology for scientific exploration. Furthermore, a TPACK-based course was designed by using the TPACK framework to enhance the TPACK of pre-service science teachers in this research. After this course, apparent differences between pre-service teachers' previous and current TK, TPK, TCK, and TPACK were observed.

Cacho (2014) conducted a study to explore the TPACK level of pre-service primary school teachers and its association with their professors' TPACK model used during the instructions. Data were collected from 54 senior pre-service teachers via self-reporting questionnaires. The research results represented that they evaluated their TPACK at a good level. However, intensive training would be helpful for increasing TK level to the level of PK and CK. Additionally, pre-service teachers believed that their professors in the university had good competence. In contrast, their supervisors in practicum had some competence since they did not use TPACK in their classes frequently. It was seen that there was a significant association between pre-service teachers' TPACK level and the used TPACK model by their professors. That is why it is vital to develop new instruction methods by professors to develop a 21st-century education model.

Chaipidech, Kajonmanee, Chaipah, Panjaburee, and Srisawasdi (2021) conducted a longitudinal study and investigated the effect of a personalized teacher professional development (TPD) program, which was designed according to andragogy theory (for supporting adult learning) and the TPACK frame, on the cognitive abilities of in-service teachers who gave STEM education in Thailand. The data was collected from

153 in-service secondary school science teachers via pre-test and post-test by including them in a two-year TPD program that contained 4 intensive workshops. The study findings demonstrated that there was a significant difference between pre and post-test. Moreover, it was seen that the TPACK framework was essential for developing the TPD program to support STEM teachers.

Aktaş and Özmen (2021) conducted a study to assess pre-service science teachers' performance in a practical TPACK training course in which pre-service teachers created micro-teaching lesson plans by focusing on only one specific topic. The data were collected from 46 pre-service science teachers via lesson plans and video records of presentations in the lesson during the training course. They were assessed by using a rubric that was improved to evaluate the TPACK-based educational surroundings. The data analysis indicated that the total TPACK score of pre-service teachers increased after the course. Moreover, after the detailed examination of the rubric, it was noticed that guiding students, supporting the active participation of students, choosing developmentally appropriate teaching techniques, including the assessment process, and giving accurate knowledge about scientific topics while teaching with technology were increased. Prospective reasons for this increase could be learning new technologies during the course, using worksheets while using digital tools, having discussions during the course to take feedback, and having a positive role model like the lecturer of the course.

Sointu, Valtonen, Hirsto, Kankaanpää, Saarelainen, Mäkitalo, Smits and Manninen (2018) published an article as a part of a larger project which was about empowering high school teachers to use the flipped classroom (FC) model and increase integration of ICT into the educational process. As the teachers were attending regular courses to support their implementation of the FC model, the researchers planned to see how students evaluated the TPACK of their teachers before and after these courses. 317 students participated in the data collection process and answered TPACK-21 and TPB-ICT scales before and after their teacher completed courses. The results of the pre-test and post-test were found to be significantly different. Following the attendance of their teachers on supportive courses, students assessed their teachers' PCK and TPK in their own subject areas as higher than before. Besides, students believed that their teachers'

attitude about technology usage in education was more optimistic than before. Moreover, the findings indicated that assessment differences between pre-test and post-test of students who were in the second grade and above grades in high school were more obvious than others who were the first-year students (139 participants). Finally, all students were positive about using the FC model in education.

Voogt, Tilya and Akker (2009) worked with four Tanzanian secondary school science teachers and their students (15 participants) to figure out how making new in-service arrangements influences integrating technology into student-centered science education. For the study, the researchers organized 3 workshops in which teachers prepared Microcomputer Based Laboratories (MBL) based lesson plans to use with their students. Data were collected via classroom observation checklist, interviews with teachers, computer-classroom environment inventory and questionnaire for students at three different times: pre-implementation, post-implementation, and six months later than implementation. The findings represented that teachers could use MBL in their lessons reasonably. Moreover, their student admired the class environment created by teachers providing a student-centered environment by supporting discovery, collaboration, and open-ended learning.

In conclusion, previous studies have been undertaken on technological pedagogical content knowledge (TPACK) in both early childhood education and other educational contexts that examined the integration of technology into education was from various perspectives. Still, studies conducted with in-service early childhood educators were fewer than others.

2.4 The Summary of the Literature Review

The literature revealed plenty of research studies focusing on 21st-century skills. While some concentrated on one specific 21st-century skill, such as creativity, leadership, technological competence, and problem-solving, some focused on total 21st-century skills. However, researchers did not give much attention to the 21st-century skills of in-service early childhood educators, and only a few studies could be found about them.

A similar situation was observed in studies related to technological pedagogical content knowledge (TPACK). Studies were mostly conducted with pre-service educators or educators from different contexts other than early childhood. Furthermore, when studies that connected TPACK and 21st-century skills were examined, a lack of research in early childhood education and a scarcity of studies in other contexts is seen. The current study therefore aimed to contribute to our understanding of these aspects.

CHAPTER 3

METHOD

This chapter aimed to provide a comprehensive methodological explanation of the research study. In line with this purpose, the research's overall design was discussed in this section. It included research questions, population and sample, instrumentation, data collection and analysis process as the pilot and the main study, ethical concerns, and limitations of the study.

3.1. Research Questions

The purpose of this study was to investigate the 21st-century skills and technological pedagogical content knowledge (TPACK) levels of in-service early childhood educators as a preliminary study and to examine the association between their 21st-century skills and TPACK. The following questions were proposed in this study.

R.Q.1. What are the 21st-century skills of in-service early childhood educators?
1.1. Is there a difference in 21st-century skills of in-service educators regarding age?
1.2. Is there a difference in 21st-century skills of in-service educators regarding years of experience?
1.3. Is there a difference in 21st-century skills of in-service educators regarding education level?
1.4. Is there a difference in 21st-century skills of in-service educators regarding training attendance on 21st-century skills?

R.Q.2. What is the TPACK levels of in-service early childhood educators?
2.1. Is there a difference in TPACK levels of in-service educators regarding age?

2.2. Is there a difference in TPACK levels of in-service educators regarding years of experience?
2.3. Is there a difference in TPACK levels of in-service educators regarding education level?
2.4. Is there a difference in TPACK levels of in-service teachers regarding training attendance on technology usage in education?

R.Q.3. Is there any relationship between 21st-century skills (Learning and Innovation Skills; Life and Career Skills; Information, Media and Technology Skills) and TPACK of in-service early childhood educators?
3.1. Is there any relationship between the 21st-century skills and TPACK of in-service early childhood educators?
3.2. Is there any relationship between the sub-factors of 21st-century skills and TPACK of in-service early childhood educators?
3.2.1. Is there any relationship between Learning and Innovation Skills and TPACK of in-service early childhood educators?
3.2.2. Is there any relationship between Life and Career Skills and TPACK of in-service early childhood educators?
3.2.3. Is there any relationship between Information, Media and Technology Skills and TPACK of in-service early childhood educators?

3.2. Research Design

This research was designed as a quantitative study to investigate the general characteristics of in-service early childhood educators regarding their 21st-century skills and TPACK level and to discover their relationship. In accordance with these primary purposes, descriptive statistics were used to identify the current status of participants, while a correlational study was used to explore a potential association that exists between two or more variables without manipulation of the variables (Fraenkel & Wallen, 2009). As an appropriate design for the research, descriptive research was used to identify the current status of the in-service early childhood educators via collected data about their demographic information, 21st-century skills and TPACK. At the same time, a correlational study was conducted to discover the

relationship between 21st-century skills and TPACK of in-service early childhood educators. These research designs were carried out by collecting data from in-service early childhood educators via three different instruments simultaneously.

3.3. Data Collection Instruments

Three data collection instruments were utilized in this research. These instruments were the Demographic Information Form which was created by the researcher, the 21st-Century Skills Scale (Anagün, Atalay, Kılıç & Yaşar, 2016), and the Technological Pedagogical Content Knowledge (TPACK) Scale (Horzum, Akgün & Öztürk, 2014).

3.3.1. Demographic Information Form

The demographic information form was prepared by the researcher to collect information from in-service early childhood educators regarding their age, years of experience, education level, the name of the city in which they work and whether they took any course or in-service training which contributes to their 21st-century skills and TPACK. Groups in the questions related to age and years of experience were created after examining some other research studies. The data obtained from the demographic information form had two purposes in this study. Firstly, the demographic data provided general information related to the characteristics of the in-service early childhood educators who attended the current research. Secondly, collected data via demographic information form helped to answer some research questions in the current study.

3.3.2. 21st-Century Skills Scale

The 21st-Century Skills Scale, which was developed by Anagün, Atalay, Kılıç, and Yaşar in 2016 for Turkish pre-service educators, was used for self-assessment of in-service early childhood educators' 21st-century skills. The scale consists of 42 items. It is a 5-Likert type like "1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always".

Minimum score that participants can take from the scale is 42 while maximum score is 210. The scale has three factors, which are Learning and Innovation Skills (16 items; e.g., “I solve the problems I encounter with original ideas.”, “I use different thinking techniques (brainstorming, thinking with six hats) to create original ideas in my life.”, “I try different solutions to solve problems.”), Life and Career Skills (18 items; e.g., “I listen to others' opinions on a topic.”, “I have effective communication skills.”, “I have the ability to work effectively in group work.”), and Information, Media and Technology Skills (8 items; e.g., “I know the purposes of the messages in the media.”, “I know that the media is effective in directing the thoughts of individuals.”, “I use appropriate media tools to obtain information.”). Besides, it includes a reversed item (item 27) under Life and Career Skills (Anagün et al., 2016).

This scale’s validity and reliability study was conducted with 660 Turkish pre-service educators. Cronbach’s alpha value was found as .889 for the internal consistency of the total scale. Cronbach’s alpha value of each factor was changing slightly: Learning and Innovation Skills (α=.845), Life and Career Skills (α=.826), and Information, Media and Technology Skills (α=.810). Moreover, the Spearman-Brown value was calculated as .731, and the Guttman split-half value was calculated as .731. Exploratory factor analysis represented that items under these three factors explain 51.301 % of the total variance. Moreover, Confirmatory factor analysis indicated that the scale has a good fit index as values ($\chi 2/sd$= 2.00, GFI=.82, AGFI=.80, CFI=.93, NFI=.87, NNFI=.93, IFI=.93, RMSEA=.055, SRMR=.061, PNFI=.81 and PGFI=.73) were examined. The findings indicated that the scale could be used to measure the 21st-century skills of pre-service educators as a self-assessment tool. Briefly, it demonstrates how pre-service educators perceive their 21st-century skills (Anagün et al., 2016).

Although the scale was developed to use with pre-service educators, this study was conducted with in-service early childhood educators. For this reason, compatibility of the scale for in-service educators was asked to the scale owners. They confirmed the suitability and permitted the use of the 21st-Century Skills Scale with in-service educators for this study. A pilot study was performed for the validity and reliability of

the scale for in-service early childhood educators. The process of the pilot study was explained in “3.4.2. The Validity and Reliability of the Scales” section.

3.3.3. Technological Pedagogical Content Knowledge (TPACK) Scale

The Technological Pedagogical Content Knowledge (TPACK) Scale, which was developed by Horzum, Akgün and Öztürk in 2014 for Turkish pre-service and in-service educators, was used for the self-assessment of in-service early childhood educators' TPACK in this study. The Technological Pedagogical Content Knowledge Scale was developed based on the TPACK framework of Koehler and Mishra. After examining other TPACK scales, Horzum, Akgün and Öztürk (2014) recognized that these scales did not include student-centered and constructivist items in addition to educator-centered items. That is why they created this scale by considering culture and educational innovations. The scale contains 7 factors and 51 items. These 7 factors are compatible with the components of the TPACK model, which was created by Koehler and Mishra. It is a 5-point Likert type like "5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, 1 = strongly disagree" and there is no reversed item in the scale. This scale has a total TPACK score (The minimum score that the participants can take is 51 while maximum score is 255.) and highly correlated factors. It means that this scale differs from other scales by proving the associated TPACK model (Horzum, Akgün & Öztürk, 2014).

The validity and reliability study of the scale was conducted by Horzum, Akgün and Öztürk (2014) with 724 pre-service educators from various departments, and early childhood education was one of them. According to the result of the study, the scale is valid and reliable. For the validity of the scale, the researchers took the opinions of 12 experts for content validity and the results indicate that experts reached a consensus on content validity. Moreover, when they examined the criterion validity of the scale, they found out that this scale and the TPACK Scale, which was adapted to Turkish in 2011 by Öztürk and Horzum, are positively correlated. Other than TPACK Scale created in 2011, the researchers also used the educator self-efficacy scale, which was developed by Yılmaz, Köseoğlu, Gerçek and Soran in 2004, for criterion validity. Thus, they found a positive correlation between this scale and the educator self-efficacy scale as well. For the reliability of the scale, the researchers used both test-retest and internal consistency methods. While test-retest correlation coefficient values were calculated between .65 and .92; Cronbach's alpha value was calculated as .98 as

the internal consistency of the total scale. Therefore, by considering these findings, we can say that this TPACK scale is a reliable instrument because all the values were significant and positive (Horzum et al., 2014).

As stated before, The TPACK scale consists of 7 factors which are TK (e.g., “I follow new technologies.”, “I know how to solve technology-related problems.”), PK (e.g., “I can adapt my teaching methods according to the developmental levels of the students.”, “I know how to measure student performance.”), CK (e.g., “I decide the scope of the topics I will teach.”, “I learn new and changing information about my field.”), TCK (e.g., “I have the necessary technological knowledge to access, organize and use resources related to my field.”, “I can use existing software related to my field.”), PCK (e.g., “I can easily prepare lesson plans for the lesson I will teach.”, “I can choose the most appropriate teaching strategy to teach a particular concept.”), TPK (e.g., “I can use technologies that will allow students to gain new knowledge and skills.”, “I have knowledge and skills to choose and use appropriate technologies for the developmental level of students to enable them to learn effectively.”), and TPCK (e.g., “I can use technology to determine the level of skill and understanding of students about a certain subject.”, “I can choose and use appropriate strategy, method, and technology according to the content of the course.”). When we examine the distribution of items under these factors; the TK includes 6 items (α=.85), the CK consists of 8 items (α=.85), PK contains 7 items (α=.82), the TCK includes 6 items (α=.84), the PCK contains 8 items (α=.87), the TPK consists of 8 items (α=.89) and finally the TPCK have 8 items (α=.88). Besides, Confirmatory factor analysis was performed, and it demonstrated that the scale had a good fitness ($\chi 2/sd=3.02$, RMSEA=0.05, GFI=0.83, AGFI=0.82, CFI=0.97, NNFI=0.97, RMR=0.09 and SRMR=0.05) for Turkish culture (Horzum et al., 2014).

Although the scale was developed for both pre-service educators and in-service educators from various subject areas to measure their TPACK self-efficacy, the researchers did not work with in-service educators. Because of this, compatibility of the scale for in-service educators was asked to the scale owners. They confirmed the suitability and permitted the use of the TPACK Scale with in-service educators. A pilot study was conducted to examine the scale’s validity and reliability for in-service early

childhood educators. The process of the pilot study was explained in the following section.

3.4. Analysis of Pilot Study

The pilot study aimed to determine the feasibility of the instruments used in the main study. For this reason, the validity and reliability of the 21st-Century Skills Scale and the Technological Pedagogical Content Knowledge (TPACK) Scale were assessed.
In a pilot study, the sample size depends on the purpose of the study, like measuring the suitability of a scale, developing a new scale, or adapting an existing scale to another group (Johanson & Brooks, 2010). In this study, the scales, which were developed with pre-service educators, were adapted for in-service early childhood educators. After examining the scale development process of the original scales used in this research, it was decided to use factor analysis techniques. There are various points of view about the sample size for factor analysis. Comley and Lee (1992) pointed out that 100 is less, 200 is moderate, and more than 300 is good as a sample size for factor analysis. Besides, Tabachnick and Fidell (1996) stated that 150 is good for a sample size to obtain sufficient factor loading. In addition to these, Kline (1994) remarked that 200 participants are generally adequate for reliable analysis. By considering all these opinions, the sample size of the pilot study was defined as 200 in-service early childhood educators. The demographic information of participants in the pilot study was provided in Appendix C.

3.4.1. Sample and Procedure of the Pilot Study

The pilot study data were collected from 200 in-service early childhood educators who work in Ankara in the fall semester of the 2021-2022 academic year. Educators from both private schools and public schools took place in the research.

In this pilot study, convenience sampling was used. Convenience sampling is a method in which participants are selected according to their availability to collect data conveniently (Fraenkel & Wallen, 2009). Moreover, data were collected via an online

platform. The reason for using this method was the conditions of the Covid-19 pandemic. Due to the Covid-19 health precautions taken by the government, schools did not allow anyone other than the school population to go into the schools. Therefore, the research instruments were transmitted into an online google form, and this online form was sent one by one to schools that accepted to share it with educators who work in those schools. The researcher communicated with schools in Ankara that have a higher number of educators to collect data from plenty of educators in a short time. Besides, the researcher shared the online form with some acquaintances and some educators on social media. Although convenience sampling was chosen for data collection, especially communicating with schools with a high number of educators, reaching the needed number of participants took more time than expected for the pilot study. In the beginning, it was planned to collect data for the pilot study from other districts of Ankara without adding the central districts of Ankara to the pilot study. However, the researcher expanded the pilot study sample by collecting data from all districts of Ankara so that the expected amount of data for the pilot study could be collected quickly.

The expansion of the pilot study sample led to expanding the main research population. To provide the similarity between the pilot research sample and the main study sample, the socio-economic development index was taken into consideration. According to Dinçer, Özaslan and Kavasoğlu (2003), Istanbul and Izmir are the closest towns to Ankara in terms of socio-economic development. Therefore, this similarity led the researcher to choose Istanbul and Izmir to provide consistency between the sample characteristics of the pilot study and the main study. The details about the main research were given in the section "3.5.1. Population and Sample".

3.4.2. The Validity and Reliability of the Scales

Factor analysis is an extensively used method to support other statistical operations by providing construct validity of scales (Çokluk, Şekercioğlu & Büyüköztürk, 2021). It can be classified under two main categories: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA is used to reduce variables by grouping them under related factors to create more manageable structures. CFA is a more complex

technique used to confirm the validity of the structure of scales (Pallant, 2013; Çokluk, Şekercioğlu & Büyüköztürk, 2021; Child, 2006).

Matsunaga (2010), Hair, Babin, Anderson, and Tatham (2006), and Worthington and Whittaker (2006) suggested using factor analysis by combining EFA and CFA for rigorous assessment of the scales. Accordingly, EFA and CFA were performed together. Exploratory factor analysis (EFA) was performed via SPSS 24 program, and confirmatory factor analysis (CFA) was conducted via the LISREL 8.8 program developed by Jöreskog and Sörbom (1993) to assess the validity and reliability of the scales used with in-service early childhood educators. Moreover, Cronbach Alpha values of the scales were calculated for reliability via SPSS 24 program. According to the statistical results of the pilot study, the necessary changes were applied to the scales. The following sections represent the result of both factor analyses and reliability tests for the 21st-Century Skills Scale and the Technological Pedagogical Content Knowledge (TPACK) Scale.

3.4.2.1. Pilot Study of 21st-Century Skills Scale

The 21st-Century Skills Scale was developed to be used for the self-assessment of pre-service early childhood educators (Anagün, Atalay, Kılıç &Yaşar, 2016). In this study, it is used for the assessment of in-service early childhood educators' 21st-century skills. For this reason, the scale was submitted to three different experts from the department of early childhood education at Middle East Technical University for in-depth analysis regarding the appropriateness of 42 items for in-service early childhood educators. The experts' opinions indicated that all items in the 21st-century scale are suitable for using the scale with in-service educators. After the approval of the experts, a pilot study was conducted by following most of the steps in the study of the original 21st-Century Skills Scale. In light of the scale development study of Anagün, Atalay, Kılıç and Yaşar (2016), exploratory factor analysis (EFA), confirmatory factor analysis (CFA), Cronbach Alpha Coefficient were conducted to prove the validity and reliability of the scale.

Before beginning to analyze the data set, it is significant to check it not to have any errors (Pallant, 2013; Çokluk, Şekercioğlu & Büyüköztürk, 2021). By considering this, the data set was checked. Thus, errors and extreme outliers were controlled, and the reverse item (Skills27) was transformed. Z scores for all variables were calculated to find univariate outliers so that potential outliers (excess of 3.29) could be examined (Tabachnick & Fidell, 1996). It was found that there were few outliers in some items (Skills30, Skills33, Skills34). However, Kurtosis and Skewness values of the variables were in the acceptable range (-2 and +2) according to Altun (2019) and George and Mallery (2003). Besides, after the examination of normal probability plots, detrended normal probability plots, box plots, and the difference between means and 5% trimmed means, they were not omitted or transformed since also there were no significant differences between means and 5% trimmed means of these items. After checking the data set, sample size, and normality, the factorability of the scale was examined by looking at Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy to decide whether exploratory factor analysis (EFA) can be performed. To conduct EFA, these assumptions need to be fulfilled (Tabachnick & Fidell, 1996; Child, 2006; Çokluk, Şekercioğlu & Büyüköztürk, 2021).

As mentioned before, there are different opinions about the sample size to conduct EFA. After the examination of various points of view, it was decided to collect data from 200 in-service early childhood educators since Kline (1994) stated that 200 is generally enough to have an appropriate sample size. When Bartlett's test of sphericity is taken into consideration to assess the normality, it is expected to have a statistically significant value ($p < .05$) to continue factor analysis (Tabachnick & Fidell, 1996; Çokluk, Şekercioğlu & Büyüköztürk, 2021). Additionally, the factorability of the scale, which is explored with KMO, should be higher than 0.60. Moreover, most of the correlation coefficient scores in the Correlation Matrix table should be higher than 0.3. Factor analysis cannot be performed if these assumptions are not fulfilled (Pallant, 2013).

Table 3.1

KMO and Bartlett's Test of the 21st-Century Skills Scale

Kaiser-Meyer-Olkin measure of sampling adequacy		.908
Bartlett's test of sphericity	Approx. Chi-Square	5190.108
	df	861
	Sig.	.000

The 42 items of the 21st-century skills scale were subjected to principal components analysis (PCA) for EFA. Bartlett's test of sphericity had a statistically significant result (p= 0). The Kaiser-Meyer-Olkin value was more than 0.60 (KMO= 0.908). Çokluk, Şekercioğlu and Büyüköztürk (2021) emphasized that a KMO value that is equal to .90 is good and more than .90 is excellent. Additionally, examination of the "Correlation Matrix" indicated the presence of many coefficients that were .3 and above. The data set was suitable for factor analysis in line with these results.

In the principal components analysis (PCA), the "Total Variance Explained" table and "Screeplot" should be examined to decide the number of components (factors). While using Kaiser's criterion, only components that have an eigenvalue above 1 are taken into consideration (Pallant, 2013; Çokluk, Şekercioğlu & Büyüköztürk, 2021). The "Total Variance Explained" table represented that there were seven components with eigenvalues greater than 1, which explained 63.04 % of the total variance. On the other hand, the "Screeplot" showed that there was an apparent break between the third and fourth components. For this reason, Parallel analysis was applied to determine and confirm the number of factors (Child, 2006; Pallant, 2013). According to parallel analysis, the eigenvalues of only the first three components were higher than the criterion value. Therefore, it supported the "Screeplot" related to having only three factors for further investigation.

Çokluk, Şekercioğlu and Büyüköztürk (2021) and Pallant (2013) expressed that after deciding the number of factors, the factor analysis can be continued by defining the exact number of factors and changing the rotation method. Because of this reason, the principal components analysis (PCA) was renewed by specifying the number of factors

as three and by choosing the rotation method as Varimax instead of Direct Oblimin since Anagün, Atalay, Kılıç, and Yaşar (2016) used Varimax for the original scale.

The "Total Variance Explained" table represented those three factors that explained 50.05 % of the total variance. The "Rotated Component Matrix" demonstrated that Skills18 was related to factor one (Learning and Innovation Skills) rather than factor two (Life and Career Skills), unlike the original research. The findings indicated that in-service educators and pre-service educators perceived this item, Skills18 (I take an initiative to improve my skills.), differently. Therefore, Skills18 was moved from factor two to factor one. Additionally, Skills17 (I use time effectively.) was found as more related to factor one and factor three (Information, Media and Technology Skills) by having highly close factor loadings instead of being related to factor two like in the original scale. According to Çokluk, Şekercioğlu and Büyüköztürk (2021) and Child (2006), if one item has very close factor loadings under different factors, it should be removed from the analysis. For this reason, Skills17 was omitted from the analysis.
After omission of an item (Skills17), all process was repeated, and any possible changes were checked. According to the repeated process, Bartlett's test of sphericity had a statistically significant result (p= 0), while the Kaiser-Meyer-Olkin value changed to 0.907.

Table 3.2

KMO and Bartlett's Test of the Renewed 21st-Century Skills Scale

Kaiser-Meyer-Olkin measure of sampling adequacy		.907
Bartlett's test of sphericity	Approx. Chi-Square	5031.680
	df	820
	Sig.	.000

Moreover, when the values on both the Component Matrix and the Rotated Component Matrix were examined, it was concluded that the last structural changes were appropriate for factoring. Therefore, at the end of the EFA, it was confirmed that the 21st-century Skills Scale had three factors. Factor 1 (Learning and Innovation Skills) included 17 items, while factor 2 (Life and Career Skills) contained 16 items, and factor 3 (Information, Media and Technology Skills) had 8 items.

After EFA, the Confirmatory Factor Analysis (CFA) was conducted to confirm the construct validity of the 21st-century Skills Scale with 3 factors. The Chi-square value (χ^2= 1554.30, N=200, df=776, p=.000) was statistically significant. However, its p-value should be more than .05 (Çokluk, Şekercioğlu & Büyüköztürk, 2021). For this reason, other goodness-of-fit indices were examined. "χ^2/sd" were equal to 2.00, so this value is an indicator of the perfect fit (Tabachnick & Fidell, 1996). Besides, the goodness of fit indexes of the scale were calculated as RMSEA=0.071, GFI=0.72, AGFI=0.69, CFI=0.96, NFI=0.92, NNFI=0.96, RMR=0.029 and SRMR=0.069. These values indicated that NFI, RMSEA and SRMR were a sign of good fit while CFI, NNFI, RMR were a sign of perfect fit, although GFI and AGFI did not meet conditions of the critical level (Çokluk, Şekercioğlu & Büyüköztürk, 2021). When the modification indexes were examined, it was noticed that there was a strong association between the error covariances of items 34 and 33 which were under the same latent variable (Life and Career Skills). Therefore, it was decided to modify them by setting error covariances of these items free.

After CFA was re-conducted by adding error covariances between item 34 and item 33, the Chi-square value (χ^2= 1480.15, N=200, df=775, p=.000) was statistically significant. For this reason, other goodness-of-fit indices were examined. "χ^2/sd" was counted as 1.91. It represented a perfect fit. Additionally, the goodness of fit indexes was calculated as RMSEA=0.068, GFI=0.73, AGFI=0.70, CFI=0.96, NFI=0.93, NNFI=0.96, RMR=0.029 and SRMR=0.068 (Path diagram was given in Appendix D). In this context, most of the goodness of fit indexes indicated good or perfect fit except GFI and AGFI. Thus, this finding led us to conclude that the structural model of the 21st-Century Skills Scale had a good fitness level for in-service early childhood educators after omitting Skills17 and making a factorial change of Skills18.

The 21st-century Skills Scale's reliability was checked after validation. Instrument reliability means the internal consistency of scores taken from an instrument (Fraenkel, Wallen & Hyun, 2012). Having a reliable result from an instrument is valuable for research. For this reason, Cronbach Alpha analysis was conducted to prove the scale's reliability. Depending on the purpose of a scale, it can have various acceptable

Cronbach Alpha values, but the recommended minimum value should be .7 for scales with more than 10 items (Pallant, 2013). However, a Cronbach Alpha value higher than .8 is preferable (Vieira, 2011; Pallant, 2013).

When the Cronbach Alpha coefficient of the scale was examined, it was .95. Moreover, "Item-Total Statistics" represented that removing any item from the scale will not improve the Cronbach Alpha coefficient. Besides, values under the "Corrected item-total Correlation" demonstrated that items in the scale ranged between .38 and .71. Pallant (2013) pointed out that if there are items under the "Corrected item-total Correlation" which have values lower than .3, they may measure something different other than the purpose of the scale. It meant that all items in this scale were related to 21st-century skills.

In addition to the scale's total Cronbach Alpha coefficient score, each factor's Cronbach Alpha was examined to see Item-Total Correlation under each specific factor. Specifically, the Learning and Innovation Skills Cronbach Alpha was focused since Skills18 was added into this factor. The Cronbach Alpha coefficient of the Learning and Innovation Skills was .94. Also, values under the "Corrected item-total Correlation" demonstrated that items ranged between .51 and .77. The value of Skills18 was .51, which showed that it adapted to factor 1 successfully since its value was above .3. All other factors' Cronbach's Alpha Coefficient and the ranges of Corrected item-total Correlation were given below.

Table 3.3

Cronbach's Alpha Coefficient and Corrected Item-total Correlation of Each Factor and the 21st-Century Skills Scale

	Number of Items	Cronbach Alpha coefficient (α)	Corrected Item-Total Correlation
Learning and Innovation Skills	17	.94	.51 - .77
Life and Career Skills	16	.90	.37 - .70
Information, Media and Technology Skills	8	.89	.50 - .72
21st-Century Skills	41	.95	.38 - .71

These findings represented that a consistency existed between factor analysis and reliability statistics. Therefore, both the validity and reliability of the 21st-Century Skills Scale were approved for in-service early childhood educators by making a slight change on the original scale. At the end of the pilot study, while factor 1 (Learning and Innovation Skills) included 17 items, factor 2 (Life and Career Skills) contained 16 items, and factor 3 (Information, Media and Technology Skills) included 8 items.

3.4.2.2. EFA and CFA of 21st-Century Skills Scale with the Data of the Main Study

Matsunaga (2010) pointed out that EFA and CFA should be used with different data sets in a study to reach more accurate results. However, the researcher used the same data set for both EFA and CFA in this research's pilot study due to an insufficient amount of data for dividing the data set into two separate parts. That is why both analyses were repeated with the data of the main study to be sure of the validity of the research.

Before beginning to analyze the data set, checking errors have an important place in the analysis (Pallant, 2013; Çokluk, Şekercioğlu & Büyüköztürk, 2021). Thus, after the reverse item (Skills27) was transformed, errors and extreme outliers were checked. Data was gathered from 410 participants and it was recognized that there was a mistake in 7 data about the reverse item since the participants (n=7) marked all questions as "5". For this reason, they were omitted. Besides, Tabachnick and Fidell (1996) suggest calculating Z scores for all variables to find univariate outliers. After cleaning, the z score of the variables was created to detect outliers. When Z scores, Kurtosis and Skewness were examined, it was noticed that there were some inappropriate values. Some extreme outliers in a few items (Skills30, Skills33, Skills34) caused these abnormalities. After examination of normal probability plots, detrended normal probability plots and box plots, 4 extreme data, which created abnormalities in the aforementioned items (Skills30, Skills33, Skills34), were omitted. After controls and corrections, 399 data were left for conducting factor analysis. Moreover, the sample size, normality, and the factorability of the scale (Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy) were examined since

these assumptions need to be fulfilled to conduct EFA (Tabachnick & Fidell, 1996; Child, 2006; Çokluk, Şekercioğlu & Büyüköztürk, 2021).

There are different opinions about the sample size to conduct EFA. As mentioned before, Comley and Lee (1992) pointed out that more than 300 is good as a sample size, while Kline (1994) stated that 200 is generally enough to have an appropriate sample size for factor analysis. For this reason, it was assumed that 399 data was good to conduct EFA. When Bartlett's test of sphericity is taken into consideration to assess the normality, it is expected to have a statistically significant value ($p < .05$) to continue factor analysis (Tabachnick & Fidell, 1996; Çokluk, Şekercioğlu & Büyüköztürk, 2021). Additionally, the factorability of the scale, which is explored with KMO, should be higher than 0.60. Moreover, most of the correlation coefficient scores in the Correlation Matrix table should be higher than 0.3. Factor analysis cannot be performed if these assumptions are not fulfilled (Pallant, 2013).

Table 3.4

KMO and Bartlett's Test of the 21st-Century Skills Scale with the Data of the Main Study

Kaiser-Meyer-Olkin measure of sampling adequacy		.947
Bartlett's test of sphericity	Approx. Chi-Square	9688.458
	df	861
	Sig.	.000

The 42 items of the 21st-century skills scale were subjected to principal components analysis (PCA) for EFA. Bartlett's test of sphericity had a statistically significant result ($p= 0$). The Kaiser-Meyer-Olkin value was more than 0.60 (KMO= 0.947), so it had an excellent value as Çokluk, Şekercioğlu and Büyüköztürk stated (2021). Additionally, examination of the "Correlation Matrix" indicated the presence of coefficients that were .3 and above. The data set was suitable for factor analysis in line with these results.

In the principal components analysis (PCA), the "Total Variance Explained" table and "Screeplot" should be examined to decide the number of components (factors). While

using Kaiser's criterion, only components that have an eigenvalue above 1 are taken into consideration (Pallant, 2013; Çokluk, Şekercioğlu & Büyüköztürk, 2021). The "Total Variance Explained" table represented that there were seven components with eigenvalues greater than 1, which explained 61.62 % of the total variance. On the other hand, the "Screeplot" showed that there was an apparent break between the third and fourth components. For this reason, Parallel analysis was applied to determine and confirm the number of factors (Child, 2006; Pallant, 2013). According to parallel analysis, the eigenvalues of only the first three components were higher than the criterion value. Therefore, this finding supported the "Screeplot" about having only three factors for further investigation as in the pilot study.

Çokluk, Şekercioğlu and Büyüköztürk (2021) and Pallant (2013) expressed that after deciding the number of factors, the factor analysis can be continued by defining the exact number of factors and changing the rotation method. Because of this reason, the principal components analysis (PCA) was renewed by specifying the number of factors as three and by choosing the rotation method as Varimax.

The "Total Variance Explained" table represented that those three factors explained 49,58 % of the total variance. The "Rotated Component Matrix" demonstrated that Skills18 (I take an initiative to improve my skills.) was related to factor one (Learning and Innovation Skills) rather than factor two (Life and Career Skills), like the findings of the pilot study. Therefore, Skills18 was moved from factor two to factor one. Besides, Skills17 (I use time effectively.) was found as more related to factor one (Learning and Innovation Skills) instead of being related to factor two (Life and Career Skills). By taking the result of the pilot study and the inappropriateness between item17 and factor one into consideration, omitting Skills17 from the analysis was decided.

After the omission of an item (Skills17), all process was repeated to check for any possible changes. According to the repeated process, Bartlett's test of sphericity had a statistically significant result (p= 0) while the Kaiser-Meyer-Olkin value stayed the same as .947.

Table 3.5

KMO and Bartlett's Test of the Renewed 21st-Century Skills Scale with The Data of the Main Study

Kaiser-Meyer-Olkin measure of sampling adequacy		.947
Bartlett's test of sphericity	Approx. Chi-Square	9432.632
	df	820
	Sig.	.000

Moreover, when the values on both the Component Matrix and the Rotated Component Matrix were examined, it was concluded that the last structural changes were appropriate for factoring. Therefore, at the end of the EFA, it was confirmed that the 21st-century Skills Scale had three factors. Factor 1 (Learning and Innovation Skills) included 17 items, while factor 2 (Life and Career Skills) contained 16 items, and factor 3 (Information, Media and Technology Skills) had 8 items.

After EFA, the Confirmatory Factor Analysis (CFA) was conducted to confirm the construct validity of the 21st-century Skills Scale with 3 factors by adding error covariances between item 15 and item 14, item 22 and item 21, item 24 and item 23, and also item 34 and item 33. The Chi-square value (χ^2= 1985.39, N=399, df=772, p=.000) was statistically significant. However, its p-value should be more than .05 (Çokluk, Şekercioğlu & Büyüköztürk, 2021). For this reason, other goodness-of-fit indices were examined. "χ^2/sd" were equal to 2.57, so this value is an indicator of the perfect fit (Tabachnick & Fidell, 2001). Besides, the goodness of fit indexes of the scale were calculated as RMSEA=0.063, GFI=0.80, AGFI=0.78, CFI=0.97, NFI=0.96, NNFI=0.97, RMR=0.025 and SRMR=0.058 (Path diagram was given in Appendix E). These values indicated that RMSEA and SRMR were a sign of good fit while CFI, NFI, NNFI and RMR were a sign of perfect fit, although GFI and AGFI did not meet conditions of the critical level (Çokluk, Şekercioğlu & Büyüköztürk, 2021). Thus, this finding led us to conclude that the structural model of the 21st-century Skills Scale had a good fitness level for in-service early childhood educators after omitting Skills17 and making a factorial change of Skills18. The validity of the renewed 21st-century Skills Scale and the pilot study's findings were confirmed.

3.4.2.3. Pilot Study of Technological Pedagogical Content Knowledge (TPACK) Scale

The TPACK Scale was developed to be used for self-assessment of both pre-service and in-service educators, although it was created by collecting data only from pre-service educators (Horzum, Akgün & Öztürk, 2014). In this study, it was used for the assessment of in-service early childhood educators' TPACK level. The pilot study was conducted by following most of the steps in the main study of the original TPACK Scale. In line with the scale development study of Horzum, Akgün and Öztürk, CFA, second-order CFA, test for Cronbach Alpha, and Pearson correlation for factor association were conducted to prove the validity and reliability of the scale.

In advance of confirmatory factor analysis (CFA), the data set was checked in terms of missing values, normality, sample size and outliers to decide whether the data set was appropriate for factor analysis (Çokluk, Şekercioğlu & Büyüköztürk, 2021). As mentioned before, 200 data were collected from in-service early childhood educators; as Kline (1994) pointed out that 200 is generally enough to have an appropriate sample size. Therefore, Z scores of all variables were calculated to find univariate outliers (excess of 3.29) (Tabachnick & Fidell, 1996). Moreover, Skewness and Kurtosis and trimmed means of items were examined, and they indicated that the normality was provided. Additionally, the examination of normal probability plots, detrended normal probability plots, and box plots showed that there were no extreme outliers (Pallant, 2013; Tabachnick & Fidell, 1996).

By using data collected from 200 participants, the first level confirmatory analysis was conducted to confirm the construct validity of the TPACK model with 7 factors. Chi-square value (χ^2= 2828.34, N=200, df=1203, p=.000) was statistically significant. Because of this reason, other goodness-of-fit indices were examined. "χ^2/sd" was equal to 2.35, so this value is an indicator of the perfect fit (Tabachnick & Fidell, 1996). Besides, the goodness of fit indexes of the scale were calculated as RMSEA=0.082, GFI=0.64, AGFI=0.61, CFI=0.97, NNFI=0.97, RMR=0.032 and SRMR=0.064. These values indicated that while RMSEA and SRMR were a sign of good fit and CFI, NNFI, and RMR were a sign of perfect fit, although GFI and AGFI did not meet conditions

of the critical level (Çokluk, Şekercioğlu & Büyüköztürk, 2021). When the modification indexes were examined, it was noticed that there was a strong association between the error covariances of items 48 and 49, which are under the same latent variable (TPCK). Therefore, it was decided to modify by setting error covariances of these items free.

After CFA was re-conducted by adding error covariances between items 48 and 49, the Chi-square value (χ^2= 2779.99, N=200, df=1202, p=.000) was statistically significant, so other goodness-of-fit indices were examined. "χ^2/sd" was counted as 2.31 and it represented a perfect fit. Additionally, the goodness of fit indexes was calculated as RMSEA=0.081, GFI=0.65, AGFI=0.61, CFI=0.97, NNFI=0.97, RMR=0.032 and SRMR=0.064 (Path diagram was given in Appendix F). In this context, most of the goodness of fit indexes indicated good or perfect fit except GFI and AGFI. Thus, this finding led us to conclude that the structural model of the TPACK Scale had a good fitness level for Turkish culture.

In addition to confirming the construct validity of the TPACK model with 7 factors, the construct validity of the TPACK total score was examined via second-order CFA. Chi-square value (χ^2= 3039.43, N=200, df=1217, p=.000) represented that the analysis had a statistically significant result. That is why other goodness-of-fit indices were examined. "χ^2/sd" was counted as 2.49, which indicated a perfect fit (Kline, 2005). Furthermore, other goodness of fit statistics was calculated as RMSEA=0.087, GFI=0.63, AGFI=0.59, CFI=0.97, NNFI=0.97, RMR=0.041 and SRMR=0.087. According to Çokluk, Şekercioğlu and Büyüköztürk (2021), RMSEA had good fitness value while CFI, NNFI, RMR, and SRMR had excellent fitness value. However, GFI and AGFI did not reach the critical level. Besides, when the modification indexes were examined, it was noticed that there was a strong association between the error covariances of CK and PK, TPCK and TPK, TCK and TK, PCK and PK, PCK and CK, items 48 and 49, items 46 and 47. Therefore, it was decided to modify errors by setting error covariances of these endogenous and exogenous variables free.

After the second-order CFA was re-conducted by adding error covariances between the aforementioned endogenous and exogenous variables, the Chi-square value (χ^2=

2839.19, N=200, df=1202, p=.000) was statistically significant. Thus, other goodness-of-fit indices were examined. "χ^2/sd" was counted as 2.36. It represented a perfect fit. Additionally, the goodness of fit indexes was calculated as RMSEA=0.082, GFI=0.64, AGFI=0.61, CFI=0.97, NNFI=0.97, RMR=0.035 and SRMR=0.069 (Path diagram was given in Appendix F). In this context, most of the goodness of fit indexes of the TPACK Scale indicated good or perfect fit except GFI and AGFI (Çokluk, Şekercioğlu & Büyüköztürk, 2021). Therefore, by analyzing these values, it could be concluded that the TPACK Scale has a valid structure to use in this research.

The TPACK Scale's reliability was checked after validation. Cronbach Alpha and Pearson correlation for factor association were conducted to prove reliability. Examination of the Cronbach Alpha coefficient of the TPACK Scale indicated that it was .97. Additionally, "Item-Total Statistics" revealed that removing any item from the scale will not improve the Cronbach Alpha coefficient. Besides, values under the "Corrected item-total Correlation" demonstrated that items ranged between .49 and .78. It means that all items are above .3 and correlated with the scale (Pallant, 2013). In conclusion, all items are related to the TPACK Scale, and the Cronbach Alpha coefficient represented that reliability of the scale was high. In addition to the scale's total Cronbach Alpha coefficient score, each factor's Cronbach Alpha was examined to view Item-Total Correlation under each specific factor.

Table 3.6

Cronbach's Alpha Coefficient and Corrected Item-Total Correlation of Each Factor and The TPACK Scale

	Number of Items	Cronbach Alpha coefficient (α)	Corrected Item-Total Correlation
TK	6	.91	.64 - .85
PK	7	.88	.51 - .78
CK	8	.92	.63 - .80
TCK	6	.89	.67 - .79
PCK	8	.92	.49 - .66
TPK	8	.93	.71 - .81
TPCK	8	.94	.74 - .86
Total TPACK	51	.97	.49 - .78

In addition to Cronbach Alpha, the Pearson correlation for factor association of the TPACK Scale was conducted. Pearson correlation coefficients (r) provide information on whether there is an association between two variables and range from –1 to +1. While r=.10 to .29 means small correlation, r=.30 to .49 means medium correlation and r=.50 to 1.0 implies large correlation (Pallant, 2013).

Table 3.7

Pearson Correlation for Factor Association of the TPACK Scale

	TK	PK	CK	TCK	PCK	TPK	TPCK
TK	1	.455**	.468**	.709**	.358**	.631**	.637**
PK	.455**	1	.720**	.513**	.725**	.571**	.606**
CK	.468**	.720**	1	.670**	.745**	.632**	.600**
TCK	.709**	.513**	.670**	1	.604**	.821**	.755**
PCK	.358**	.725**	.745**	.604**	1	.701**	.620**
TPK	.631**	.571**	.632**	.821**	.701**	1	.868**
TPCK	.637**	.606**	.600**	.755**	.620**	.868**	1
Total TPACK	.740**	.777**	.816**	.873**	.805**	.909**	.891**

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

Analysis of the Pearson correlation between the factors of the scale and the total score of the scale indicated that there was a high positive correlation. While the TK and PK factors had scores above .70, the CK, PCK, TCK and TPCK had above .80, and the TPK had above .90. Furthermore, when the correlations between the factors of the scale were examined, it was noticed that they changed between .35 and .86. This implied that there were medium or large positive correlations among all the factors of the scale, and all factors had a significant relationship with the Total TPACK score at the .01 level.

3.5. Data Analysis for Main Study

The purpose of the main study is to investigate the research questions offered by the researchers. In this section, the targeted population and selected sample, data collection process, and data analysis process were presented with details.

3.5.1. Population and Sample

The population in this study is in-service early childhood educators in Ankara, Istanbul, and Izmir. The main research data were collected from 410 in-service early childhood educators who worked in Ankara, Istanbul, and Izmir in the spring semester of the 2021-2022 academic year. Educators from both private schools and public schools attended the research.

In this study, convenience sampling was used. Convenience sampling is a method in which participants are selected according to their availability to collect data conveniently (Fraenkel & Wallen, 2009). The reason for using this method was the conditions of the Covid-19 pandemic. In pandemic conditions, convenience sampling was decided to use by choosing schools from each district of Ankara, Istanbul and Izmir according to the number of educators in schools. The researcher paid attention to communicating with the schools with many educators to collect data from more educators quickly. However, when data were not collected from schools with high number of educators, some schools were called randomly at the end of the data collection process to gather in a short time. Nearly 200 schools were contacted, and the online form was sent to the schools that accepted to share it with educators who work in those schools. Moreover, the researcher shared the online form with some acquaintances and some educators on social media. In that way, 410 in-service early childhood educators filled out the online form to assess their 21st-century skills and TPACK level by attending the research voluntarily.

3.5.2. Data Collection Process

Before beginning to collect data, permission was taken from the Human Subjects Ethics Committee (HSEC) of Middle East Technical University (METU) and the Ministry of National Education (MONE) to conduct a research study in Ankara, İstanbul and İzmir during the 2021-2022 academic year. At the beginning of the online form, it was ensured that the participants' identities were confidential due to privacy

issues. Besides, consent forms were filled out by participants about attending the study voluntarily and giving permission to use their data.

The study instruments were transmitted into an online google form, and this online form was sent to schools and educators. The researcher communicated with schools by calling them one by one. Therefore, the online form was sent to the schools which accepted to share it with educators who work in those schools. Besides, the online form was shared with some acquaintances and some educators on social media. The data collection period of the pilot study started in August 2021 and finished in December 2021. After analyzing the pilot study's data, the main research data collection period began in January 2022 and ended in March 2022.

3.5.3. Data Analysis Process

Quantitative and qualitative data analyses were used in this study, which will be mentioned in detail in the following parts. First of all, quantitative analysis was explained.

3.5.3.1. Quantitative Data Analysis

The data of the main research was analyzed by using SPSS 24.0 program. At the beginning of the analysis, the data screening process was applied for the accuracy of the data set by examining entry errors, missing values, outliers and the assumptions of normality, as Pallant (2013) and Tabachnick and Fidell (1996) pointed out.

During the data screening, some mistakes were noticed due to entry errors, so they were corrected. Moreover, during the examination of entry errors, it was recognized that some participants (n=7) filled the form by marking all the questions "5" including the reversed question. Thus, 7 data were deleted not to affect the analysis adversely. Educators filled out the form online. Filling out all the questions was compulsory to complete the form. For this reason, there were no missing values in the data set. Before the factor analysis of the 21st-century skills scale, which was conducted using the main

study's data set, 4 outliers were deleted since they were extreme values and led to abnormalities.

Tabachnick and Fidell (1996) suggested univariate and multivariate outliers should be detected before the analysis since they can cause Type I and Type II errors which impact the generalization of the study findings. Because of this, all variables related to 21st-century skills and TPACK were examined. Firstly, Z scores for all variables were calculated to find univariate outliers by benefitting from standard scores (Z scores). According to Tabachnick and Fidell (1996), Z scores over 3.29 were accepted as possible outliers. Similarly, Büyüköztürk, Cakmak, Akgün, Karadeniz and Demirel (2016) recommended accepting scores in excess of 4.00 as outliers for large sample size. The examination of normal probability plots, detrended normal probability plots, and box plots indicated that some cases went beyond the recommended scores in some variables. There were some univariate outliers in the data set. Tabachnick and Fidell (1996) pointed out that if the sample size is large, a few outliers that are over 3.29 are not a problem. Therefore, the most repeated extreme outliers (n=7) were omitted to reduce their impact on the analysis, while few outliers were kept in the study.

In addition to univariate outliers, multivariate outliers were detected before the main analysis by using Mahalanobis Distance (Tabachnick & Fidell, 1996; Pallant, 2013). After calculating Mahalanobis Distance, the p-value was calculated for each case to find multivariate outliers. Outliers were calculated by comparing the critical Chi-Square value, which had $p.<0.001$. Its degree of freedom equaled the number of independent variables. It meant $\chi^2(11) = 31.264$. According to this information, there were 10 multivariate outliers.

In line with the suggestion of Tabachnick and Fidell (1996), different strategies were taken into consideration to reduce the impact of outliers on the analysis. Since it is difficult to find the reason for the discrepancy related to multivariate outliers, the multivariate outliers (n=10) were deleted from the data set to reduce their impact on the main analysis. After the cleaning of univariate and multivariate outliers, further analyses were conducted with 382 data in the study.

After Outliers, Normality, Homogeneity of variances, Linearity, and Homoscedasticity of the data set were examined to provide assumptions about the research, descriptive statistics were investigated to indicate the general features of the research. Moreover, Two-way ANOVA, and Correlation study were conducted for further investigations.

3.5.3.2. Qualitative Data Analysis

In addition to quantitative data analysis, content analysis was applied to analyze the answers of the early childhood educators about a taken course or training on 21st-century skills and technology usage in education. Content analysis is a type of qualitative analysis that can be used for open-ended questions in extensive quantitate studies to enable researchers to examine the details of these questions (Dawson, 2007). In this study, the educators' answers about training on 21st-century skills were categorized by the researcher according to the sub-factors of the 21st-century skills. Moreover, the researcher divided the educators' responses about training on technology usage in education into four groups (Coding, Digital awareness, Distance learning, and Basic Technological knowledge). The answers to the open-ended questions were assessed by two researchers to test the intercoder reliability of the content analysis. After the researchers coded responses, the percent agreement and Cohen's kappa indexes were calculated by "ReCal", which is a web-based intercoder reliability calculator, for the intercoder reliability (Freelon, 2010). The percent agreement related to training on 21st-century skills was 86.4 %. At the same time, Cohen's kappa was 0.796. Moreover, the percent agreement related to training on technology usage in education was 93.1 %, while Cohen's kappa was 0.906. Lombard, Snyder-Duch and Bracken (2017) emphasized that if the coefficient score is higher than .80, it is generally acceptable. If it is .70, it can be suitable for some exploratory studies. Considering this, intercoder reliability was provided in this study.

3.6. Ethical Concerns

All ethical concerns were taken into consideration carefully before the research. The ethical principles were examined seriously to protect the participants from physical, mental, and emotional harm by providing confidentiality. Moreover, deceiving the participants was avoided. Besides, participants attended to the research voluntarily by having the right to leave the form whenever they wanted if they did not feel comfortable with questions. Additionally, personal information of the participants, like e-mail, was not requested (Fraenkel & Wallen, 2009). The ethical appropriateness of the study was approved by the Human Subjects Ethics Committee (HSEC) of METU.

3.7. Limitations of the Study

The study had some limitations that should be taken into consideration during the evaluation process of the study findings.

- The participants of this study were only limited to in-service early childhood educators who worked in Ankara, İstanbul, and İzmir during the 2021-2022 academic year.
- In this study, data were collected from in-service early childhood educators only by using the self-assessment instruments, which are the Demographic Information Form, 21st-Century Skills Scale, and Technological Pedagogical Content Knowledge (TPACK) Scale. For this reason, it was assumed that participants in the research have evaluated their skills and knowledge honestly and accurately.
- Data about educators' age and years of experience were only collected as categorical variables instead of continuous variables. That situation hindered in deep research about these variables.

CHAPTER 4

RESULTS

In this chapter, the research findings were expressed in detail. The research questions were analyzed by using three different methods, which were two-way ANOVA, and correlation analyses. Besides, the details of the preliminary analysis were shared to provide information about the assumptions of the used methods. The analysis result was presented one by one for each research question by providing assumptions at the beginning of the inferential analysis.

4.1. Assumptions

To apply the analysis of two-way ANOVA and correlational study, some assumptions should be met. For conducting two-way ANOVA, there should be two categorical independent variables and one continuous dependent variable (Pallant, 2013; Gravetter & Wallnau, 2014). Besides, Independence of observation, Random sampling, Normal distribution, and Homogeneity of variances should be provided for implementing both analyses (Huizingh, 2007; Pallant, 2013). For conducting a correlation study, there should be two continuous variables to examine the relationship between them (Pallant, 2013; Gravetter & Wallnau, 2014). Besides, scores of the variables should be collected from the same participants. In addition, Independence of observation, Random sampling, Normal distribution, Linearity, and Homoscedasticity should be provided (Huizingh, 2007; Pallant, 2013).

4.1.1. Assumptions of Two-Way ANOVA with The Total Score of 21st-Century Skills

Tabachnick and Fidell (1996), Huizingh (2007) and Pallant (2013) explained that data need to be collected independently not to be affected by other measurements. This study fulfilled the Independence of observation. Moreover, while collecting data, the convenient sampling method was used by communicating with schools with a high number of educators from various distinct of Ankara, İzmir and İstanbul. Although having a random sampling in real-life research is difficult (Pallant, 2013), it can be assumed that the sample was randomly chosen since after communicating with schools with a high number of educators, other schools which have an average number of educators were called randomly.

The normal distribution is about whether data are cumulated around the center instead of being far from the mean or not (Tabachnick & Fidell, 1996; Gravetter & Wallnau, 2014). To conduct two-way ANOVA, the normality of the total score of 21st-century skills was examined in terms of age, years of experience, education level, and training attendance.

To decide the normality of the total score of 21st-century skills regarding age, Kolmogorov-Smirnov was examined. It was .007 for the age of 30 and below, .001 for the ages of 31-40, and .001 for the age of 41 and above. These values indicated that none of them provided normality, but the current study had more than 30 participants in each age group, so these values did not lead to any major problems. Besides, skewness and kurtosis scores of the age of 30 and below were -.434 and -.669, skewness and kurtosis scores of the ages of 31-40 were -.591 and -.411, and skewness and kurtosis scores of the age of 41 and above were -.422 and -.716. These values demonstrated that all of them were between the range of -2 and +2 and provided normality. Additionally, when the histogram, Normal Q-Q Plot, Detrended Normal Q-Q Plot, and Boxplot for all age groups were examined, we noticed that there was not any outlier in the groups. Briefly, by considering all of these, data provided normality. Thus, two-way ANOVA can be conducted to evaluate the differences in the total score of 21st-century skills regarding age groups of educators.

To decide the normality of the total score of 21st-century skills regarding years of experience, we examined the Kolmogorov-Smirnov. It was .200 for 0-3 years of experience, .012 for 4-7 years of experience, and .000 for 8+ years of experience. Thus, these values indicated that only educators with 0-3 years of experience provided normality, but the current study had more than 30 participants in other groups, so not providing normality did not lead to any major problem. Besides, skewness and kurtosis scores of educators with 0-3 years of experience were -.213 and -.780, skewness and kurtosis scores of educators with 4-7 years of experience were -.670 and -.548, and skewness and kurtosis scores of educators with 8+ years of experience were -.509 and -.526. These values demonstrated that all of them were between -2 and +2 and provided normality. Additionally, when we looked at the histogram, Normal Q-Q Plot, Detrended Normal Q-Q Plot, and Boxplot for different years of experience, there was no outlier in the groups. Briefly, by taking all of these into consideration, data provided normality and two-way ANOVA can be conducted to evaluate the differences in the total score of 21st-century skills regarding educators' years of experience.

To decide the normality of the total score of 21st-century skills regarding the education level of educators, Kolmogorov-Smirnov was examined. It was .027 for the associate degree, .000 for the undergraduate degree, and .093 for the master's degree. Thus, these values indicated that both associate and master's degree provided normality, but also, the current study had more than 30 participants who had the undergraduate degree (N=286), so not providing normality did not lead to any major problem. Besides, skewness and kurtosis scores of educators with the associate degree were -.788 and -.024, skewness and kurtosis scores of educators with the undergraduate degree were -.424 and -.704, and skewness and kurtosis scores of educators with the master's degree were -.703 and -.135. These values demonstrated that all of them were between -2 and +2, so they were normal. Additionally, when the histogram, Normal Q-Q Plot, Detrended Normal Q-Q Plot and Boxplot for the education level of educators were examined, there was not any outlier in the groups. Briefly, by considering all of these, data provided normality, and two-way ANOVA can be conducted to evaluate the differences in the total score of 21st-century skills regarding the education level of educators.

Kolmogorov-Smirnov was examined to decide the normality of the total score of 21st-century skills regarding training attendance on 21st-century skills. It was .000 for educators who did not attend any training and .000 for educators who attended any training. Thus, these values indicated that they were not normal, but the current study had more than 30 participants in each group, so it did not lead to any major problems. Besides, skewness and kurtosis scores of educators who did not attend any training were -.332 and -.837, and skewness and kurtosis scores of educators who attended any training were -.888 and .473. These values demonstrated that all of them were between -2 and +2 and provided normal distribution. Additionally, when the histogram, Normal Q-Q Plot, Detrended Normal Q-Q Plot, and Boxplot for both groups were examined, there was only one outlier on Boxplot in the group of educators who attended training. Since it was not an extreme outlier and other examinations did not indicate any problem, an outlier was not omitted. Briefly, when all of these were considered, data provided normality, and two-way ANOVA can be conducted to evaluate the differences in the total score of 21st-century skills regarding attended training by educators.

The final assumption was related to Homogeneity of variance, which refers to obtaining the sample from populations of equal variances. It was examined via Levene's test to decide the Homogeneity of variance (Pallant, 2013; Huizingh, 2007; Gravetter & Wallnau, 2014).

Additionally, Levene's test was checked for the total score of 21st-century skills of educators for age groups and years of experience, its significance value calculated as .124. The meaning of having a value greater than .05 is that assumption about the homogeneity of variances was not violated (Pallant, 2013; Huizingh, 2007).

Moreover, Levene's test was examined for the total score of 21st-century skills of educators for education level and attended training. Its significance value (.079) demonstrated that equal variance was assumed. It meant that homogeneity of variances was provided since its p-value was greater than .05 (Pallant, 2013; Huizingh, 2007).

4.1.2. Assumptions of Two-Way ANOVA with The Total TPACK Score

Tabachnick and Fidell (1996), Huizingh (2007) and Pallant (2013) expressed that data need to be collected independently not to be affected by other measurements. This study fulfilled the Independence of observation. Moreover, while collecting data, the convenient sampling method was used by communicating with schools with a high number of educators from various distinct of Ankara, İzmir and İstanbul. Although having a random sampling in real-life research is difficult (Pallant, 2013), it can be assumed that the sample was randomly chosen since after communicating with schools with a high number of educators, other schools with an average number of educators were called randomly.

To conduct two-way ANOVA, the normality of the total TPACK score was examined in terms of age, years of experience, education level and training attendance. To decide the normality of the total TPACK score regarding age, Kolmogorov-Smirnov was examined. It was .000 for the age of 30 and below, .000 for 31-40, and .003 for the age of 41 and above. Thus, these values indicated that all of them were not normal, but the current study had more than 30 participants in each age group, so it did not lead to any major problems. Besides, skewness and kurtosis scores of the age of 30 and below were -.769 and -.271, skewness and kurtosis scores of the age of 31-40 were -.697 and -.195, and skewness and kurtosis scores of the age of 41 and above were -.663 and -.246. It demonstrated that all of them were between -2 and +2 and were accepted as normal. Additionally, when the histogram, Normal Q-Q Plot, Detrended Normal Q-Q Plot, and Boxplot for all age groups were examined, there were only two outliers on Boxplot. Since they were not extreme outliers and other examinations did not indicate any problem, outliers were not omitted. Briefly, data provided normality, and two-way ANOVA can be carried out to evaluate the differences in the total TPACK score regarding age groups.

Kolmogorov-Smirnov was examined to decide the normality of the total TPACK score regarding years of experience. It was .070 for 0-3 years, .000 for 4-7 years, and .000 for 8+ years. Thus, these values indicated that only educators with 0-3 years of experience provided normality, but the current study had more than 30 participants in

other groups, so not providing normality did not lead to any major problem. Besides, skewness and kurtosis scores of educators with 0-3 years of experience were -.635 and -.718, skewness and kurtosis scores of educators with 4-7 years of experience were -.992 and .210, and skewness and kurtosis scores of educators with 8+ years of experience were -.648 and -.260. These values demonstrated that all of them were between -2 and +2 and were accepted as normal. Additionally, when the histogram, Normal Q-Q Plot, Detrended Normal Q-Q Plot, and Boxplot for different years of experience were examined, there was no outlier in the groups. Thus, data provided normality, and two-way ANOVA can be conducted to evaluate the differences in the total TPACK score regarding educators' years of experience.

To decide the normality of the total TPACK score regarding the education level of educators, Kolmogorov-Smirnov was examined. It was .001 for the associate degree, .000 for the undergraduate degree, and .031 for the master's degree. Thus, these values indicated that they did not provide normality. However, since we had more than 30 participants in each group, this situation did not lead to any major problems. Besides, skewness and kurtosis scores of educators with the associate degree were -1.085 and .649, skewness and kurtosis scores of educators with the undergraduate degree were -.661 and -.324, and skewness and kurtosis scores of educators with the master's degree were -.950 and 1.132. These values demonstrated that all of them were between -2 and +2 and provided normality. Additionally, when the histogram, Normal Q-Q Plot, Detrended Normal Q-Q Plot, and Boxplot for the education level of educators were examined, there was only one outlier. It was not an extreme outlier, and other examinations were normal, so it was not omitted. Briefly, considering all these, data provided normality, and two-way ANOVA can be conducted to evaluate the differences in the total TPACK score regarding the education level of educators.

Kolmogorov-Smirnov was examined to decide the normality of the total TPACK score regarding training attendance on technology usage in education. It was .000 for educators who did not attend any training, and .000 for educators who attended any training. Thus, these values indicated that all of them were not normal, but the current study had more than 30 participants in each group, so it did not lead to any major problems. Besides, skewness and kurtosis scores of educators who did not attend any

training were -.586 and -.336, and also, skewness and kurtosis scores of educators who attended any training were -.930 and .200. These values demonstrated that both of them were between -2 and +2 and were accepted as normal. Additionally, when the histogram, Normal Q-Q Plot, Detrended Normal Q-Q Plot, and Boxplot were examined according to training attendance, there was only one outlier on Boxplot in the groups of educators who attended any training. Since it was not an extreme outlier and other examinations did not indicate any problem, an outlier was not omitted. Briefly, by taking all of these into consideration, data provided normality, and two-way ANOVA can be conducted to evaluate the differences in the total TPACK score regarding attended training by educators.

The final assumption was about Homogeneity of variance, which refers to obtaining the sample from populations of equal variances. It was examined via Levene's test to decide the Homogeneity of variance (Pallant, 2013; Huizingh, 2007; Gravetter & Wallnau, 2014).

Besides, Levene's test was checked for the total TPACK score of educators for age groups and years of experience, its significance value calculated as .008. The meaning of having a value less than .05 is that assumption about the homogeneity of variances was violated (Pallant, 2013; Huizingh, 2007). In that case, Pallant (2013) recommended continuing the analysis by changing the significant level (p) of the analysis to a more stringent value like .01.

Moreover, Levene's test was examined for the total TPACK score of educators for education level and training attendance. Its significance value (.316) demonstrated that equal variance was assumed. It meant that homogeneity of variances was provided since its p-value was greater than .05 (Pallant, 2013; Huizingh, 2007).

4.1.3. Assumptions of Correlational Study

Tabachnick and Fidell (1996) and Pallant (2013) explained that data need to be collected independently not to be affected by other measurements. This study fulfilled the Independence of observation.

The normal distribution was checked for the total TPACK score, as stated before. When the normal distribution was checked, Kolmogorov-Smirnov was .000, so it violated the normality distribution. However, Pallant (2013) highlighted that violation of the normal distribution in the large sample size should not lead to any significant problem. Therefore, this Kolmogorov-Smirnov score may not be a problem for the analysis. Also, when the tables and graphs were examined, it was noticed that they did not violate the normal distribution. Therefore, data provided normality for conducting a correlation study.

Moreover, when the normal distribution was checked for the total 21st-Century Skills, Kolmogorov-Smirnov was .000, so it violated the normal distribution. However, Pallant (2013) pointed out that violation of the normal distribution in the large sample size should not lead to any major problems. The number of participants was 382, which was a large sample size. Therefore, this Kolmogorov-Smirnov score may not be a problem for the analysis. Additionally, Normal Q-Q Plot, Detrended Normal Q-Q Plot and Boxplot were examined; there were no outliers. Therefore, data provided normality to conduct a correlation study.

Furthermore, when the normal distribution for the Learning and Innovation Skills was examined, Kolmogorov-Smirnov was .000 for the Learning and Innovation Skills, so it violated the normality distribution. Nevertheless, this Kolmogorov-Smirnov score did not lead to any major problems due to the large sample size in the present study (N=382) (Pallant, 2013). When the tables and graphs were examined, the shape of the histogram was tended to the shape of negative skewness. The skewness score is –0.476, and the kurtosis score is -.667, indicating that they were in the accepted range and did not violate the normal distribution. Additionally, Normal Q-Q Plot, Detrended Normal Q-Q Plot, and Boxplot were examined; there were not any outliers. Therefore, data provided normality to conduct a correlation study.

The normal distribution of the Life and Career Skills was checked. Kolmogorov-Smirnov was .000 for the Life and Career Skills, so it violated the normality distribution. Nevertheless, Pallant (2013) pointed out that violation of the normal

distribution does not lead to any major problem if the sample size is large. Thus, the violated value of Kolmogorov-Smirnov was not a problem for this study (N= 382). When the tables and graphs were examined, the shape of the histogram was tended to the shape of negative skewness. The skewness score is – 0.822, and the kurtosis score is .220, so these values indicated that they were not so far from the center and did not lead to a problem for the normal distribution. On the other hand, when Normal Q-Q Plot and Detrended Normal Q-Q Plot, and Boxplot were examined, there were a few outliers. For this reason, it was concluded that non-parametric methods could be used to analyze the association related to Life and Career Skills.

The normal distribution of the Information, Media and Technology Skills was checked. Kolmogorov-Smirnov was .000 for the Information, Media and Technology Skills, so it violated the normality distribution. Nevertheless, this Kolmogorov-Smirnov score did not lead to any significant problems for the analysis due to the large sample size (N=382) (Pallant, 2013). When the tables and graphs were examined, the shape of the histogram was tended to the shape of negative skewness. The skewness score is – 0.827, and the kurtosis score is -.215. Altun (2019) and George and Mallery (2003) expressed that if the skewness and kurtosis values are within the range of -2 to +2, the distribution can be accepted as a normal distribution. Therefore, these values did not lead to any problem for the normal distribution. Additionally, when Normal Q-Q Plot, Detrended Normal Q-Q Plot and Boxplot were examined, there were no outliers. Therefore, data provided normality to conduct a correlation study.

In addition to normality, linearity and homoscedasticity were examined. A scatter plot indicates the correlations between the variables with the help of the distribution of dots. Therefore, the shape of the distribution of dots provides information related to linearity and homoscedasticity (Tabachnick & Fidell, 1996; Pallant, 2013).

When the scatterplot graph of the total 21st-Century Skills and the total TPACK score were examined, linearity (there was a positive relationship between scores of two scales) was provided. Although some dots were far from the line and they did not create a perfect cigar shape, most of them were clustered around the line to fulfill the

linearity. However, homoscedasticity was violated since the dots got narrow from one side to the other side by gathering together more closely than the dots on the other side (Pallant, 2013). For this reason, it was concluded that non-parametric methods could be used to analyze the association related to the total 21st-Century Skills.

When the scatterplot graph of the Learning and Innovation Skills and the total TPACK score were examined, linearity (there was a positive relationship between scores of two scales) was provided. Although some dots were far from the line and they did not create a perfect cigar shape, most of them were clustered around the line to fulfill the linearity. However, homoscedasticity was violated since the dots got narrow from one side to the other side by gathering together more closely than the dots on the other side (Pallant, 2013). For this reason, it was concluded that non-parametric methods could be used to analyze the association related to Learning and Innovation Skills.

When the scatterplot graph of the Life and Career Skills and the total TPACK score were examined, linearity (there was a positive relationship between scores of two scales) was provided. Although some dots were far from the line and did not create a perfect cigar shape, most of them were clustered around the line to fulfill the linearity. However, homoscedasticity was violated since the dots got narrow from one end to the other by gathering together more closely than the dots on the other side (Pallant, 2013). Therefore, it was concluded that non-parametric methods could be used to analyze the association related to Life and Career Skills.

When the scatterplot graph of the Information, Media and Technology Skills and the total TPACK score were examined, it can be concluded that linearity (there was a positive relationship between scores of two scales) and homoscedasticity were provided. Even though some dots were far from the line, most of them were clustered around the line at a similar distance and created almost a perfect cigar shape (Pallant, 2013).

4.2. Descriptive Results

In this part, the demographic information and the general descriptive statistics (i.e., the means, standard deviations, minimum and maximum values) related to the characteristics of the participants were shared in detail.

4.2.1. Demographic Information of the Participants

The participants of the current study were 382 early childhood educators who worked in Ankara (*f* =105, 27.5 %), İstanbul (*f* =136, 25.6 %), and İzmir (*f* =141, 36.9 %) in the 2021-2022 academic year. While most of the participants were female (*f*= 363), few were male (*f*=19) in-service early childhood educators. Among the 382 participants, 123 educators were 30 years old or below, while there were 162 educators whose ages were between 31 and 40. Additionally, 97 educators were 41 years old and above.

When the early childhood educators' years of experience were examined, it was seen that most participants had more than 8 years of experience (*f* =260, 68.1 %). Moreover, educators who had years of experience between 4 and 7 (*f* =70, 18.3 %) and educators who had years of experience between 0 and 3 (*f* =52, 13.6 %) followed the educators who had more than 8 years of experience, respectively. Among the education level of in-service early childhood educators, the undergraduate degree (*f* =286, 74.9 %) was the most frequent one. Then, the master's degree (*f* =52, 13.6 %) and the associate degree (*f* =44, 11.5 %) followed the undergraduate degree in order. When training attendance on 21st-century skills was examined, the most participants were pointed out that they did not attend any training related to 21st-century skills (*f*=255, 66.8 %), while some of them stated that they participated in some training about 21st-century skills (*f* =127, 33.2 %).

Additionally, the answers of the early childhood educators about taken 21st-century skills-related courses or training were analyzed using content analysis. The educators' responses were divided into three groups in line with the sub-groups of 21st-century

skills. Coded responses showed that educators' answers were related to Learning and Innovation Skills (37.34 %), Information, Media and Technology Skills (31.65 %), and Life and Career Skills (31.01 %), respectively. Learning and Innovation Skills category included courses like material design, first aid, critical thinking, STEM education, Lego education, and drama. Besides, Information, Media and Technology Skills consisted of courses like digital thinking, Web-2 tools usage, Fatih project, digital pedagogy, Canva, coding, and image analysis training. Life and Career Skills group contained answers like sign language course, cultural sensitivity education, reflective thinking, social-emotional learning, storytelling, STEM education, and Waldorf education.

When technology-related training attendance was examined, the number of participants who pointed out that they did not attend any training related to technology (*f* =209, 54.7 %) was higher than the number of participants who stated that they participated in some technology-related training (*f* =173, 45.3 %). Furthermore, the answers of the early childhood educators about taken course or training related to technology usage in education were analyzed using content analysis. The educators' responses were divided into four groups: Coding, Digital awareness, Distance learning, and Basic technological knowledge. After the responses were coded, it was seen that educators' answers were related to Basic technological knowledge (57.34 %), Distance learning (20.98 %), Coding (11.89 %), and Digital awareness (9.79 %) in order. The Basic technological knowledge category contained answers like using smart boards, Fatih project, Web-2 tools usage, Canva, and Microsoft office programs. The category of Distance learning included training such as literacy and mathematics in distance education, online education, the EBA platform, and zoom. The coding group had answers like Arduino, robotics, Python, and software training. Finally, Digital awareness consisted of answers like digital literacy in early childhood, using the internet consciously, digital media usage in education, digital pedagogy, digital entrepreneurship, and technological innovations (3D).

Table 4.1

Demographic Information of In-Service Early Childhood Educators in the Main Study

		f	%
Age groups	30 and below	123	32.2
	31-40	162	42.4
	41 and above	97	25.4
	Total	382	100
Years of experience	0-3 years	52	13.6
	4-7 years	70	18.3
	8+ years	260	68.1
	Total	382	100
Education level	Associate Degree	44	11.5
	Undergraduate	286	74.9
	Master	52	13.6
	Total	382	100
Training on 21st-century skills	No	255	66.8
	Yes	127	33.2
	Total	382	100
Training on technology usage in education	No	209	54.7
	Yes	173	45.3
	Total	382	100

4.2.2. General Descriptive Statistics about the Scales

The means, standard deviations, and minimum-maximum values of the 21st-Century Skills Scale and TPACK Scale were examined to see the general characteristics of participants who evaluated themselves via the scales. The total score of the 21st-Century Skills Scale and the scores of sub-groups of the 21st-Century Skills Scale were examined. The possible minimum and maximum total scores which can be taken from the 21st-century skills scale are 41 and 205. In this study, most participants assessed themselves close to the highest total 21st-century skills score (*min*=137, *max*=205, *M*=183.25, *SD*=15.90).

Additionally, scores from the sub-factors of the 21st-Century Skills Scale were examined in detail. The possible minimum and maximum scores which can be taken from Learning and Innovation Skills are 17 and 85. Most participants assessed their Learning and Innovation Skills high (*min*=51, *max*=85, *M*=74.17, *SD*=8.60).

The possible minimum and maximum scores which can be taken from Life and Career Skills are 16 and 80. It was seen that most participants assessed their Life and Career Skills at a high level (*min*=52, *max*=80, *M*=73.04, *SD*=5.75).

The possible minimum and maximum scores which can be taken from Information, Media and Technology Skills are 8 and 40. Most participants assessed themselves close to the highest Information, Media and Technology Skills score (*min*=24, *max*=40, *M*=36.04, *SD*=4.01).

Table 4.2

Descriptive Statistics for the Scale Regarding the 21st-Century Skills

	M	*SD*	Taken Min. Score	Taken Max. Score	Possible Min. Score	Possible Max. Score
Total 21st-Century Skills	183.25	15.904	137	205	41	205
Learning and Innovation Skills	74.17	8.599	51	85	17	85
Life and Career Skills	73.04	5.747	52	80	16	80
Information, Media and Technology Skills	36.04	4.006	24	40	8	40

In addition to the 21st-Century Skills Scale, the total score of the TPACK Scale and the scores of sub-groups of the TPACK Scale were examined. The possible minimum and maximum scores which can be taken as total TPACK scores are 51 and 255. Most participants were prone to assess themselves close to the highest total TPACK score (*min*=152, *max*=255, *M*=226.97, *SD*=23.88).

The possible minimum and maximum scores which can be taken from TK (Technological Knowledge) are 6 and 30. Most participants assessed their TK at a high level (*min*=13, *max*=30, *M*=24.71, *SD*=3.97). The possible minimum and maximum scores which can be taken from PK are 7 and 35. Most participants assessed

themselves close to the highest PK score (*min*=20, *max*=35, *M*=31.54, *SD*=3.56). The possible minimum and maximum scores which can be taken from CK are 8 and 40. Most participants assessed their CK as close to the highest score (*min*=24, *max*=40, *M*=36.89, *SD*=3.71).

The possible minimum and maximum scores which can be taken from TCK are 6 and 30. Most participants assessed their TCK at a high level (*min*=16, *max*=30, *M*=26.21, *SD*=3.56). The possible minimum and maximum scores which can be taken from PCK are 8 and 40. Most participants assessed themselves close to the highest PCK score (*min*=24, *max*=40, *M*=36.87, *SD*=3.74). The possible minimum and maximum scores which can be taken from TPK are 8 and 40. Most participants were prone to assess their TPK at a high level (*min*=20, *max*=40, *M*=35.88, *SD*=4.47).

The possible minimum and maximum scores which can be taken from TPCK are 8 and 40. Most participants assessed themselves close to the highest TPCK score (*min*=18, *max*=40, *M*=35.16, *SD*=4.69).

Table 4.3

Descriptive Statistics for the Scale Regarding the TPACK

	M	*SD*	Taken Min. Score	Taken Max. Score	Possible Min. Score	Possible Max. Score
Total TPACK	226.97	23.883	152	255	51	255
TK	24.71	3.970	13	30	6	30
PK	31.54	3.560	20	35	7	35
CK	36.89	3.714	24	40	8	40
TCK	26.21	3.561	16	30	6	30
PCK	36.87	3.742	24	40	8	40
TPK	35.58	4.466	20	40	8	40
TPCK	35.16	4.688	18	40	8	40

All these data from both the 21st-Century Skills Scale and the TPACK Scale revealed that most early childhood educators had a quite positive view on the sub-factors of both scales. Therefore, they generally evaluated their skills and knowledge high.

4.2.3. Analysis of In-Service Educators' 21st-Century Skills Regarding Their Age, Years of Experience, Education Level, and Training Attendance on 21st-Century Skills

The study's first research question was about the 21st-century skills of in-service early childhood educators. Two-way between-groups analysis of variance (ANOVA) were used to answer this question. The sub-research questions were

1.1. Is there a difference in 21st-century skills of in-service educators regarding age?

1.2. Is there a difference in 21st-century skills of in-service educators regarding years of experience?

1.3. Is there a difference in 21st-century skills of in-service educators regarding education level?

1.4. Is there a difference in 21st-century skills of in-service educators regarding training attendance on 21st-century skills?

A two-way ANOVA was conducted to explore differences in the total score of 21st-century skills of in-service educators in regards to age and years of experience. Participants were divided into three groups according to their age (Group 1: <30, Group 2: 31-40, Group 3: 41>) and three groups according to their years of experience (Group a: 0-3, Group b: 4-7 and Group c: 8+). The interaction effect between age groups and years of experience was not statistically significant at the $p < .05$ level: [$F(3, 374) = 1.088$, $p=.354$]. Besides, the main effect of age was not significant at the $p < .05$ level: [$F(2, 374) = .279$, $p=.757$]. There was not a statistically significant main effect for years of experience at the $p < .05$ level: [$F(2, 374) = .399$, $p=.671$]. According to these results, the mean scores for the age of 30 and below (M=183.91, SD= 15.72), the ages of 31-40 (M=184.30, SD= 15.656), and the age of 41 and above (M=180.68, SD= 16.423) did not differ significantly from each other. Moreover, the mean scores for 0-3 years of experience (M=181.94, SD= 15.26), 4-7 years of experience (M=184.51, SD= 17.46), and 8+ years of experience (M=183.18, SD= 15.63) did not differ significantly from each other.

Table 4.5

Difference In the Total Score of 21st-Century Skills Regarding Age, Years of Experience and Their Interaction

	df	F	Sig.
Age	2	,279	,757
Experience	2	,399	,671
The Interaction Between Age and Experience	3	1,088	,354

A two-way ANOVA was conducted to explore differences in the total score of 21st-century skills of in-service educators regarding the education level and training attendance. Participants were divided into three groups according to their education level (Group 1: Associate Degree, Group 2: Undergraduate, and Group 3: Master) and two groups according to their training attendance as educators who did not attend any training on 21st-century skills, and educators who attended training on 21st-century skills. The interaction effect between education level and training attendance was not statistically significant at the $p < .05$ level: [$F (2, 376) = .055$, $p=.946$]. Besides, the main effect of the education level was not significant at the $p < .05$ level: [$F (2, 376) = 1.914$, $p=.149$]. However, there was a statistically significant main effect for training attendance at the $p < .05$ level: [$F (1, 376) = 5.684$, $p=.018$, $\eta p2 =.015$]. According to these results, the mean score for the associate degree (M=187.75, SD= 14.86), the undergraduate degree (M=182.28, SD= 16.17), and the master's degree (M=184.79, SD= 14.76) did not differ significantly from each other. On the other hand, Post-hoc comparisons using the Tukey HSD test indicated that there was a significant difference in scores for educators who did not attend any training about 21st-century skills (M= 181.365 SD= 15.995) and educators who took training about 21st-century skills (M= 187.047, SD= 15.080).

Table 4.6

Difference In the Total Score of 21st-Century Skills Regarding Education Level, Training Attendance and Their Interaction

	df	F	Sig.
Education Level	2	1,914	,149
Training Attendance on 21st-Century Skills	1	5,684	,018
The Interaction Between Education Level and Training Attendance	2	,055	,946

4.2.4. Analysis of In-Service Educators' TPACK Scores Regarding Their Age, Years of Experience, Education Level, and Training Attendance on Technology Usage in Education

The second research question of the study was about of TPACK level of in-service early childhood educators. Two-way ANOVA were used for the analysis of the question. The sub-research questions were

2.1. Is there a difference in TPACK levels of in-service educators regarding age?

2.2. Is there a difference in TPACK levels of in-service educators regarding years of experience?

2.3. Is there a difference in TPACK levels of in-service educators regarding education level?

2.4. Is there a difference in TPACK of in-service educators regarding training attendance on technology usage in education?

A two-way ANOVA was conducted to explore differences in the total TPACK score of in-service educators regarding age and years of experience. Participants were divided into three groups according to their age (Group 1: <30, Group 2: 31-40, Group 3: 41>) and three groups according to their years of experience (Group a: 0-3, Group b: 4-7 and Group c: 8+). When Levene's test was examined, it was noticed that its significance value (.008) was less than .05, so it violated the homogeneity of variances. For that reason, the new p-value was assigned as .01 for this analysis. The interaction effect between age groups and years of experience was not statistically significant at

the p < .01 level: [F (3, 374) = 1.190, *p*=.313]. Besides, the main effect of age was not significant at the p < .01 level: [F (2, 374) = .156, *p*=.856]. There was not a statistically significant main effect for years of experience at the p < .01 level: [F (2, 374) = .792, *p*=.454]. According to analysis results, the mean scores for the age of 30 and below (M=230.96, SD= 21.56), the ages of 31-40 (M=227.42, SD= 23.867) and the age of 41 and above (M=221.15, SD= 25.742) did not differ significantly from each other. Moreover, the mean scores for 0-3 years of experience (M=231.15, SD= 19.572), 4-7 years of experience (M=228.90, SD= 26.625), and 8+ years of experience (M=225.61, SD= 23.841) did not differ significantly from each other. Although the analysis showed that the p-value of the age groups was greater than .01, post-hoc comparisons using the Tukey HSD test indicated that there was a significant mean difference between younger and older educators at the .01 level. The scores of educators who were the age 30 and below were significantly higher (9.80) than the scores of educators who were the age 41 and above.

Table 4.8

Difference In the Total TPACK Score Regarding Age, Years of Experience and Their Interaction

	df	F	Sig.
Experience	2	,792	,454
Age	2	,156	,856
The Interaction Between Age and Experience	3	1,190	,313

A two-way ANOVA was conducted to explore differences in the total TPACK score of in-service educators in regards to the education level and training attendance. Participants were divided into three groups according to their education level (Group 1: Associate Degree, Group 2: Undergraduate, and Group 3: Master) and two groups according to their training attendance as educators who did not attend any training on technology usage in education, and educators who attended training on technology usage in education. The interaction effect between education level and training attendance was not statistically significant at the p < .05 level: [F (2, 376) = .179, *p*=.837]. Besides, the main effect of education level was not significant at the p < .05 level: [F (2, 376) = 2.186, *p*=.114]. There was not a statistically significant main effect

for training attendance at the $p < .05$ level: [$F(1, 376) = .998$, $p = .318$]. According to these results, the mean score for the associate degree (M=231.43, SD= 25.29), the undergraduate degree (M=225.52, SD= 24.04), and the master's degree (M=231.13, SD= 21.09) did not differ significantly from each other. Besides, there was no significant difference in scores for educators who did not attend any training about technology usage in education (M= 225.61 SD= 23.285) and educators who took training about technology usage in education (M= 228.61, SD= 24.553).

Table 4.9

Difference In the Total TPACK Score Regarding Education Level, Training Attendance and Their Interaction

	df	F	Sig.
Education Level	2	2,186	,114
Training Attendance on Technology Usage in Education	1	,998	,318
The Interaction Between Education Level and Training Attendance	2	,179	,837

4.2.5. Analysis of The Relationship Between 21st-Century Skills and TPACK of In-Service Educators

The third research question of the study was related to the relationship between 21st-century skills (Learning and Innovation Skills; Life and Career Skills; Information, Media and Technology Skills) and TPACK of in-service early childhood educators. The relationship between scores taken from the 21st-century skills scale and the TPACK scale was investigated using Pearson Correlation Coefficient (*r*) and Spearman Rank Order Correlation (*rho*). The sub-research questions were

3.1. Is there any relationship between the 21st-century skills and TPACK of in-service early childhood educators?

3.2. Is there any relationship between the sub-factors of 21st-century skills and TPACK of in-service early childhood educators?

3.2.1. Is there any relationship between Learning and Innovation Skills and TPACK of in-service early childhood educators?

3.2.2. Is there any relationship between Life and Career Skills and TPACK of in-service early childhood educators?

3.2.3. Is there any relationship between Information, Media and Technology Skills and TPACK of in-service early childhood educators?

The relationship between the total 21st-century skills and the total TPACK score was investigated by using Spearman Rank Order Correlation. The preliminary analysis was performed to ensure no violation of assumptions of normality, linearity, and homoscedasticity. However, a violation was detected in homoscedasticity. Thus, a non-parametric method was used in the analysis. The result of the analysis demonstrated that there was a large positive correlation between the two variables, *rho*=.753, N=382, p <.01 (2- tailed). The high total 21st-century skills were associated with the high total TPACK score. The total 21st-century skills helped explain nearly 56.70 % of the variance in the total TPACK score of early childhood educators.

Table 4.10

C*orrelation Between the Total 21st-Century Skills and the Total TPACK Score*

	N	Sig.	Total TPACK (rho)
The Total 21st-Century Skills	382	.000	.753**

Note: **= Correlation is significant at the 0.01 level (2-tailed)

The relationship between the Learning and Innovation Skills and the total TPACK score was investigated by using Spearman Rank Order Correlation. The preliminary analysis was performed to ensure no violation of assumptions of normality, linearity, and homoscedasticity. However, a violation was detected in homoscedasticity. Thus, a non-parametric method was used in the analysis. The result of the analysis

demonstrated that there was a large positive correlation between the two variables, *rho*=.654, N=382, *p* <.01 (2- tailed). The high levels of the Learning and Innovation Skills were associated with the high total TPACK score. Scores of the Learning and Innovation Skills helped explain nearly 42.77 % of the variance in the total TPACK score of early childhood educators.

Table 4.11

Correlation Between the Learning and Innovation Skills and the Total TPACK Score

	N	Sig.	Total TPACK (rho)
Learning and Innovation Skills	382	.000	.654**

Note: **= Correlation is significant at the 0.01 level (2-tailed)

The relationship between the Life and Career Skills and the total TPACK score was investigated by using Spearman Rank Order Correlation. The preliminary analysis was performed to ensure no violation of assumptions of normality, linearity, and homoscedasticity. However, a violation was detected in normality and homoscedasticity. Thus, a non-parametric method was used in the analysis. The analysis result indicated that there was a large positive correlation between the two variables, *rho*=.641, N=382, *p* <.01 (2- tailed). The high levels of Life and Career Skills were associated with the high total TPACK score. Scores of the Life and Career Skill helped explain nearly 41.09 % of the variance in the total TPACK score of early childhood educators.

Table 4.12

Correlation Between the Life and Career Skills and the Total TPACK Score

	N	Sig.	Total TPACK (rho)
Life and Career Skills	382	.000	.641**

Note: **= Correlation is significant at the 0.01 level (2-tailed)

The relationship between the Information, Media and Technology Skills and the total TPACK score was shown by using Pearson Correlation Coefficient. The preliminary analysis was performed to ensure no violation of normality, linearity and homoscedasticity. The result of the analysis demonstrated that there was a large positive correlation between the two variables, r=.694, N=382, p <.01 (2- tailed). The high levels of the Information, Media and Technology Skills were associated with the high total TPACK score. Scores of the Information, Media and Technology Skills helped explain nearly 48.16 % of the variance in the total TPACK score of early childhood educators.

Table 4.13

Correlation Between the Information, Media and Technology Skills and the Total TPACK Score

	N	Sig.	Total TPACK (r)
Information, Media and Technology Skills	382	.000	.694**

Note: **= Correlation is significant at the 0.01 level (2-tailed)

4.3. Summary of the Results

The results of this study were obtained by conducting various analyses. Before the main analysis to find the answers to the research questions, the pilot study was conducted with 200 early childhood educators from Ankara to approve the validity and reliability of the TPACK scale and the 21st-century skills scale. The pilot study revealed that the TPACK scale was valid and reliable for in-service early childhood educators. Additionally, the result of the EFA in the pilot study indicated that item 17 and item 18 of the 21st-century skills scale did not occur under the second factor. Therefore, the place of item 18 was changed from the second factor to the first factor. Moreover, item 17 took place under both the first and third factors with high relative value. For this reason, it was omitted from the scale. After these changes, the analysis showed that the 21st-century skills scale was valid and reliable for in-service early childhood educators.

After completion of the pilot study, the main study data was collected from 410 early childhood educators from Ankara, İzmir, and İstanbul. The main study data were checked to see whether there were any entry errors and outliers in the data set from the 21st-Century Skills Scale. And then, the validity of the 21st-Century Skills Scale was confirmed again by conducting EFA and CFA. After the data screening process was applied for the accuracy of all data sets by examining error correction, missing values, univariate and multivariate outliers, and normality, further analyses were conducted with data collected from 382 in-service early childhood educators.

First of all, the assumptions for the main study were tested. According to the result of the assumptions, parametric or non-parametric methods were used for data analyses. Most educators stated that they did not attend any training on 21st-century skills or technology. When scores taken from each scale were examined, it was seen that most participants assessed their 21st-century skills and TPACK as close to the highest scores of the scales.

The study's first research question was about the 21st-century skills of in-service early childhood educators. Educators' 21st-century skills were examined regarding their

age, years of experience, education level, and training attendance on the 21st-century skills. Two-way ANOVA were used for the analysis. The findings indicated that there was not a statistically significant difference in the 21st-century skills scores in terms of age, years of experience, and education level. Moreover, there was no interaction effect between age groups and years of experience or education level and training attendance. The only statistically significant difference was detected between educators who have attended training on 21st-century skills and educators who have never participated in any training on 21st-century skills. Scores of educators who took any training about 21st-century skills were slightly higher than scores of educators who did not attend any training about 21st-century skills.

The second research question was about of TPACK level of in-service early childhood educators. Educators' TPACK level was examined regarding their age, years of experience, education level, and whether they took any course or in-service training. Two-way ANOVA were used for the analysis. The findings indicated no statistically significant difference in the total TPACK scores in terms of age, years of experience, education level, and training attendance. Moreover, there was no interaction effect between age groups and years of experience or education level and training attendance. Although there was no statistically significant difference among age groups in two-way ANOVA, post-hoc analysis demonstrated a statistically significant difference between educators who were 30 years old and below and educators who were 41 years old and above. The scores of educators who were the age of 30 and below were significantly higher (9.80) than the scores of educators who were the age of 41 and above.

The third research question was related to the relationship between 21st-century skills and the total TPACK score of in-service early childhood educators. The relationship between scores was investigated using Pearson Correlation Coefficient (r) or Spearman Rank Order Correlation (rho). At the end of the analysis, it was seen that the total 21st-century skills and all sub-factors of 21st-century skills (Learning and Innovation Skills; Information, Media and Technology Skills; and Life and Career Skills) had a large positive correlation with the total TPACK (Details of the analysis of the main study was given in Appendix H).

CHAPTER 5

DISCUSSION

The motivation beyond conducting this study was to investigate in-service early childhood educators' general characteristics of 21st-century skills and TPACK level regarding their age, years of experience, education level, and training attendance. Another motivation was to examine the potential association between the sub-factors of 21st-century skills and TPACK of in-service early childhood educators. In this chapter, the study's findings are interpreted considering the literature along with their implications, followed by recommendations for future research.

5.1. Discussion of the Findings

In this study, the findings indicated that educators evaluated their 21st-century skills and TPACK close to highest level. Additionally, educators' 21st-century skills were differed regarding training attendance and educators' TPACK was only differed between younger and older educators. Moreover, high positive correlation was found between total 21st-century skills, Learning and Innovation skills, Life and Career skills and Information, Media and Technology skills. Furthermore, the adaptation study of the 21st-century scale for in-service early childhood educators was conducted in the pilot study.

The current study sought to beneficial in terms of four significant issues. During the literature review, the researcher noticed that limited studies exist on in-service early childhood educators' 21st-century skills and TPACK. Previous studies were generally related to the knowledge and skills of pre-service educators or educators from other areas. Moreover, the few existing research studies about early childhood educators' 21st-century skills usually were qualitative studies that focused on educators'

opinions, beliefs, and attitudes (Kardeş, 2020; Rentzou, 2021) or quantitative studies which focused on specific skills like creativity under Learning and Innovation skills (Çoban & İnan, 2020).

The present study, firstly examined how educators evaluated their 21st-century skills and TPACK. This is thought crucial because educators' capabilities are highly influential in preparing their students for the complex world and the unknown future (WEF, 2016; Shafie, Majid & Ismail, 2019) and by being leaders in educational changes (Lee & Reigeluth, 1994).

Secondly, this study investigated how in-service preschool educators' 21st-century skills and TPACK change according to age, years of experience, education level, and training undertaken on 21st-century skills and technology usage in education. Thus, this research adds to information about the skills and knowledge of in-service early childhood educators.

Thirdly, this study can be useful for the literature by adapting the 21st-Century Skills Scale (Anagün et al., 2016) from pre-service educators to in-service early childhood educators. The original scale has three factors, which are Learning and Innovation Skills (16 items, α=.845), Life and Career Skills (18 items, α=.826), and Information, Media and Technology Skills (8 items, α=.810) (Anagün et al., 2016). After EFA and CFA with the collected data from in-service early childhood educators, it was seen that item 17 and item 18, which are under Life and Career Skills in the original scale, changed factors. While item 17 (I use time effectively.) was omitted from the scale since it was under both Learning and Innovation Skills and Information, Media and Technology Skills with high relative values, item 18 (I take initiative to improve my abilities.) was moved from Life and Career Skills to Learning and Innovation Skills.
In the end, the 21st-century Skills Scale for early childhood educators had three factors: Learning and Innovation Skills (17 items α=.94), Life and Career Skills (16 items, α=.90), and Information, Media and Technology Skills (8 items, α=.89). This difference demonstrated that while pre-service early childhood educators perceived item 18 (I take initiative to improve my abilities.) under Life and Career Skills probably because it includes "initiative" as a keyword; in-service early childhood

educators perceived item 18 under Learning and Innovation Skills since it has “to improve” as a keyword. That means that pre-service and in-service educators can interpret the same item from different perspectives.

Finally, this study increased information on the relationship between 21st-century skills and TPACK by filling the gap about how they are related to each other. Although various studies (Smith et al.,2016; Valtonen et al., 2017; Mtebe & Raphael, 2018; Başaran, 2020; Liesa-Orús et al., 2020; Yılmaz, 2020) emphasized the importance of technology usage in educational settings for improving 21st-century skills of students, any study which investigated the exact association between them in terms of educators was not able to be found.

In conclusion, the study results provided helpful information to the literature on 21st-century skills, technological pedagogical content knowledge (TPACK), and their association. The study findings are compared with previous research studies below.

5.1.1. Discussions Regarding Descriptive Results

In this study, the participants were 382 early childhood educators who worked in Ankara (*f* =105), İstanbul (*f* =136), and İzmir (*f* =141) in the 2021-2022 academic year. While 363 participants were female, 19 participants were male in-service early childhood educators. Although comparing two groups with unequal group size might be seen as difficult, Keppel (1993) pointed out that research studies do not need to have equal group sizes to compute correct statistics because most statistical programs adjust for differences by using different analytical processes. Therefore, compared results were examined and shared to answer the research questions.

In terms of years of experience, it was seen that most educators in this study had more than 8 years of experience. The likely reason being that data was collected from Ankara, İstanbul, and İzmir, being large cities, where competition for places in public-preschools means that educators usually gain experience elsewhere. Furthermore, less than one third of the 382 study participants work in private preschools.

When the education level of in-service early childhood educators was examined, most had completed an undergraduate degree, while some had a master's degree or an associate degree. Additionally, educators were asked whether they attended any courses on 21st-century skills and technology usage in education. When the ratio of answers to these questions ("Yes" or "No") was examined, most educators reported that they did not attend any training on 21st-century skills or technology usage in education. On the other hand, the number of educators who reported attendance in technology-related training was higher than the number of educators who reported attendance in 21st-century skills-related training.

When attended technology-related courses were examined in detail, it was seen that educators generally reported that they attended courses about basic technological knowledge (57.34 %), while a few stated courses about digital awareness (9.79 %). Therefore, it can be concluded that although the number of educators who reported that they attended technology-related training was higher than the number of educators who reported that they attended 21st-century skills-related training, few of them attended advanced-level technology-related training. From this finding, it can be concluded that in-service educators need more advanced level technology-related courses since courses on technology usage in education can make a difference in the TPACK level of educators, as highlighted by some previous studies. To illustrate, Köse (2012) conducted research to enhance the TPACK level of in-service primary school teachers by designing and applying in-service training as a single-group pretest-posttest experimental study. The results showed that the TPACK level of teachers increased after the training. However, the researcher remarked that every usage of technology in education does not mean the integration of technology into education. For this reason, the content and quality of the training are critical to support teachers correctly. Similarly, Tanak (2018) aimed to search whether a TPACK-based course influenced the TPACK of 15 pre-service science teachers. The TPACK-based course was designed using the TPACK framework to enhance the TPACK of pre-service science teachers. After this course, apparent differences between pre-service teachers' previous and current TK, TPK, TCK, and TPACK were observed.

Additionally, when attended 21st-century skills-related courses were examined in detail, the teachers mention they received training on Learning and Innovation Skills (37.34 %), followed by Information, Media and Technology Skills (31.65 %) and Life and Career Skills (31.01 %). This finding supports the statement of Trilling and Fadel (2009), who pointed out that Learning and Innovation Skills are the most common 21st-century skills than other skills.

In addition to the results of the demographic information form, the general results of the scales were investigated. The examination of total scores and the scores of sub-groups of both the 21st-Century Skills Scale and TPACK revealed that most early childhood educators had a quite positive view of their 21st-century skills and Technological Pedagogical Content Knowledge (TPACK). Therefore, they evaluated their skills and knowledge as high.

Similar to the finding on educators' 21st-century skills in the current study, Eğmir and Çengelci (2020) pointed out that not only early childhood educators but also 308 teachers working in early childhood education, primary, middle and high school in Afyonkarahisar evaluated their own 21st-century teaching skills highly as well. Also, the researchers noticed that early childhood educators considered their 21st-century teaching skills to be higher than teachers in other education levels. In conclusion, it appears that educators have a tendency to evaluate their 21st-century skills higher.

Similar to the finding on educators' TPACK level in the current study, Özdurak Sıngın and Gökbulut's (2020) analysis of the techno-pedagogic competencies of preschool educators found that early childhood educators have high levels of techno-pedagogical competence. Besides, Sancar-Tokmak et al. (2013) revealed that pre-service early childhood educators had a high self-confidence on TPACK. Furthermore, Cacho (2014) remarked that pre-service primary school teachers evaluated their TPACK at a good level, while Cemaloğlu et al. (2019) stated that the perception of the vocational high school teachers on their 21st-century skills was at a high level. Additionally, Sumba-Nacipucha, et al. (2021) used the TPACK framework to review college educators' skills and knowledge following the covid pandemic and found they had a high TPACK level, including TK and TPK specifically. Destiani and Purnawarman

(2020) measured the TPACK level of in-service English teachers and found that more than half of the participants had high TPACK levels, while others had average or low TPACK levels. Thus, when all these findings were considered, it may be concluded that pre-service and in-service educators are inclined to consider their TPACK at a high level.

5.1.2. Discussions on Findings Regarding 21st-Century Skills of In-service Early Childhood Educators

The study findings regarding the first research question helped us to examine the 21st-century skills of in-service educators regarding their age, years of experience, education level, and training attendance on 21st-century skills. The details are discussed below.

In order to determine if age was a factor, participants were divided into three age groups (Group 1: <30, Group 2: 31-40, Group 3: 41>). Although there were no significant differences between groups in this study, the examination of results showed that the mean of the younger early childhood educators (M=183.91) was almost similar to the mean of the educators between 31 and 40 (M=184.30). However, the mean of the total 21st-century skills of the older educators (M=180.68) was slightly lower than the means of educators younger than 41. Its reason may be that younger educators had more up-to-date knowledge and skills since they had graduated recently and were supported by in-service training. In comparison, older educators may have had less opportunity to improve themselves. According to Ginting and Linarsih (2022), the development of teachers is an ongoing progress, and educators need to adapt to constant changes and have a tendency to self-improvement. Their development should include professional knowledge, skills, and technological abilities. Therefore, this finding revealed the importance of professional development programs to provide needed support constantly.

When the literature was examined, a similar result was found about a sub-skill of Learning and Innovation Skills. Çoban and İnan (2020) researched in-service early childhood educators' creativity levels based on self-assessment and differences in their

creativity regarding the age of the educators. Quantitative data collected from 85 in-service early childhood educators demonstrated that a significant difference could not be found regarding the age of the educators. Elsewhere, Eğmir and Çengelci (2020) pointed out that early childhood education has a flexible and versatile curriculum, so the characteristics of this department could lead in-service early childhood educators to have a relatively high and close level of 21st-century skills through all ages.

Similar to age groups, no significant difference was found in the total 21st-century skills scores based on the years of experience of early childhood educators. Participants were divided into three groups according to their years of experience (Group 1: 0-3, Group 2: 4-7, and Group 3: 8+). Comparisons among them represented that even though it was not statistically significant, there was a slight difference. The mean of 21st-century skills of educators who had less experience (M=181.94) was lower than the mean of the educators who had experience between 4 and 7 years (M=184.51) and the mean of the educators who had more than 8 years experience (M=183.18). These results suggest that new teachers may rate their 21st-century skills at a lower level than colleagues who have undertaken significant professional development already.

Similar to the current study's finding, some previous research supported the idea that the 21st-century skills of educators did not vary by year of experience. Çoban and İnan (2020) looked at in-service early childhood educators' creativity (a sub-skill of Learning and Innovation Skills) levels based on self-assessment and differences in their creativity regarding years of experience. Quantitative data which were collected from 85 in-service early childhood educators showed that significant differences could not be found regarding years of experience. Besides, Cemaloğlu et al. (2019) stated that the perception of vocational high school teachers on their 21st-century skills did not vary according to experience. On the other hand, Eğmir and Çengelci (2020) found the opposite in a study conducted with 308 teachers in Afyonkarahisar. Therefore, having both significant and insignificant results in various studies indicate that differences in teachers' 21st-century skills based on years of experience may depend on other variables such as the location and education.

Apart from the comparisons of participants' 21st-century skills in terms of age, and years of experience, their 21st-century skills were also compared regarding their education level. In line with comparisons of different education levels, no statistically significant difference was found in the total score for 21st-century skills. However, it was seen that educators with an associate degree (M=187.75) had the highest 21st-century skills scores, followed by those with a master's degree (M=184.79). Educators with an undergraduate degree scored lowest (M=182.28). Educators with master's degree (M=184.79) had a higher score than educators with an undergraduate degree (M=182.28), which was the expected result since master degree students are taking more advance courses during their educational life like research methods course, although the difference was not statistically significant. However, the reason for having the highest 21st-century skills score of the educators with an associate degree can be examined in detail to understand whether the quality and content of the courses taken in the associate degree are better in terms of supporting 21st-century skills.

In the current study, a significant difference could not be found regarding the education level of in-service educators except for slight differences between groups. Also, a previous study supported this finding. Cemaloğlu et al. (2019) worked with vocational high school teachers to examine their 21st-century skills. The researchers found that the 21st-century skills of vocational high school teachers did not differ according to their education level.

Even though all comparisons regarding early childhood educators' age, years of experience, and education level represented that there were no statistically significant differences, it was revealed that there was a significant difference in 21st-century skills scores of educators who did not attend any training about 21st-century skills (M= 181.365) and educators who took training about 21st-century skills (M= 187.047). As expected, educators who participated in training on 21st-century skills had higher scores. It was demonstrated that taken courses related to Learning and Innovation Skills (37.34 %), Information, Media and Technology Skills (31.65 %), and Life and Career Skills (31.01 %) were effective in creating a difference in early childhood educators' 21st-century skills. Although most of the courses were to increase educational knowledge of educators for providing a quality education for children, like

STEM education, Lego education, Fatih project, storytelling, and drama; there were a few stated courses that were designed directly for educators' personal enhancement, such as sign language course, cultural sensitivity, and reflective thinking. Thus, it represented that both courses designed for personal and academic development of educators helped them to enhance their 21st-century skills.

Moreover, previous studies supported this finding. To illustrate, Ciğerci (2020) investigated how digital storytelling influences the 21st-century skills of pre-service primary school educators. The researcher conducted a pre-test, and after pre-service primary school educators prepared and used digital storytelling, a post-test was applied to pre-service educators. When the results of tests were compared, the post-test scores of pre-service educators were higher than their pre-test scores. Ghani et al. (2020) conducted a study to test pre-service early childhood educators' ability development to be multimedia program builders by providing two different workshops. The study findings represented that pre-service early childhood educators were capable of creating multimedia programs and using their creativity and critical thinking skills if the opportunity was given. Akcanca (2020) investigated pre-service early childhood educators' attitudes respecting Problem-Based Learning (PBL), and how STEM Education affected the prediction of their mastery perception of the 21st-century skills. The results showed that 20 percent of mastery perception of 21st-century skills could be explained by pre-service educators' attitudes about PBL and STEM Education. Moreover, the researcher recommended that both pre-service and in-service educators could be engaged with various and innovative educational approaches which focus on the development of 21st-century skills. Therefore, it can be referred that if effective professional development programs are provided for pre-service or in-service educators to improve their skills, it can lead them to have better 21st-century skills and also these educators can provide more quality education for their students.

5.1.3. Discussions on Findings Regarding TPACK Level of In-service Early Childhood Educators

The study findings regarding the second research question helped us to examine the change in TPACK level of in-service early childhood educators regarding their age,

years of experience, education level, and training attendance on technology usage in education. The findings are discussed in detail below.

When the influence of various age groups on the total TPACK score of early childhood educators was investigated, no statistically significant difference was seen in the total TPACK score of educators regarding different age groups. However, on post-hoc examination, a significant difference existed between the mean of the younger early childhood educators (M=230.96) and the older ones (M=221.15), with the mean aged between 31 and 40 (M=227.42). This finding represented that early childhood educators' total TPACK score decreased with age. This situation can have a couple of explanations. Creighton (2018) stated that individuals born before 1980 are digital immigrants and those older than the age of 41 might not be as familiar with technology as younger educators. Thus, it may lead them to have lower TPACK scores in this study. Another explanation can be about in-service training. They might not have enough training to up-to-date their knowledge. For that reason, other reasons behind this situation need to be searched.

A previous study supported the significant difference in age groups only for technological Knowledge (TK). Lavidas et al. (2021) investigated 147 Greek in-service early childhood educators' self-perception related to TPACK. They discovered that younger educators perceived their TK higher than older ones and mention this might be related to them having participated in pre-service or in-service ICT courses. On the other hand, some other previous studies carried out with pre-service and in-service educators from different areas defended the similar point with the present study by remarking that age groups did not lead to statistically significant results. For example, Koh et al. (2010) investigated the TPACK of pre-service elementary and secondary school teachers in Singapore. They noticed that pre-service educators' perception of their TPACK did not change according to age. Moreover, Schmid et al. (2020) also found no distinction by age in the self-evaluation of TPACK among 173 pre-service upper secondary school teachers. Lin, et al. (2012) carried out research to investigate what the perceptions of science teachers were about TPACK. They too found there were no differences according to age. Besides, Li et al. (2021) carried out a study in which the TPACK level of college teachers at Zhejiang University was

examined during the Covid 19 Pandemic. The analysis indicated that any factors of TPACK did not differ regarding the age of teachers. As a result, even though it was expected to find some distinctions in the TPACK score of in-service teachers, other variables such as education level, branch, years of experience and courses taken can produce differences in teachers' TPACK according to age.

In this study with in-service early years educators, no statistically significant difference in the total TPACK scores was seen in terms of their years of experience. Participants were divided into three groups according to their years of experience (Group 1: 0-3, Group 2: 4-7, and Group 3: 8+) for the investigation. Despite not producing a statistically significant difference, it was noticed that the total TPACK score reduced with increasing years of experience. Less experienced educators (M=231.15) had the highest TPACK score, followed respectively by those with between 4 and 7 (M=228.90) and more than 8 (M=225.61) years experience. It might be inferred that less experienced educators had up-to-date knowledge to evaluate their total TPACK score higher because they were newly graduated educators and had experienced a more technology-involved education life.

Previous research has not produced a consensus as to whether length of experience produces differences in the TPACK level of early childhood educators. Liang et al. (2013) conducted a study with 366 in-service preschool educators in Taiwan to investigate their TPACK. The study results indicated that more experienced preschool educators could be more resistant to technology usage in the educational process than others. This previous study found a different result than the current research finding by pointing out that working experience affected educators' TPACK levels by creating statistically significant differences. However, it also helped us to see the possible reason for the slight decrease in TPACK level with years of experience in the study, which might be related to the resistance of experienced educators to technology usage in education.

On the other hand, there were some previous studies that supported the finding of the current study. Özdurak Sıngın and Gökbulut (2020) conducted a study with 1,169 early childhood educators in Ankara to detect the techno-pedagogic competencies of

preschool educators. As a result of this study, the researchers found that early childhood educators' techno-pedagogical competencies did not rely on their professional seniority. Besides, Lin, et al. (2012) carried out research to investigate what the perceptions of science teachers were about TPACK. They found no differences between TPACK perception of teachers according to age. In conclusion, having both opponent and supportive studies can be an indicator of taken pre-service and in-service training impact whether the years of experience of educators led to a significant difference in TPACK or not.

When the impact of the educators' education level on their total TPACK level was explored, it was seen that there was not any statistically significant difference in the total TPACK score of educators regarding their education level. Participants were divided into three groups in accordance with their education level (Group 1: Associate Degree, Group 2: Undergraduate, and Group 3: Master). Although the difference was not statistically significant, educators with an associate degree (M=231.43) and educators with a master's degree (M=231.13) had almost similar scores, and they had higher scores than educators with an undergraduate degree (M=225.52). Educators with master's degree (M=231.13) had a higher score than educators with an undergraduate degree (M=225.52), which might be an expected result since master degree students are taking more advance course during their education like research methods course, although the difference was not statistically significant. Nevertheless, the reason for educators with an associate degree having high TPACK scores of can be studied in detail to understand whether the quality and content of the courses taken are better in terms of supporting TPACK.

Likewise, Özdurak Sıngın and Gökbulut (2020) conducted a study with 1,169 early childhood educators in Ankara to detect the techno-pedagogic competencies of preschool educators. As a result of this study, the researchers found that early childhood educators' techno-pedagogical competencies did not rely on their education level. On the contrary, Liang et al. (2013) conducted a study with 366 in-service preschool educators in Taiwan to investigate their TPACK. They found a positive relationship between the educational qualification of educators and their tendency to have knowledge related to technology integration into education. These findings

indicate that the effect of the education level may change according to other independent variables, like the number of the participants or the country of the study. In addition to comparisons of the TPACK level of early childhood educators regarding their age, years of experience, and education level, the total TPACK score of educators was compared regarding attendance on any training course on technology usage in education. No significant difference was seen in the TPACK score of educators who did not attend any training about technology usage (M= 225.61) and educators who took training about technology usage (M= 228.61). Even though a significant difference was expected by looking at previous studies, there was only a slight change between means. This meant that taking courses on technology usage in education may not be enough to cause a significant difference in the total TPACK score of educators because increasing the TPACK level is more complicated than just taking courses on basic technological knowledge (57.34 %) or distance learning (20.98 %). As Ginting and Linarsih (2022) remarked, the findings presented that development of TPACK of educators needs to be supported with practice on integration of sub-groups of TPACK and ongoing development.

On this issue, Luo et al. (2020) pointed out that pre-service early childhood educators had positive attitudes towards technology usage. However, they did not use technology in the teaching settings frequently. The researchers suggested that pre-service educators are supported to improve their self-confidence in technology usage. Moreover, Lavidas et al. (2021) investigated 147 Greek in-service early childhood educators' self-perception related to TPACK. They noticed that educators who took training related to technology integration improved their knowledge and abilities about TK and all interrelated factors. Besides, Oakley (2020) carried out research to examine the point of view of 67 pre-service teachers from the Primary and Early Childhood Department about using digital storybooks. The findings represented that pre-service teachers believe that creating digital storybooks and utilizing them in the teaching process is beneficial for improving their TPACK. Furthermore, Kildan and Incikabi (2015) researched how preparing digital stories influence the self-perception of the pre-service early childhood educators about TPACK. The study findings revealed that preparing digital stories enhanced the TPACK of pre-service educators. Additionally,

it was seen that their focus changed from TPK, TCK, and PCK to TPACK after the study.

Similar to other previous studies, Tanak (2018) looked at whether a TPACK-based course influenced the TPACK of 15 pre-service science teachers. The course was designed using the TPACK framework to enhance the TPACK of pre-service science teachers. After this course, apparent differences between pre-service teachers' previous and current TK, TPK, TCK, and TPACK were observed. Moreover, Köse (2012) carried out research to enhance the TPACK level of in-service primary school teachers by conducting in-service training as a single-group pretest-posttest experimental study. The result of the study showed that the TPACK level of teachers increased after the training. Also, while they did not have enough knowledge about technology integration before the training, they gained experience in integrating technology into education. By attending the training, they noticed that only using technology in education did not mean incorporating technology into education. All these results represented that not only attending technology-related training is important, but also the quality and content of the course are crucial for enhancing educators' TPACK level.

5.1.4. Discussions on Findings Regarding the Relationship between 21st-Century Skills and TPACK Level of In-service Early Childhood Educators

The study findings regarding the third research question helped us to examine the relationship between sub-factors of 21st-century skills (Learning and Innovation Skills; Life and Career Skills; and Information, Media and Technology Skills) and the total TPACK score of in-service early childhood educators. This study provided information about the relationship between 21st-century skills and Technological pedagogical content knowledge (TPACK). Some studies imply that there is some form of relation between them. Valtonen et al. (2017) and Mtebe and Raphael (2018) focused on 21st-century skills by combining them with TPACK and pointing out that educators should learn how to integrate 21st-century skills into TPACK because ICT can support children to gain 21st-century skills, and the pedagogical component of

TPACK is connected with 21st-century skills. Moreover, WEF (2015) stated that educational technologies might be an excellent helper to support children in gaining 21st-century skills. Moreover, Yılmaz (2020) carried out a study to investigate how technology integration influenced the multidimensional 21st-century skills of 144 pre-service educators in early childhood education, elementary school education, and science education. The research was conducted in three stages. The study findings represented that integrating technology made a positive change from the first phase to the third phase of the study in pre-service educators' multidimensional 21st-century skills, critical thinking, creativity, and academic achievements.

On the contrary, these studies did not indicate how the various 21st-century skills of educators and TPACK are connected. However, the current study helps us to see their relationship clearly. The study findings proved that there was a large positive correlation between the total 21st-century skills and the total TPACK (*rho*=.753, N=382). The high total 21st-century skills were associated with the high total TPACK score. The total 21st-century skills helped explain nearly 56.70 % of the variance in the total TPACK score of early childhood educators. Additionally, the correlation between the sub-factors of 21st-century skills (Learning and Innovation Skills; Life and Career Skills; and Information, Media and Technology Skills) and TPACK was examined in detail in this research.

The study findings represented that there was a strong positive correlation between the Learning and Innovation Skills and the total TPACK score (*rho*=.654, N=382). The high level of the Learning and Innovation Skills of in-service educators was associated with the high total TPACK score. The score of the Learning and Innovation Skills helped explain nearly 42.77 % of the variance in the total TPACK score of early childhood educators. Learning and Innovation Skills are the most frequently referred to among other 21st-century skills. They help people keep up with their complicated life in the 21st century, like learning to learn, creativity and invention, critical thinking and problem-solving skills, and communication and collaboration skills (Trilling and Fadel, 2009; BattelleForKids, 2019a; BattelleForKids, 2019b). This high correlation means that if educators' Learning and Innovation Skills are supported, this can make a contribution to increase of their TPACK, or in reverse, if their TPACK is supported,

this can make a contribution to the improvement of their Learning and Innovation Skills.

Although there were no directly related previous studies on this topic, some studies supported this point. To illustrate, Yılmaz (2020) carried out a study to investigate how technology integration influenced the multidimensional 21st-century skills of 144 pre-service educators in early childhood education, elementary school education, and science education. The research found that integrating technology positively changed pre-service educators' multidimensional 21st-century skills, critical thinking, and creativity. Moreover, Hung and Sitthiworachart (2020) conducted a study with 89 in-service educators from various departments to explore educators' points of view about creativity and its relation to technology. They declared that educators believed that technology might be a good supporter of children's creativity even though it is not compulsory to be creative. Besides, Akgül and Şahin-İzmirli (2021) carried out a study with 262 preservice educators on the association between their critical thinking and ICT-decoding skills, which was about understanding an ICT experience based on past experiences. Thus, they found a moderate and positive relationship between them. All in all, these previous studies might support the current research by indicating a mutual relationship because if educators are encouraged to improve their TPACK, it can develop their Learning and Innovation Skills.

Besides, there was a strong positive correlation between the Life and Career Skills and the total TPACK score (*rho*=.641, N=382). The high level of Life and Career Skills was associated with the high total TPACK score. Scores for the Life and Career Skill helped explain nearly 41.09 % of the variance in the total TPACK score of early childhood educators. Life and Career Skills are required for people to adapt to their work and social environment. They contain self-management skills, leadership, social and cross-cultural skills, flexibility, liability, adaptability, and also being innovative and productive (Trilling and Fadel, 2009; BattelleForKids, 2019a; BattelleForKids, 2019b). If educators' Life and Career Skills are supported, this support can make a contribution to the enhancement of their TPACK level, or the other way around, if their TPACK is supported, this can make a contribution to the enhancement of their Life and Career Skills.

There were some previous studies that supported this point, although there were no directly related studies on this topic. Kiraz (2021) examined 143 school administrators' ICT usage self-efficacy, management skills, and transformational leadership behaviors. According to simple linear regression analysis, the researcher found that ICT usage self-efficacy was an important predictor of transformational leadership behaviors. Moreover, Chen and Jang (2019) investigated the correlation between TPACK and Self-Regulation (SR) (a sub-skills of Life and Career Skills) of in-service educators who worked in a secondary school as science educators. Self-Regulation consisted of ICT, monitoring and controlling capability (MC/CC), planning capability (PC), and reflecting capability (RC). The correlation result demonstrated that the components of TPACK and SR had a positive correlation. Thus, RC and MC/CC had a higher association with CK and PCK. These findings might support the current research because if educators are encouraged to improve their TPACK, it can develop their Life and Career Skills.

Finally, the study findings revealed a high positive correlation between the Information, Media and Technology Skills and the total TPACK score (r=.694, N=382). The high level of the Information, Media and Technology Skills were associated with the high total TPACK score. Scores for the Information, Media and Technology Skills helped explain nearly 48.16% of the variance in the total TPACK score of early childhood educators. Information, Media, and Technology Skills contain information literacy, which is about reaching, assessing, using, and operating information appropriately and efficiently; media literacy, which is related to analyzing written or visual messages correctly and creating media tools; and ICT literacy, which is regarding using digital/ technological tools effectively and ethically to research, access, organize, communicate and evaluate (Trilling and Fadel, 2009; BattelleForKids, 2019a; BattelleForKids, 2019b). This high correlation means that when educators are encouraged to improve their Information, Media and Technology Skills, it can make a contribution to the improvement of their TPACK level. Reciprocally, if their TPACK is supported, this can make a contribution to the advancement of their Information, Media and Technology Skills.

To illustrate, Mtebe and Raphael (2018) focused on 21st-century skills by adapting TPACK to support educators. They pointed out that technology usage can support children in gaining 21st-century skills. Additionally, Liesa-Orús et al. (2020) examined the points of view of 345 professors from various departments in a university of Spain about using the Information and Communication Technologies (ICTs) to make a contribution to the improvement of students' 21st-century skills. It was found that university professors were aware of the significance of ICTs usage and took the positive impact of ICTs usage on the development of 21st-century skills into consideration. Therefore, the researchers emphasized the importance of preparing appropriate lessons for a technological learning culture to encourage students to be ready for the 21st-century. Besides, Sherouk and Raad (2020) carried out a study to see how educator educators in universities think and behave when they encountered six of the usual learning problems, especially in e-learning during the Covid 19 pandemic, since thinking and behaving successfully in unforeseen and complex conditions is one of the 21st-century skills. At the end of the study, it was stated that ICT could positively affect students' learning process if their educators have advanced digital literacy and know how to combine ICT with educational content. For this reason, the researchers recommended that teacher educators should be supported to enhance their 21st-century skills.

When all these findings were taken into consideration, it can be expressed that encouraging in-service early childhood educators to develop their 21st-century skills in one sub-factor or as a whole will help them to increase their TPACK level. By examining which sub-factors explain the variance in TPACK more, it was recognized that enhancement of Information, Media and Technology Skills (48.16 %), Learning and Innovation Skills (42.77 %) and then Life and Career Skills (41.09 %) could help educators to increase their TPACK level. Therefore, if educators' 21st-Century Skills (56.70 %) are supported, it can help them increase their TPACK level. The other way around, if educators' TPACK level is supported via various training or any other activities, their 21st-century skills can be improved at different levels.

Both 21st-century skills and the TPACK of educators are important for supporting the readiness of children to cope with complex life situations in the future (AACTE &

P21, 2010; Valtonen et al., 2017; Mtebe & Raphael, 2018). After the connection between them was seen with the current research, they should be supported by benefitting from the correlation between them so that early childhood educators can be more competent individuals to help their students be prepared for the complex needs of the 21st Century.

5.2. Implications

The current study contributes to our understanding of the educational improvement of educators' skills and knowledge, specifically early childhood educators because it was a preliminary study to investigate in-service early childhood educators' 21st-century skills regarding various mostly demographic, independent variables. Educators' skills are essential for the development of the educational system since educators' capabilities are highly influential in the preparation of their students for the complex world and the unknown future (WEF, 2016; Shafie, Majid & Ismail, 2019) by being leaders in educational changes (Lee & Reigeluth, 1994). In line with the findings of the present study, three significant contributions of the study are defined in this part. These implications are expected to guide future studies to explore educators' 21st-century skills and TPACK profoundly.

First of all, this study could guide future studies about whether they should investigate educators' skills based on different variables or not. When the literature was examined, it was realized that there are few previous studies on this topic. Therefore, this study provided information about how in-service early childhood educators evaluated their own 21st-century skills and the 21st-century skills of educators regarding their age, years of experience, education level, and attendance of training on 21st-century skills as a preliminary study. The findings indicated that most educators believed that their 21st-century skills were close to the highest level. Additionally, it was seen that there was not a statistically significant difference in their scores in terms of age, years of experience, and education level. The only statistically significant difference was detected between educators who attended training on 21st-century skills and educators who did not. Therefore, this study can help other researchers to focus on only training related variables in their studies.

Additionally, detailed information about 21st-century skills of in-service early childhood educators was collected via the 21st-Century Skills Scale, which was created by Anagün et al. (2016) for pre-service educators. That scale was adapted to in-service early childhood educators by the researcher of this study. That is another contribution of the present study to the literature. When the literature was investigated, it was recognized that there was not an appropriate scale to measure the 21st-century skills of in-service educators. Most of the researchers used the 21st-Century Skills Scale, which was developed for pre-service educators without testing whether it is suitable for in-service educators or not. In this study, it was realized that the original format of the scale was not totally appropriate for in-service early childhood educators. Thus, one item was omitted from the scale and another item was amended. In other studies, the original scale or the adapted scale in the current study can be tested with in-service educators from other departments for their validity and reliability before collecting data for the main research.

Secondly, this study could guide future studies about whether they should investigate early childhood educators' TPACK based on different variables or not. When the literature was examined, it was realized that there are not many studies conducted with in-service early childhood educators on this topic. Therefore, this study provided information about how in-service early childhood educators evaluated their own TPACK level and the TPACK of educators regarding their age, years of experience, education level, and attendance of training on technology usage in education as a preliminary study. The findings indicated that most educators believed their TPACK was close to the highest level. Additionally, it was seen that there was not a statistically significant difference in scores in terms of different age groups, years of experience, education level, and training attendance. Therefore, this study can help other researchers to focus on content and quality of the TPACK-related training in their studies since this study result indicated that not only training attendance but also other factors related to training are important.

Finally, this study provided an investigation, especially about whether there is any relationship between the sub-factors (Learning and Innovation Skills; Information,

Media and Technology Skills; and Life and Career Skills) of 21st-century skills and TPACK of in-service early childhood educators. It was seen that all sub-factors of the 21st-century skills had a large positive correlation with TPACK.

Both the 21st-century skills and the TPACK of educators are crucial for preparing children to cope with complex life situations in the future (AACTE & P21, 2010; Valtonen et al., 2017; Mtebe & Raphael, 2018). Nevertheless, before this study, a handful of studies implied a kind of relationship exists between 21st-century skills and Technological pedagogical content knowledge (TPACK). Besides, the relationship between TPACK and Technology Skills was generally highlighted in the previous studies (Ferrari, Punie & Redecker, 2012; Karakoyun & Lindberg, 2020) as if technology skills are the only essential one among the whole 21st-century skills. After the current study, the correlation between them was seen clearly. For this reason, this study is of special significance to early childhood education and relevant to all educational contexts. As Smith, Burrow, Fite, and Guerra (2016) said, supporting educators enables them to develop children by using the skills and knowledge they have learned and developed in the classroom.

5.3. Recommendations for Future Research

The present study explored early childhood educators' 21st-century skills, TPACK, and their association. By taking the study's findings into consideration, some recommendations are offered for future research in this section.

The findings indicated that most early childhood educators believed that their 21st-century skills were close to the highest level. However, it was based on self-assessment. That is why qualitative studies can be conducted, like observing educators during school time or during an event that will be designed for educators to use their 21st-century skills in future studies.

Moreover, a statistically significant difference was detected between educators who attended training on 21st-century skills and educators who did not participate in any. Although this was an expected result, it was based on only quantitative data. Thus, an

experimental study can be applied to in-service early childhood educators by conducting pre-test, training, and post-test.

Besides, the 21st-Century Skills Scale, created by Anagün et al. (2016) for pre-service educators, was adapted to in-service early childhood educators in this study because an appropriate scale to measure the 21st-century skills of in-service early childhood educators was not found. Even though the validity and reliability of the adapted scale were checked, further studies can be conducted for the validity and reliability of the scale with different in-service early childhood educators. Also, similar adaptations can be made for in-service educators from other departments in future studies.

If the aim of education is to have 21st-century learners, educators' 21st-century skills and their applications in the classroom should be focused on as an initial step. Therefore, as Kim, Raza, and Seidman (2019) and Haviz et al. (2020) suggested, suitable curriculums, methods and quality teaching activities can be created. Then, their effects on educators' 21st-century skills can be examined.

Like 21st-century skills, most early childhood educators evaluated their TPACK as close to the highest level. However, this assessment was based on self-evaluation. That is why qualitative studies can be conducted, like an observation of educators and examination of the curriculum in detail. For example, Schmid, Brianza and Petko (2020) researched whether there is any correlation between self-evaluation of TPACK and integration of technology in the lesson plans of pre-service upper secondary school teachers. Similar studies can be conducted with in-service early childhood educators. Additionally, the finding of the present study indicated that no statistically significant difference in TPACK level of educators was detected for any independent variable. Because this result is based on only teachers' self-assessment, qualitative research can be applied to in-service early childhood educators. Experimental studies can be implemented by conducting pre-test, training and post-test after appropriate TPACK-based training is offered to in-service educators.

Masoumi (2020) detected that there are no mandatory courses specifically related to technology usage in the early years. This situation represents that the TPACK of both

pre-service educators, in-service educators and teacher educators should be supported, and their knowledge should be increased about technology usage in education during the early years. For this reason, curriculum development studies can be carried out for in-service early childhood educators by using the TPACK framework. Moreover, suggestion of Luo et al. (2020) can be taken into consideration and teacher preparation programs can be improved, and more opportunities can be offered to pre-service educators to practice field-based technology usage before they become an educator.

This study was also conducted to explore the relationship between the sub-factors of 21st-century skills and the total TPACK score of in-service early childhood educators. This relationship can be examined in other departments. Besides, the association of each sub-factor of 21st-century skills with each sub-factor of TPACK can be discussed in future studies as well. Moreover, this study can inspire people to focus on this connection in future research studies for creating different scales for better integration of educators' 21st-century skills and TPACK.

As Hannaway and Steyn (2016) suggested, there should be a teacher training program to improve educators' pedagogical and technological abilities and 21st-century skills. However, Kaya and Yılayaz (2013), Bozkurt (2020), Bayrak and Bayrak (2021) and Teo et al. (2021) pointed out that content of pre-service and in-service training programs is not sufficient for educators. By considering these, educators' professional development programs can be directed according to their connection in further studies to support educators' 21st-century skills and TPACK at the same time. Therefore, they can encourage children better to adapt to the needs of the complex world.

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APPENDICES

A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE AND MINISTRY OF NATIONAL EDUCATION

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TURKEY
T: +90 312 210 22 91
F: +90 312 210 79 59
ueam@metu.edu.tr
www.ueam.metu.edu.tr

Sayı: 28620816 /

20 Mayıs 2021

Konu : Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Hasibe Özlen Demircan

Danışmanlığını yürüttüğünüz Hilal Asena Cangül'ün "Okul Öncesi Öğretmenlerinin 21. Yüzyıl Becerileri ile Teknolojik Pedagojik Alan Bilgileri (TPAB) arasındaki ilişkinin incelenmesi" başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **183-ODTU-2021** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Dr.Öğretim Üyesi Şerife SEVİNÇ
İAEK Başkan Vekili

T.C.
MİLLÎ EĞİTİM BAKANLIĞI
Strateji Geliştirme Başkanlığı

Sayı : E-49614598-605.01-40209380 30.12.2021
Konu : Araştırma Uygulama İzin Talebi

DAĞITIM YERLERİNE

İlgi: a) Orta Doğu Teknik Üniversitesi Rektörlüğü'nün 10/11/2021 tarihli ve 54850036-044-E.253 sayılı yazısı.
b) Millî Eğitim Bakanlığı'nın 21/01/2020 tarihli ve 2020/2 Nolu Araştırma Uygulama İzinleri Genelgesi.

İlgi (a) yazı ile Orta Doğu Teknik Üniversitesi, Sosyal Bilimler Enstitüsü Temel Eğitim Anabilim Dalı Okul Öncesi Eğitimi Yüksek Lisans Programı öğrencisi Hilal Asena CANGÜL'ün "Okul Öncesi Öğretmenlerinin 21. Yüzyıl Becerileri ile Teknolojik Pedagojik Alan Bilgileri (TPAB) Arasındaki İlişkinin İncelenmesi" konulu çalışmasına veri sağlamak amacıyla anket çalışması yapma izin talebine ilişkin ilgi yazı ve ekleri Bakanlığımız tarafından incelenmiştir.

Bakanlığımıza bağlı resmi/özel okul ve kurumlarda öğrenci, öğretmen ve okul yöneticilerinin katılımıyla yapılması planlanan uygulamanın covid-19 tedbirlerine uyulması ve denetimi il/ilçe millî eğitim müdürlükleri ve okul/kurum idaresinde olmak üzere, kurum faaliyetlerini aksatmadan, gönüllülük esasına göre; onaylı bir örneği Bakanlığımızda muhafaza edilen ve uygulama sırasında da mühürlü ve imzalı örnekten çoğaltılan, veri toplama araçlarının https://forms.gle/ro117ihiYAgidX2u8 adresinden online olarak uygulanmasına ilgi (b) Genelge doğrultusunda izin verilmiştir.

Gereğini bilgilerinize rica ederim.

Mehmet Fatih LEBLEBİCİ
Bakan a.
Başkan

Ek: Onaylı Veri Toplama Araçları (7 Sayfa)

Dağıtım:
Gereği: Bilgi:
Ankara, İstanbul ve İzmir Valiliklerine Orta Doğu Teknik Üniversitesi Rektörlüğüne
(İl Milli Eğitim Müdürlüğü)

Bu belge güvenli elektronik imza ile imzalanmıştır.
Adres : MEB Atatürk Bulvarı No:98 Bakanlıklar/ANKARA
Belge Doğrulama Adresi : https://www.turkiye.gov.tr/meb-ebys
Bilgi için: Muhammed TURŞAK
Telefon No : 0 (312) 413 55 98
Unvan : Şube Müdürü
E-Posta: sgb_arastirmaizinleri@meb.gov.tr
İnternet Adresi: www.meb.gov.tr
Faks:3124186401
Kep Adresi : meb@hs01.kep.tr

B. ORIJINAL SCALES

Demografik Bilgi Formu

1) Lütfen cinsiyetinizi belirtiniz.

Kadın/Erkek

2) Lütfen yaşınızı belirtiniz.

30 yaş ve altı
31-40 yaş
41 yaş ve üzeri

3) Deneyim yılınız nedir?

0-3 yıl
4-7 yıl
8+ yıl

4) Lütfen eğitim seviyenizi belirtiniz.

Lise
Ön lisans
Lisans
Yüksek Lisans
Doktora

5) Teknolojinin eğitimde kullanılması konusunda size yardımcı olduğunu düşündüğünüz dersler/ hizmet içi eğitimler aldınız mı?

Evet/Hayır

- Bunlar neler? Lütfen belirtiniz….

6) 21. yüzyıl becerilerini kazanma konusunda size yardımcı olduğunu düşündüğünüz dersler/ hizmet içi eğitimler aldınız mı?

Evet/Hayır

- Bunlar neler? Lütfen belirtiniz….

21. YÜZYIL BECERİLERİ ÖZYETERLİK ALGISI ÖLÇEĞİ		Her zaman	Sık sık	Bazen	Nadiren	Hiçbir zaman
Öğrenme ve Yenilenme Becerileri						
1	Karşılaştığım sorunların çözümüne yönelik özgün fikirler geliştiririm.	**5**	**4**	**3**	**2**	**1**
2	Yaşamımda özgün fikirler oluşturmak için farklı düşünme tekniklerini (beyin fırtınası, altı şapkalı düşünme) kullanırım.	**5**	**4**	**3**	**2**	**1**
3	Bir problemi sonuca ulaştırmak için farklı çözüm yolları denerim.	**5**	**4**	**3**	**2**	**1**
4	Bütün- parça arasında alışılmışın dışında ilişkiler kurarım.	**5**	**4**	**3**	**2**	**1**
5	Problemlerin çözümü için hayal gücümü kullanırım.	**5**	**4**	**3**	**2**	**1**
6	Yeni fikirleri analiz ederek değerlendiririm.	**5**	**4**	**3**	**2**	**1**
7	Bir konuya ilişkin düşüncelerin farklı boyutlarını anlamaya çalışırım.	**5**	**4**	**3**	**2**	**1**
8	Problemi çözerken farklı bakış açılarını belirlemek için sorular sorarım.	**5**	**4**	**3**	**2**	**1**
9	Problemlere çözüm üretmek için sabırlı bir biçimde çalışırım.	**5**	**4**	**3**	**2**	**1**
10	Bir iddiayı sorgulayarak görüşün dayandığı temel dayanakları araştırırım.	**5**	**4**	**3**	**2**	**1**
11	Karşılaştığım problemleri çözmek için akıl yürütme yollarını kullanırım	**5**	**4**	**3**	**2**	**1**
12	Problemlerin çözümünde bütün-parça arasındaki ilişkileri analiz ederim.	**5**	**4**	**3**	**2**	**1**
13	Farklı bakış açılarını değerlendiririm.	**5**	**4**	**3**	**2**	**1**
14	Bilgi ve argümanlar arasında ilişkiler kurarak sentezlerim.	**5**	**4**	**3**	**2**	**1**
15	Sonuçlara bilgileri analiz ederek ulaşırım.	**5**	**4**	**3**	**2**	**1**
16	Edindiğim bilgiyi farklı yollarla (yazılı, sözlü gibi) diğerleriyle paylaşırım.	**5**	**4**	**3**	**2**	**1**
Yaşam ve Kariyer Becerileri						
17	Zamanı etkili kullanırım.	**5**	**4**	**3**	**2**	**1**
18	Yeteneklerimi geliştirmek için girişimde bulunurum.	**5**	**4**	**3**	**2**	**1**
19	Diğerlerinin bir konu üzerindeki düşüncelerini dinlerim.	**5**	**4**	**3**	**2**	**1**
20	Etkili iletişim becerilerine sahibim.	**5**	**4**	**3**	**2**	**1**
21	Grup çalışmalarında etkin bir biçimde çalışabilme becerisine sahibim.	**5**	**4**	**3**	**2**	**1**
22	Grup üyeleriyle uyumlu bir biçimde çalışırım.	**5**	**4**	**3**	**2**	**1**
23	Grup çalışmalarında sorumluluk üstlenirim.	**5**	**4**	**3**	**2**	**1**
24	Grup çalışmalarında bireysel katkılara değer veririm.	**5**	**4**	**3**	**2**	**1**
25	Başkalarının önerilerine dayalı olarak fikirlerimi değiştirme konusunda esneğimdir.	**5**	**4**	**3**	**2**	**1**

26	Yaşamımdaki farklı rollere (arkadaş, vatandaş, ekonomik, güç, aile üyesi) uyum sağlarım.	**5**	**4**	**3**	**2**	**1**
27	Yeni durumlara uyum sağlamada rahat değilimdir.	**5**	**4**	**3**	**2**	**1**
28	Eleştirilere açığımdır.	**5**	**4**	**3**	**2**	**1**
29	Sorunlara çözüm üretmek için farklı bakış açılarını önemserim.	**5**	**4**	**3**	**2**	**1**
30	Öğrenmenin yaşam boyu devam eden bir süreç olduğunu bilirim.	**5**	**4**	**3**	**2**	**1**
31	Gelecekteki olayları tahmin etmek için geçmiş deneyimlerinden yararlanırım.	**5**	**4**	**3**	**2**	**1**
32	Ne zaman konuşup ne zaman dinlemem gerektiğini bilirim.	**5**	**4**	**3**	**2**	**1**
33	Başkalarıyla iletişimimde saygılıyımdır.	**5**	**4**	**3**	**2**	**1**
34	Farklı kültürlere saygı duyarım.	**5**	**4**	**3**	**2**	**1**
Bilgi, Medya ve Teknoloji Becerileri						
35	Diğerleriyle iletişim kurmak için medya ve teknolojiyi etkin kullanırım.	**5**	**4**	**3**	**2**	**1**
36	Medyadaki mesajların hangi amaçlara yönelik olarak yapılandırıldığını bilirim.	**5**	**4**	**3**	**2**	**1**
37	Medyanın bireylerin düşüncelerini yönlendirmede etkili olduğunu bilirim.	**5**	**4**	**3**	**2**	**1**
38	Bilgi edinmede uygun medya araçlarını kullanırım.	**5**	**4**	**3**	**2**	**1**
39	Farklı medya araçlarını kullanırım.	**5**	**4**	**3**	**2**	**1**
40	Bilgiye ulaşmada teknolojik araçları kullanırım.	**5**	**4**	**3**	**2**	**1**
41	Bilgiyi analiz ederken teknolojik araçları kullanırım.	**5**	**4**	**3**	**2**	**1**
42	Bilgi paylaşımında sosyal ağları kullanırım.	**5**	**4**	**3**	**2**	**1**

TEKNOLOJİK PEDAGOJİK ALAN BİLGİSİ ÖLÇEĞİ

Değerli Katılımcı

Bu çalışmada alan bilginiz, teknoloji bilginiz ve pedagoji bilginizle ilgili maddeler yer almaktadır. Sizden beklentimiz her bir maddeyi okuduktan sonra, maddede ifade edilen durumla ilgili katılma düzeyinizi belirtmenizdir. Soruların herkes için geçerli doğru yanıtları bulunmamaktadır. Ölçeği doldururken adınız sorulmamaktadır. Lütfen gerçek durumu belirtir samimi yanıtınızı işaretleyiniz.

"Bu ölçek aşağıda yazılı yazarlar ve künyesi verilen çalışmaya aittir, atıf için aşağıdaki künyeyi kullanınız:

Horzum, M. B., Akgün, Ö.E., & Öztürk, E. (2014). The Psychometric Properties of the Technological Pedagogical Content Knowledge Scale. *International Online Journal of Educational Sciences, 6*(3), 544-557."

Aşağıdaki maddelerde kendinize ne kadar güvendiğinizi yan tarafta yer alan maddelerde işaretleyiniz. Bu maddelerde

"1=Hiç katılmıyorum, 2= Katılmıyorum, 3= Kararsızım, 4= Katılıyorum ve 5=Tamamen katılıyorum olarak değerlendirilmelidir."

Maddeler		Katılma Düzeyiniz				
		1	**2**	**3**	**4**	**5**
1.	Yeni teknolojileri takip ederim.					
2.	Teknoloji ile ilgili karşılaştığım problemleri nasıl çözebileceğimi bilirim.					
3.	İhtiyaç duyduğum teknolojileri kullanma konusunda yeterli bilgiye sahibim.					
4.	Bilgiye erişmek için gerekli olan teknoloji bilgisine sahibim.					
5.	Eriştiğim kaynaklardaki bilgileri kullanmak için gerekli teknoloji bilgisine sahibim.					
6.	Sınıfımdaki öğrenciler teknoloji kullanımıyla ilgili problem yaşadıklarında onlara destek verecek yeterli bilgiye sahibim.					
7.	Öğrencilerin öğrenme düzeylerine bağlı olarak öğretimimi uyarlayabilirim.					
8.	Öğrenci performansını nasıl ölçeceğimi bilirim.					
9.	Farklı öğrenme sitillerine sahip öğrenciler için öğretim sürecini uyarlayabilirim.					
10.	Sınıfın özelliklerine göre öğretim stratejileri, yöntemleri ve teknikleri arasından uygun olanını kullanırım.					
11.	Dersimde sınıfı gerektiği gibi yönetirim.					
12.	Öğrencilerin etkin katılımlarını sağlamak için gerekli yöntem ve teknikleri bilirim.					
13.	Öğrencilerin birbirlerini değerlendirmelerini sağlarım.					
14.	Anlatacağım konuların kapsamına karar veririm.					
15.	Alanımla ilgili yeni ve değişen bilgileri öğrenirim.					
16.	Alanımla ilgili gelişmeleri takip ederim.					
17.	Alanımdaki bilgilerin mevcut sınıflandırmasını bilirim.					
18.	Alanımla ilgili terimleri bilirim.					
19.	Alanımdaki bilgi kaynaklarını bilirim.					
20.	Alanımla ilgili öğrencilerimi yönlendirebileceğim, onlara uygun kaynakları bilirim.					
21.	Alanımda kendimi nasıl geliştireceğimi bilirim.					
22.	Alanımla ilgili kaynaklara erişmek, kaynakları düzenlemek ve kullanmak için gerekli teknoloji bilgisine sahibim.					
23.	Alanımla ilgili hazır yazılımları kullanabilirim.					
24.	Alanımdaki öğretim program(lar)ıyla ilgili güncellemeleri ve değişiklikleri interneti kullanarak takip ederim.					

25.	Öğrencilerimin alanımla ilgili teknolojileri kullanmalarını sağlarım.					
26.	Mesleki açıdan gelişmek için alanımla ilgili uzmanların bir araya geldiği sosyal ağlardan yararlanabilirim.					
27.	Alanımla ilgili bilgilerimi geliştirmek için gerekli teknolojik bilgi ve becerilere sahibim.					
28.	Anlatacağım dersle ilgili ders planlarını kolaylıkla hazırlarım.					
29.	Belirli bir kavramı öğretmek için en uygun öğretim stratejisini seçebilirim.					
30.	Öğrencilerimin problem çözmede doğru ve yanlış girişimlerini ayırt edebilirim.					
31.	Belirli bir konuyla ilgili öğrencilerde oluşabilecek kavram yanılgılarını bilir ve ona göre hareket ederim.					
32.	Öğrencilerimi alanımla ilgili düşündürmeye ve öğrenmeye yönlendirmek için gerekli öğretme yaklaşımını seçebilirim.					
33.	Anlattığım konulara uygun öğretme stratejilerini kullanırım.					
34.	Alanımla ilgili öğrencilerin zor öğrendiği konuları bilirim.					
35.	Anlatacağım kavramları uygun şekilde sıralayabilirim.					
36.	Öğrencilerin yeni bilgi ve beceriler kazanmasına olanak sağlayacak teknolojiler kullanabilirim.					
37.	Öğrencilerin etkin öğrenmelerini sağlamak için gelişim düzeylerine uygun teknolojileri seçme ve kullanma bilgi ve becerisine sahibim.					
38.	Kullanacağım teknolojilerin ve öğretim yaklaşımlarının birbirini nasıl etkileyeceğini bilirim.					
39.	Öğrencilerimin daha iyi öğrenmelerini sağlayabilecek teknolojileri seçebilirim.					
40.	Daha zengin öğrenme ortamları oluşturmak için teknolojiyi kullanabilirim.					
41.	Teknolojiyi derslerde nasıl kullanabileceğimi tartışabilecek düzeyde bilgi sahibiyim.					
42.	Gerektiğinde öğretme performansımı geliştirmek için teknolojiyi kullanırım.					
43.	Farklı öğretme yöntemlerini kullanırken öğrendiğim yeni teknolojileri öğretimime uyarlayabilirim.					
44.	Öğrencilerin belli bir konuyla ilgili beceri ve anlama düzeylerini belirlemede teknolojiyi kullanabilirim.					
45.	Dersin içeriğine uygun, strateji, yöntem ve teknolojiyi seçip kullanabilirim.					
46.	Konuya uygun yöntemlerin ve teknolojilerin seçiminde ve kullanılmasında diğer meslektaşlarıma liderlik yapabilirim.					
47.	Konu alanına, öğretim yöntemine ve mevcut teknolojiye uygun öğretim materyalleri geliştirebilirim.					
48.	Ders anlatırken konunun daha iyi anlaşılmasını sağlayacak teknolojileri kullanabilirim.					
49.	Anlattığım konuya göre öğrencilerin daha etkin öğrenmesini sağlayacak yöntem ve teknolojileri kullanabilirim.					
50.	Konunun daha iyi öğrenilmesini sağlayacak öğretim yöntemine uygun teknolojileri öğrencilerin kullanmasını sağlarım.					
51.	Öğrencilerin konuyu daha istekli çalışmalarını sağlayacak öğretim yöntem ve teknolojilerini seçebilirim.					

Cinsiyetiniz: Kız ( ) Erkek ( )
Okuduğunuz lisans programının adı:……..……..
Yaşınız:……..
Öğretim türü: Birinci Öğretim ( ) İkinci Öğretim ( ) Pedagojik Formasyon ( )
Okuduğunuz Sınıfı Yazınız:……

Çalışmamıza katıldığınız için teşekkür ederiz

C. DEMOGRAPHIC INFORMATION IN PILOT STUDY

		F	%
Age Groups	30 and below	38	19
	31-40	104	52
	41 and above	58	29
	Total	200	100
Years of experience	0-3 years	24	12
	4-7 years	32	16
	8+ years	144	72
	Total	200	100
Education level	High School	2	1
	Associate Degree	16	8
	Undergraduate	80	80
	Master	11	11
	Total	200	100
Training on 21st-century skills	No	137	68.5
	Yes	63	31.5
	Total	200	100
Training on technology usage in education	No	114	57
	Yes	86	43
	Total	200	100

D. PILOT STUDY ANALYSIS- 21ST CENTURY SKILLS SCALE

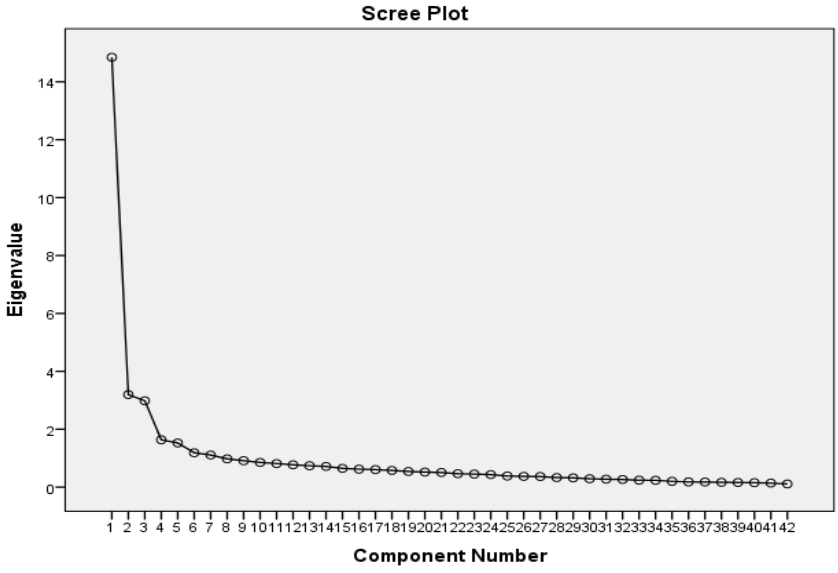
EFA Results of 21st-Century Skills Scale in the Pilot Study

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	14,845	35,345	35,345	14,845	35,345	35,345	11,916
2	3,195	7,608	42,953	3,195	7,608	42,953	7,856
3	2,981	7,098	50,050	2,981	7,098	50,050	8,192
4	1,636	3,896	53,946	1,636	3,896	53,946	4,389
5	1,526	3,634	57,580	1,526	3,634	57,580	1,885
6	1,186	2,824	60,404	1,186	2,824	60,404	3,202
7	1,110	2,643	63,047	1,110	2,643	63,047	3,142
8	,977	2,325	65,372				
9	,913	2,173	67,545				
10	,854	2,034	69,579				
40	,153	,365	99,405				
41	,139	,332	99,736				
42	,111	,264	100,000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.



Rotated Component Matrix of Original 21st-Century Skills Scale

	Components		
	1	2	3
Skills6	,794		
Skills8	,768		
Skills14	,751		
Skills7	,749		
Skills12	,739		
Skills15	,712		
Skills4	,708		
Skills11	,697		
Skills10	,673		
Skills5	,644		
Skills13	,633	,306	
Skills1	,632		
Skills2	,610		
Skills9	,603		
Skills3	,552	,304	
Skills16	,508		,310
Skills18	,464		
Skills17	,377		,371
Skills26		,769	
Skills23		,756	
Skills22		,722	
Skills24		,648	
Skills29	,438	,629	
RSkills27		,621	
Skills21	,400	,589	
Skills25		,569	
Skills28	,337	,565	
Skills32		,561	
Skills19	,331	,559	
Skills33		,549	,316
Skills31		,491	
Skills34		,457	,300
Skills20	,329	,438	
Skills30		,368	
Skills40			,797
Skills39			,771
Skills38			,758
Skills41			,741
Skills42			,712
Skills35			,700
Skills36			,671
Skills37			,487

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 6 iterations.

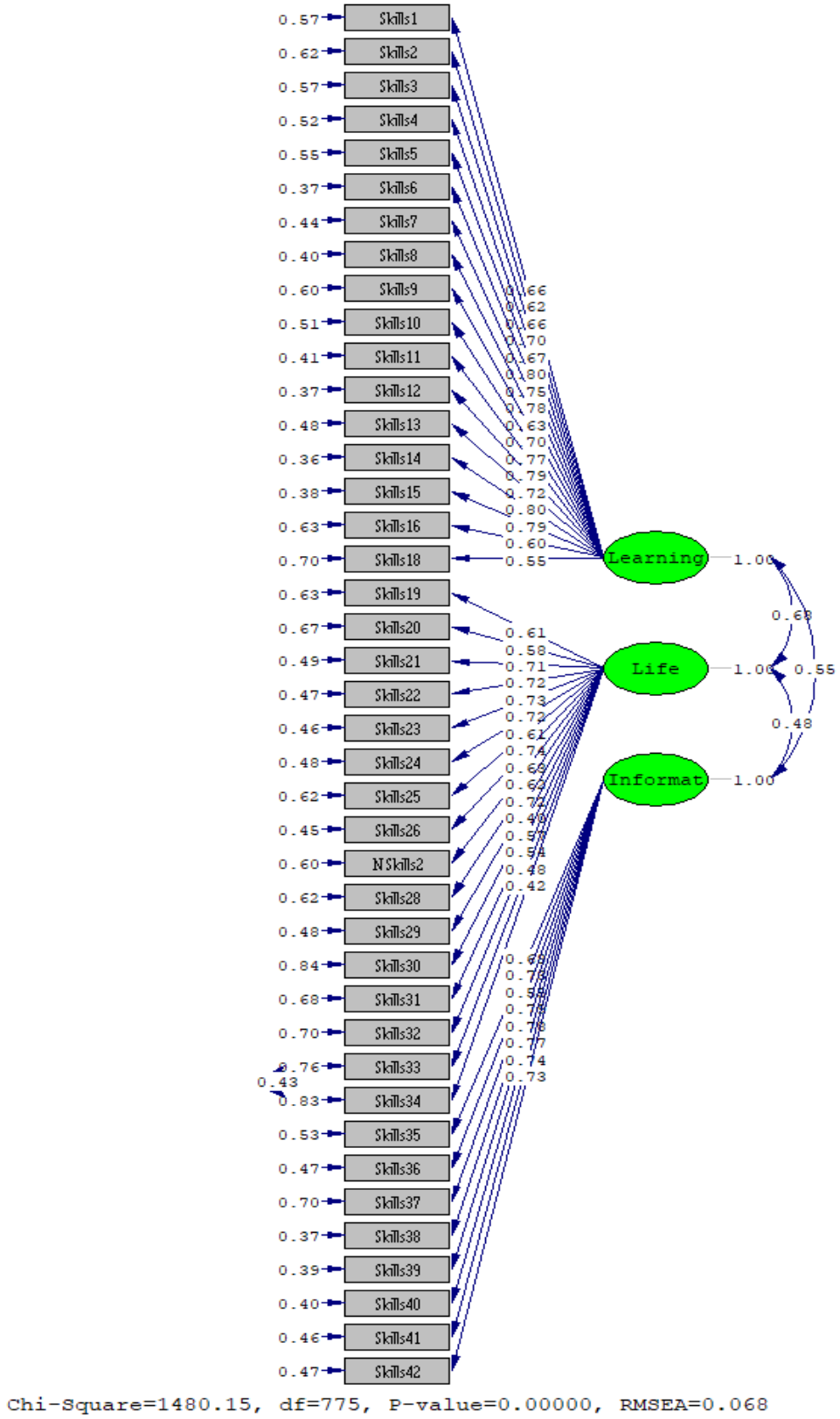
Rotated Component Matrix After Omitting Skills17 in the Pilot Study

	Components		
	1	2	3
Skills6	,795		
Skills8	,768		
Skills14	,752		
Skills7	,751		
Skills12	,741		
Skills15	,713		
Skills4	,708		
Skills11	,699		
Skills10	,674		
Skills5	,645		
Skills13	,634	,307	
Skills1	,632		
Skills2	,608		
Skills9	,602		
Skills3	,553	,305	
Skills16	,508		,303
Skills18	,462		
Skills26		,769	
Skills23		,757	
Skills22		,724	
Skills24		,650	
Skills29	,438	,629	
RSkills 27		,621	
Skills21	,399	,591	
Skills25		,568	
Skills28	,338	,565	
Skills32		,562	
Skills19	,330	,560	
Skills33		,549	,325
Skills31		,492	
Skills34		,457	,305
Skills20	,327	,441	
Skills30		,368	
Skills40			,794
Skills39			,776
Skills38			,756
Skills41			,730
Skills42			,707
Skills35			,707
Skills36			,672
Skills37			,501

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

CFA of 21st-Century Skills Scale in the Pilot Study



The Reliability of 21st-Century Skills Scale in the Pilot Study

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	Inter-Item Correlations
Skills1	176,68	239,204	,591	,951	,952	,331
Skills2	176,99	236,392	,549	,951		
Skills3	176,66	238,497	,653	,950		
Skills4	177,05	235,304	,620	,951		
Skills5	176,69	237,893	,600	,951		
Skills6	176,75	235,658	,682	,950		
Skills7	176,71	238,127	,637	,951		
Skills8	176,73	236,892	,641	,950		
Skills9	176,67	238,224	,580	,951		
Skills10	176,98	235,552	,587	,951		
Skills11	176,64	238,201	,697	,950		
Skills12	176,82	236,011	,694	,950		
Skills13	176,63	238,115	,669	,950		
Skills14	176,85	235,770	,702	,950		
Skills15	176,83	235,546	,717	,950		
Skills16	176,80	236,821	,610	,951		
Skills18	176,76	238,005	,550	,951		
Skills19	176,48	241,738	,538	,951		
Skills20	176,79	238,217	,554	,951		
Skills21	176,62	237,855	,631	,951		
Skills22	176,47	241,155	,545	,951		
Skills23	176,39	241,747	,533	,951		
Skills24	176,44	240,469	,603	,951		
Skills25	176,77	239,065	,490	,952		
Skills26	176,54	240,340	,540	,951		
RSkills27	176,96	240,300	,516	,951		
Skills28	176,89	237,857	,514	,951		
Skills29	176,54	239,154	,641	,951		
Skills30	176,19	247,160	,384	,952		
Skills31	176,49	241,377	,489	,951		
Skills32	176,57	241,885	,433	,952		
Skills33	176,29	245,564	,416	,952		
Skills34	176,29	245,853	,384	,952		
Skills35	176,69	239,803	,465	,952		
Skills36	176,77	237,183	,574	,951		
Skills37	176,55	242,159	,471	,951		
Skills38	176,58	240,114	,567	,951		
Skills39	176,74	239,369	,486	,952		
Skills40	176,55	241,826	,481	,951		
Skills41	176,66	240,318	,496	,951		
Skills42	176,76	238,035	,484	,952		

The Reliability of Learning and Innovation Skills

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	Inter-Item Correlations
Skills1	68,75	64,754	,645	,530	,937	,940	,487
Skills2	69,06	63,148	,594	,430	,938		
Skills3	68,73	65,085	,635	,470	,937		
Skills4	69,12	62,384	,687	,542	,936		
Skills5	68,76	64,085	,645	,487	,937		
Skills6	68,81	62,416	,776	,668	,934		
Skills7	68,78	63,854	,726	,595	,935		
Skills8	68,80	63,058	,737	,636	,935		
Skills9	68,73	64,389	,613	,484	,937		
Skills10	69,04	62,471	,653	,517	,937		
Skills11	68,71	64,430	,736	,606	,935		
Skills12	68,88	62,970	,756	,665	,934		
Skills13	68,69	64,637	,679	,554	,936		
Skills14	68,91	62,856	,763	,659	,934		
Skills15	68,90	63,035	,750	,670	,935		
Skills16	68,87	64,375	,575	,404	,938		
Skills18	68,82	64,962	,517	,345	,940		

The Reliability of Life and Career Skills

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	Inter-Item Correlations
Skills19	67,98	33,135	,579	,394	,896	,902	,371
Skills20	68,30	32,259	,518	,370	,899		
Skills21	68,13	31,698	,662	,536	,892		
Skills22	67,98	32,366	,674	,569	,893		
Skills23	67,90	32,466	,687	,636	,892		
Skills24	67,95	32,575	,660	,586	,893		
Skills25	68,27	31,625	,569	,503	,897		
Skills26	68,04	31,717	,709	,556	,891		
RSkills27	68,47	32,180	,603	,499	,895		
Skills28	68,40	31,165	,591	,485	,896		
Skills29	68,05	32,134	,687	,521	,892		
Skills30	67,70	35,510	,377	,263	,902		
Skills31	68,00	33,010	,517	,372	,898		
Skills32	68,07	32,819	,507	,382	,898		
Skills33	67,80	34,495	,491	,565	,899		
Skills34	67,79	34,820	,411	,439	,901		

The Reliability of Information, Media and Technology

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	Inter-Item Correlation
Skills 35	30,96	13,225	,669	,481	,876	,890	,508
Skills 36	31,04	13,003	,703	,569	,872		
Skills 37	30,82	14,775	,506	,371	,890		
Skills 38	30,85	13,796	,722	,564	,872		
Skills 39	31,01	12,975	,725	,554	,870		
Skills 40	30,83	13,934	,701	,612	,874		
Skills 41	30,93	13,678	,660	,521	,877		
Skills 42	31,03	12,768	,666	,502	,878		

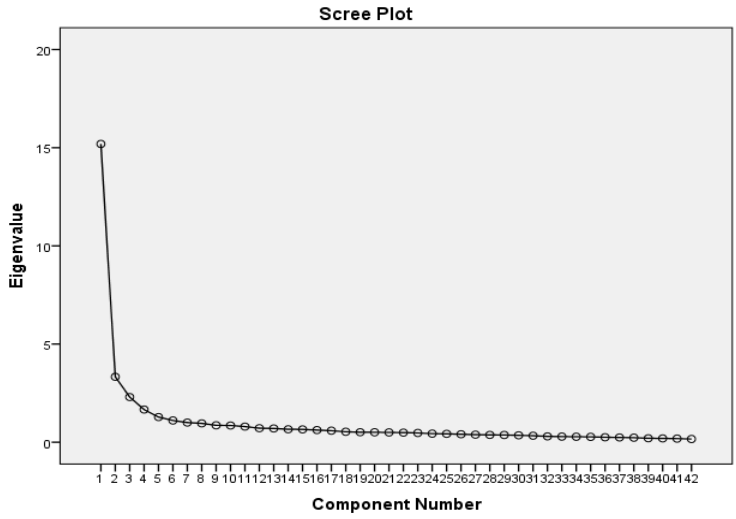
E. EFA AND CFA OF 21ST CENTURY SKILLS SCALE WITH THE DATASET OF THE MAIN STUDY

Total Variance Explained

Component	Initial Eigenvalues Total	% of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %	Rotation Sums of Squared Loadings[a] Total
1	15,192	36,171	36,171	15,192	36,171	36,171	11,913
2	3,330	7,930	44,101	3,330	7,930	44,101	8,091
3	2,301	5,480	49,580	2,301	5,480	49,580	8,926
4	1,666	3,966	53,547	1,666	3,966	53,547	5,828
5	1,283	3,054	56,601	1,283	3,054	56,601	3,751
6	1,107	2,635	59,236	1,107	2,635	59,236	3,784
7	1,001	2,384	61,620	1,001	2,384	61,620	1,369
8	,960	2,286	63,905				
9	,861	2,051	65,956				
10	,853	2,031	67,988				
40	,195	,464	99,167				
41	,185	,441	99,608				
42	,165	,392	100,000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.



Rotated Component Matrix[a]

	Components		
	1	2	3
Skills15	,774		
Skills14	,749		
Skills12	,743		
Skills7	,734		
Skills11	,733		
Skills6	,732		
Skills10	,717		
Skills8	,713		
Skills5	,702		
Skills4	,678		
Skills3	,654		
Skills13	,631	,365	
Skills2	,610		
Skills9	,595	,371	
Skills1	,589		
Skills18	,540		
Skills16	,523	,351	
Skills17	,447		
Skills22		,718	
Skills26		,667	
Skills33		,643	
Skills21	,377	,634	
Skills24		,570	
Skills19	,363	,569	
Skills34		,569	
Skills32		,561	
Skills30		,554	
Skills29	,427	,547	
Skills23		,532	,331
Skills20	,371	,484	
Skills31		,449	
Skills25	,303	,431	
Skills28		,412	
NRSkills27		,355	
Skills39			,812
Skills40			,790
Skills41			,786
Skills38			,749
Skills42			,683
Skills35			,661
Skills36		,348	,594
Skills37		,318	,592

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

Rotated Component Matrix After Omitting Skills17 in the Main Study

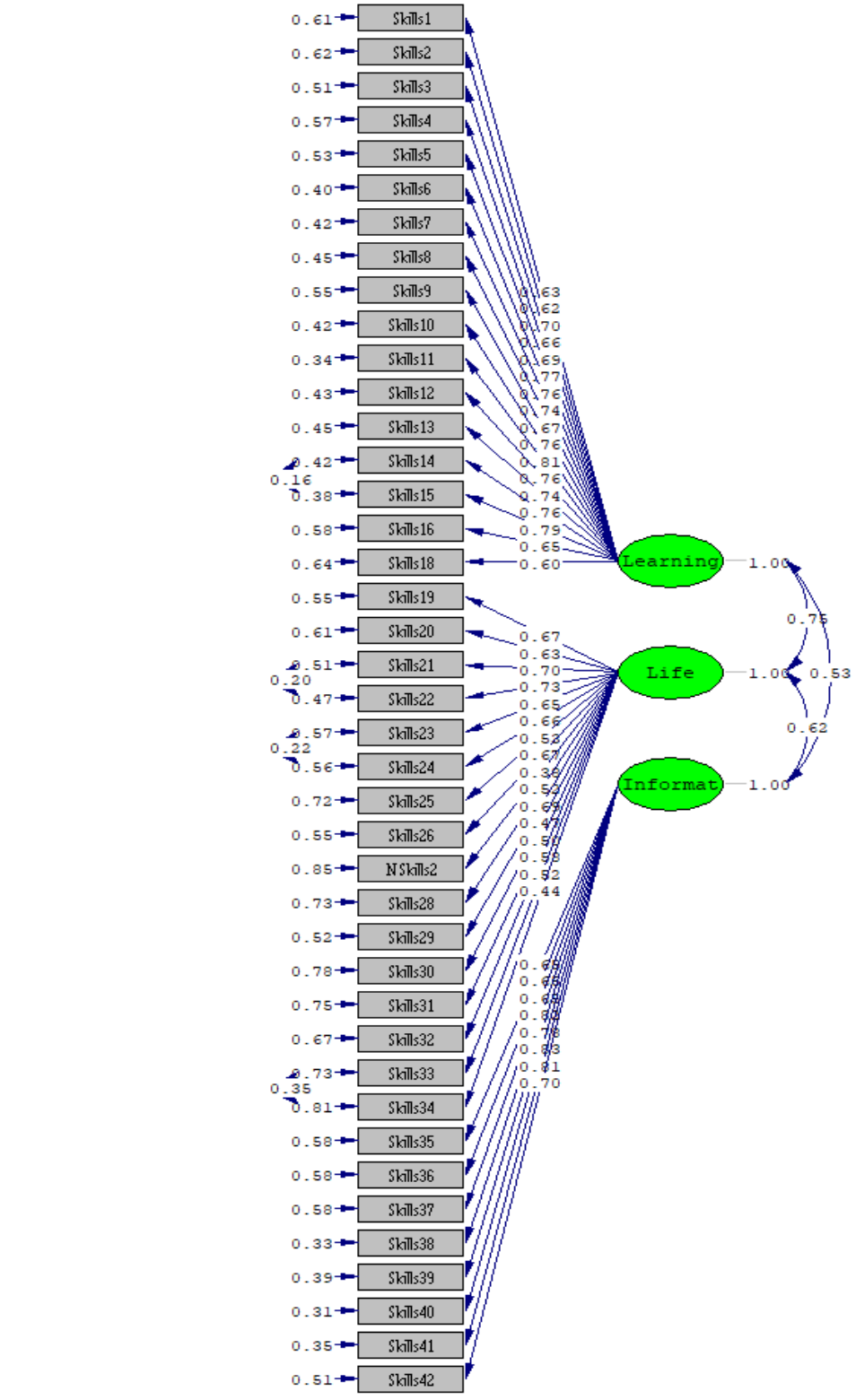
	Components		
	1	2	3
Skills15	,773		
Skills14	,751		
Skills12	,742		
Skills7	,738		
Skills11	,736		
Skills6	,735		
Skills10	,715		
Skills8	,713		
Skills5	,702		
Skills4	,677		
Skills3	,657		
Skills13	,632	,367	
Skills2	,605		
Skills9	,591	,373	
Skills1	,586		
Skills18	,530		
Skills16	,521	,353	
Skills22		,720	
Skills26		,668	
Skills33		,643	
Skills21	,373	,636	
Skills19	,361	,571	
Skills24		,571	
Skills34		,568	
Skills32		,560	
Skills30		,554	
Skills29	,428	,549	
Skills23		,534	,331
Skills20	,364	,485	
Skills31		,450	
Skills25		,432	
Skills28		,413	
NRSkills27		,356	
Skills39			,812
Skills40			,791
Skills41			,786
Skills38			,750
Skills42			,683
Skills35			,660
Skills36		,349	,595
Skills37		,319	,593

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

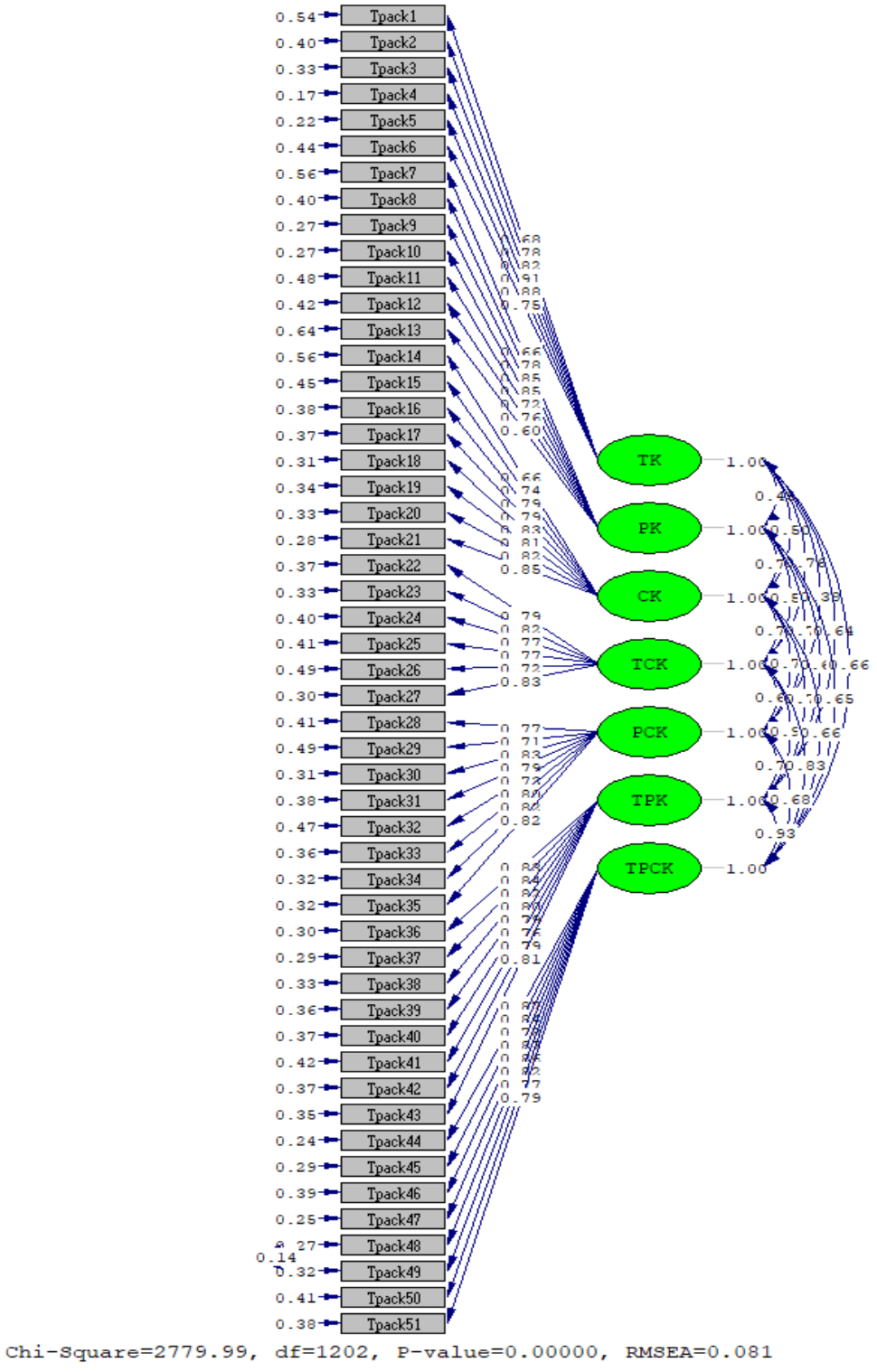
CFA of 21st-Century Skills Scale Without Skills17 in the Main Study



Chi-Square=1985.39, df=772, P-value=0.00000, RMSEA=0.063

F. PILOT STUDY ANALYSIS- THE TPACK SCALE

The First Level CFA of The TPACK Scale in the Pilot Study



Goodness of Fit Statistics

Degrees of Freedom = 1202
Minimum Fit Function Chi-Square = 2771.52 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 2779.99 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 1577.99
90 Percent Confidence Interval for NCP = (1428.22; 1735.43)

Minimum Fit Function Value = 13.93
Population Discrepancy Function Value (F0) = 7.93
90 Percent Confidence Interval for F0 = (7.18; 8.72)
Root Mean Square Error of Approximation (RMSEA) = 0.081
90 Percent Confidence Interval for RMSEA = (0.077; 0.085)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00

Expected Cross-Validation Index (ECVI) = 15.22
90 Percent Confidence Interval for ECVI = (14.46; 16.01)
ECVI for Saturated Model = 13.33
ECVI for Independence Model = 299.91

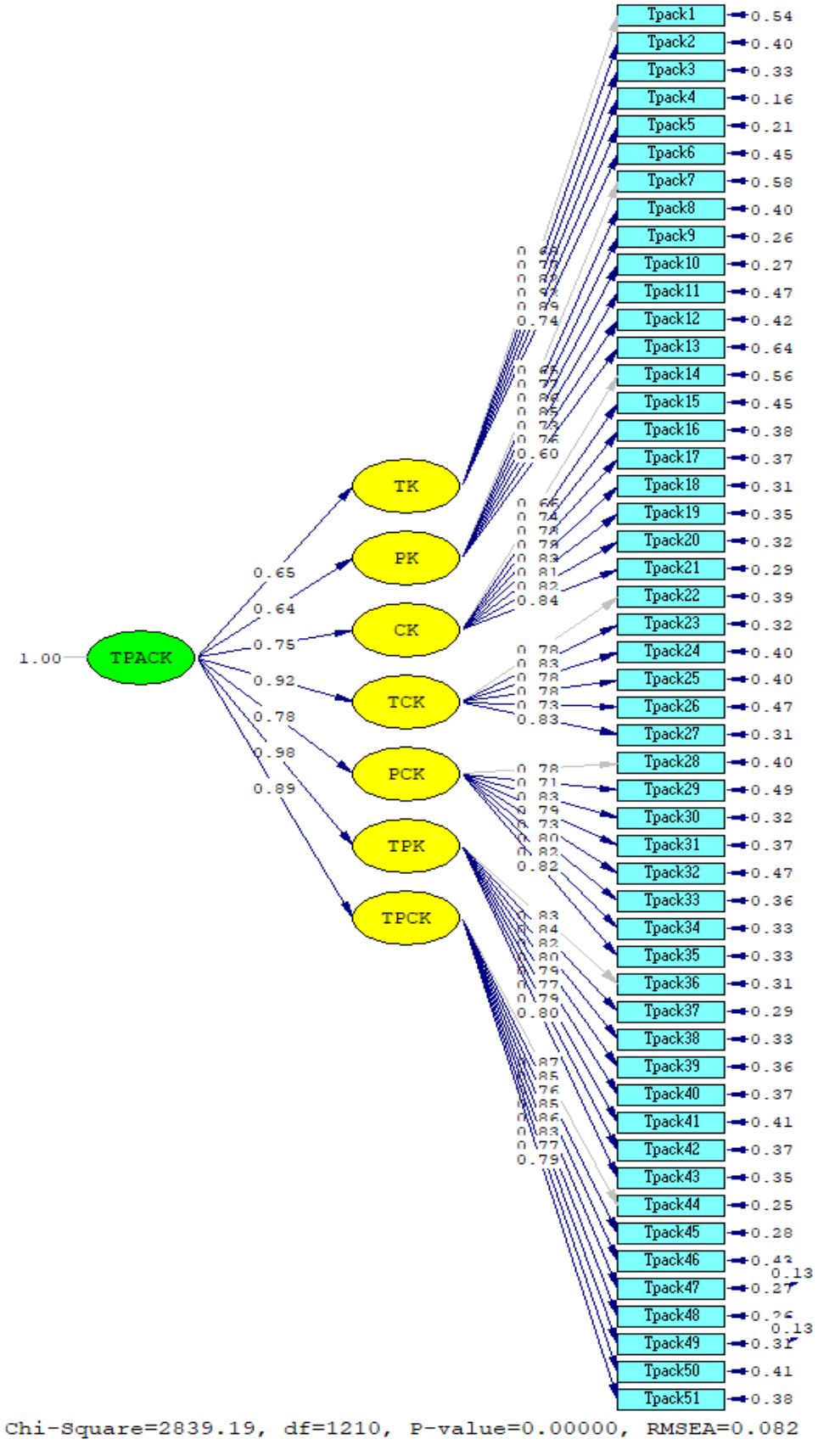
Chi-Square for Independence Model with 1275 Degrees of Freedom = 59580.80
Independence AIC = 59682.80
Model AIC = 3027.99
Saturated AIC = 2652.00
Independence CAIC = 59902.01
Model CAIC = 3560.98
Saturated CAIC = 8351.57

Normed Fit Index (NFI) = 0.95
Non-Normed Fit Index (NNFI) = 0.97
Parsimony Normed Fit Index (PNFI) = 0.90
Comparative Fit Index (CFI) = 0.97
Incremental Fit Index (IFI) = 0.97
Relative Fit Index (RFI) = 0.95

Critical N (CN) = 95.71

Root Mean Square Residual (RMR) = 0.032
Standardized RMR = 0.064
Goodness of Fit Index (GFI) = 0.65
Adjusted Goodness of Fit Index (AGFI) = 0.61
Parsimony Goodness of Fit Index (PGFI) = 0.59

The Second-order CFA of TPACK Scale in the Pilot Study



Goodness of Fit Statistics

Degrees of Freedom = 1210
Minimum Fit Function Chi-Square = 2809.48 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 2839.19 (P = 0.0) Estimated Non-centrality Parameter (NCP) = 1629.19
90 Percent Confidence Interval for NCP = (1477.48; 1788.56)

Minimum Fit Function Value = 14.12
Population Discrepancy Function Value (F0) = 8.19
90 Percent Confidence Interval for F0 = (7.42; 8.99)
Root Mean Square Error of Approximation (RMSEA) = 0.082
90 Percent Confidence Interval for RMSEA = (0.078; 0.086)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00

Expected Cross-Validation Index (ECVI) = 15.43
90 Percent Confidence Interval for ECVI = (14.67; 16.23)
ECVI for Saturated Model = 13.33
ECVI for Independence Model = 299.91

Chi-Square for Independence Model with 1275 Degrees of Freedom = 59580.80
Independence AIC = 59682.80
Model AIC = 3071.19
Saturated AIC = 2652.00
Independence CAIC = 59902.01
Model CAIC = 3569.80
Saturated CAIC = 8351.57

Normed Fit Index (NFI) = 0.95
Non-Normed Fit Index (NNFI) = 0.97
Parsimony Normed Fit Index (PNFI) = 0.90
Comparative Fit Index (CFI) = 0.97
Incremental Fit Index (IFI) = 0.97
Relative Fit Index (RFI) = 0.95

Critical N (CN) = 95.02

Root Mean Square Residual (RMR) = 0.035
Standardized RMR = 0.069
Goodness of Fit Index (GFI) = 0.64
Adjusted Goodness of Fit Index (AGFI) = 0.61
Parsimony Goodness of Fit Index (PGFI) = 0.59

The Reliability of the TPACK Scale in the Pilot Study

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	Inter-Item Correlations
Tpack1	218,55	557,776	,635	,976	,976	,457
Tpack2	218,89	559,425	,538	,976		
Tpack3	218,97	558,335	,559	,976		
Tpack4	218,83	556,303	,613	,976		
Tpack5	218,83	556,272	,627	,976		
Tpack6	218,66	558,346	,616	,976		
Tpack7	218,43	561,493	,634	,976		
Tpack8	218,42	563,321	,568	,976		
Tpack9	218,44	559,494	,642	,976		
Tpack10	218,32	563,262	,617	,976		
Tpack11	218,27	566,019	,525	,976		
Tpack12	218,22	565,368	,601	,976		
Tpack13	218,65	559,405	,499	,976		
Tpack14	218,23	566,831	,564	,976		
Tpack15	218,23	564,085	,648	,976		
Tpack16	218,19	565,572	,666	,976		
Tpack17	218,29	562,134	,673	,976		
Tpack18	218,26	565,259	,620	,976		
Tpack19	218,29	564,888	,632	,976		
Tpack20	218,26	563,075	,661	,976		
Tpack21	218,27	561,012	,734	,975		
Tpack22	218,43	558,457	,730	,975		
Tpack23	218,57	554,829	,709	,976		
Tpack24	218,42	558,948	,712	,976		
Tpack25	218,63	554,728	,675	,976		
Tpack26	218,48	559,276	,637	,976		
Tpack27	218,57	556,016	,730	,975		
Tpack28	218,32	561,927	,671	,976		
Tpack29	218,26	565,671	,595	,976		
Tpack30	218,25	563,837	,686	,976		
Tpack31	218,31	562,818	,668	,976		
Tpack32	218,28	566,152	,550	,976		
Tpack33	218,27	564,942	,641	,976		
Tpack34	218,20	565,414	,624	,976		

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	Inter-Item Correlations
Tpack35	218,17	566,189	,648	,976		
Tpack36	218,39	556,431	,788	,975		
Tpack37	218,41	556,334	,753	,975		
Tpack38	218,40	557,487	,756	,975		
Tpack39	218,39	559,003	,714	,975		
Tpack40	218,44	558,469	,693	,976		
Tpack41	218,64	553,295	,703	,976		
Tpack42	218,42	557,309	,747	,975		
Tpack43	218,46	557,466	,761	,975		
Tpack44	218,48	554,231	,818	,975		
Tpack45	218,45	556,781	,746	,975		
Tpack46	218,69	551,632	,716	,976		
Tpack47	218,61	552,341	,764	,975		
Tpack48	218,43	556,166	,761	,975		
Tpack49	218,42	557,530	,740	,975		
Tpack50	218,59	555,881	,698	,976		
Tpack51	218,42	557,491	,712	,975		

The Reliability of Technological Knowledge (TK)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Tpack1	19,85	13,565	,640	,433	,914	,914
Tpack2	20,19	12,533	,758	,619	,899	
Tpack3	20,26	12,334	,786	,665	,895	
Tpack4	20,13	11,999	,859	,778	,884	
Tpack5	20,13	12,281	,825	,739	,889	
Tpack6	19,96	13,320	,684	,521	,909	

The Reliability of Pedagogical Knowledge (PK)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Tpack7	26,51	11,035	,582	,403	,873	,880
Tpack8	26,50	10,452	,720	,598	,856	
Tpack9	26,52	9,980	,778	,680	,848	
Tpack10	26,39	10,480	,785	,689	,850	
Tpack11	26,35	10,862	,681	,516	,862	
Tpack12	26,30	10,993	,725	,557	,859	
Tpack13	26,73	10,190	,514	,311	,894	

The Reliability of Content Knowledge (CK)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Tpack14	31,87	11,364	,630	,469	,926	,927
Tpack15	31,86	10,975	,718	,606	,919	
Tpack16	31,83	11,160	,763	,648	,916	
Tpack17	31,92	10,607	,765	,638	,916	
Tpack18	31,90	10,768	,803	,713	,913	
Tpack19	31,92	10,848	,776	,698	,915	
Tpack20	31,89	10,701	,767	,712	,916	
Tpack21	31,91	10,639	,783	,693	,914	

The Reliability of Technological Content Knowledge (TCK)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Tpack22	21,38	10,045	,690	,511	,886	,899
Tpack23	21,52	9,005	,791	,630	,870	
Tpack24	21,36	9,890	,728	,532	,881	
Tpack25	21,57	9,091	,718	,522	,883	
Tpack26	21,42	9,752	,677	,480	,888	
Tpack27	21,51	9,417	,762	,587	,875	

The Reliability of Pedagogical Content Knowledge (PCK)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Tpack28	31,91	10,308	,738	,607	,913	,923
Tpack29	31,85	10,795	,674	,541	,918	
Tpack30	31,84	10,490	,797	,668	,908	
Tpack31	31,90	10,386	,753	,579	,911	
Tpack32	31,87	10,740	,651	,495	,920	
Tpack33	31,86	10,577	,767	,619	,910	
Tpack34	31,78	10,554	,775	,665	,910	
Tpack35	31,75	10,781	,781	,646	,910	

The Reliability of Technological Pedagogical Knowledge (TPK)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Tpack36	30,48	17,125	,795	,706	,921	,932
Tpack37	30,49	16,804	,811	,725	,920	
Tpack38	30,48	17,256	,770	,660	,923	
Tpack39	30,47	17,225	,784	,687	,922	
Tpack40	30,52	17,025	,775	,663	,923	
Tpack41	30,73	16,432	,710	,554	,930	
Tpack42	30,50	17,307	,743	,649	,925	
Tpack43	30,54	17,325	,761	,660	,924	

The Reliability of Technological Pedagogical Content Knowledge (TPCK)

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Tpack44	30,04	20,571	,806	,689	,936	,944
Tpack45	30,00	20,673	,795	,680	,937	
Tpack46	30,25	19,663	,745	,634	,942	
Tpack47	30,16	19,492	,855	,761	,932	
Tpack48	29,99	20,246	,866	,798	,932	
Tpack49	29,97	20,582	,833	,778	,934	
Tpack50	30,15	20,386	,751	,620	,940	
Tpack51	29,98	20,778	,762	,588	,939	

The Pearson Correlation

Correlations

		TK	PK	CK	TCK	PCK	TPK	TPCK	TOTAL SCORE
TK	Pearson	1	,455**	,468**	,709**	,358**	,631**	,637**	,740**
	Sig. (2-tailed)		,000	,000	,000	,000	,000	,000	,000
PK	Pearson	,455**	1	,720**	,513**	,725**	,571**	,606**	,777**
	Sig. (2-tailed)	,000		,000	,000	,000	,000	,000	,000
CK	Pearson	,468**	,720**	1	,670**	,745**	,632**	,600**	,816**
	Sig. (2-tailed)	,000	,000		,000	,000	,000	,000	,000
TCK	Pearson	,709**	,513**	,670**	1	,604**	,821**	,755**	,873**
	Sig. (2-tailed)	,000	,000	,000		,000	,000	,000	,000
PCK	Pearson	,358**	,725**	,745**	,604**	1	,701**	,620**	,805**
	Sig. (2-tailed)	,000	,000	,000	,000		,000	,000	,000
TPK	Pearson	,631**	,571**	,632**	,821**	,701**	1	,868**	,909**
	Sig. (2-tailed)	,000	,000	,000	,000	,000		,000	,000
TPCK	Pearson	,637**	,606**	,600**	,755**	,620**	,868**	1	,891**
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000		,000
TOTAL SCORE	Pearson	,740**	,777**	,816**	,873**	,805**	,909**	,891**	1
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000	,000	

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

G. ASSUMPTIONS OF THE MAIN STUDY

The Normal Distribution of the Total 21st-Century Skills

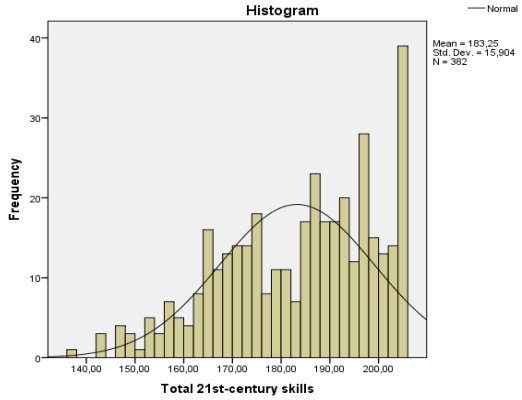
Descriptive

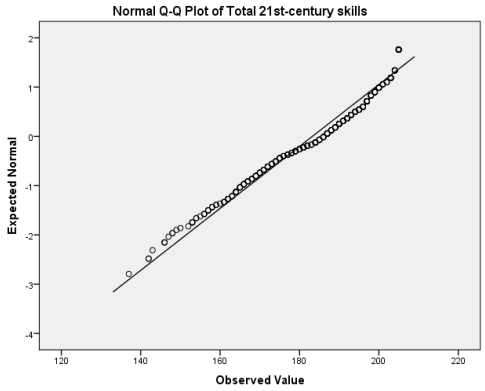
			Statistic	Std. Error
Total 21st-century skills	Mean		183,2539	,81374
	95% Confidence Interval for Mean	Lower Bound	181,6539	
		Upper Bound	184,8539	
	5% Trimmed Mean		183,9907	
	Skewness		-,497	,125
	Kurtosis		-,587	,249

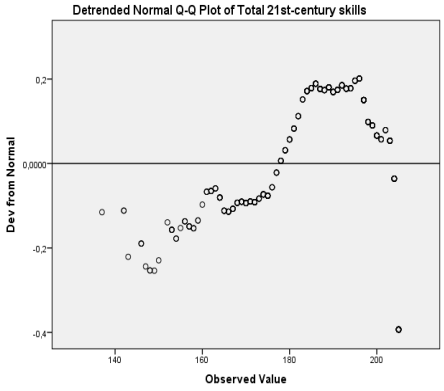
Tests of Normality

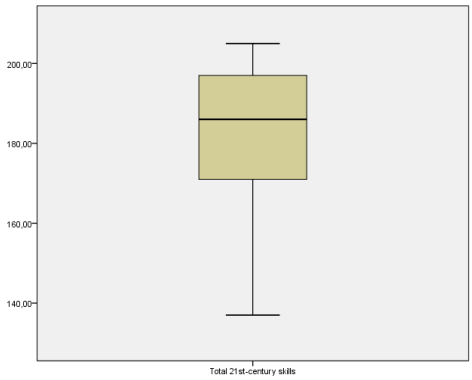
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Total 21st-century skills	,088	382	,000	,952	382	,000

a. Lilliefors Significance Correction






Detrended Normal Q-Q Plot of Total 21st-century skills
Dev from Normal
0,2
0,0000
-0,2
-0,4
140
160
180
200
Observed Value


200,00
180,00
160,00
140,00
Total 21st-century skills

The Normal Distribution of the Total 21st-century Skills Regarding Age

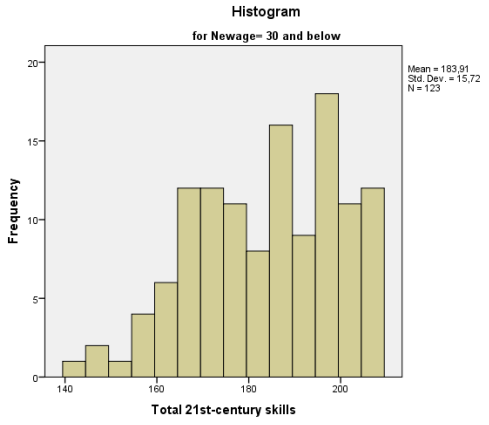
Descriptives

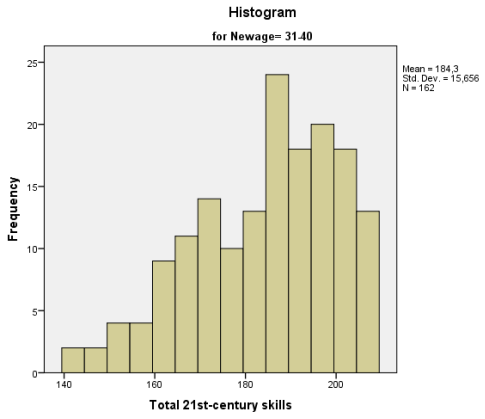
	The age groups		Statistic	Std. Error
Total 21st-century skills	30 and below	Mean	183,91	1,417
		5% Trimmed Mean	184,60	
		Skewness	-,434	,218
		Kurtosis	-,669	,433
	31-40	Mean	184,30	1,230
		5% Trimmed Mean	185,12	
		Skewness	-,591	,191
		Kurtosis	-,411	,379
	41 and above	Mean	180,68	1,667
		5% Trimmed Mean	181,28	
		Skewness	-,422	,245
		Kurtosis	-,716	,485

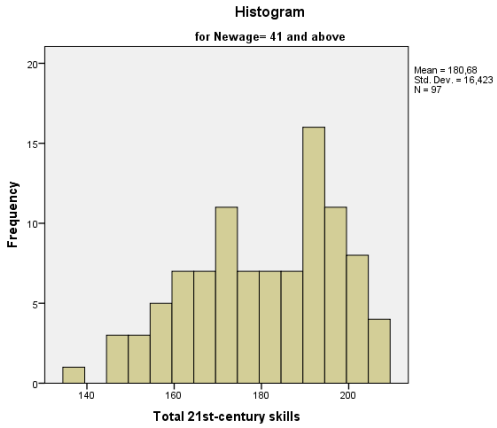
Tests of Normality

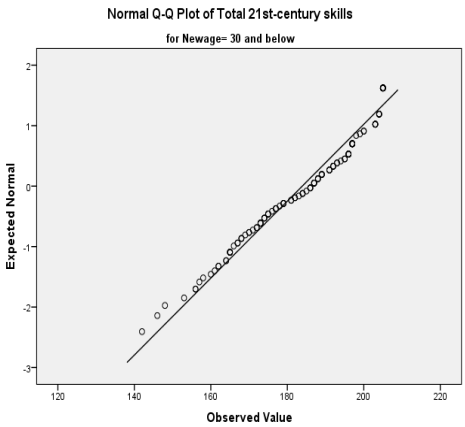
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	The age groups	Statistic	df	Sig.	Statistic	df	Sig.
Total 21st-century skills	30 and below	,096	123	,007	,950	123	,000
	31-40	,097	162	,001	,946	162	,000
	41 and above	,127	97	,001	,954	97	,002

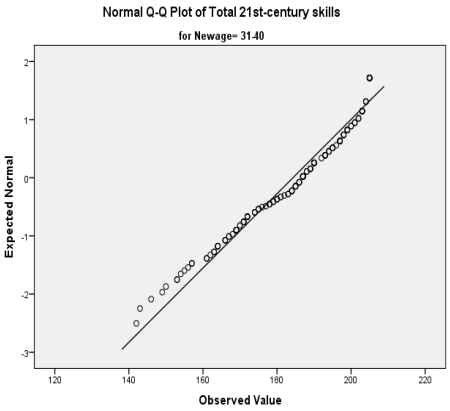
a. Lilliefors Significance Correction

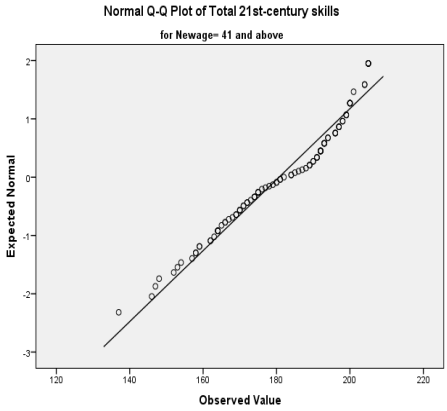


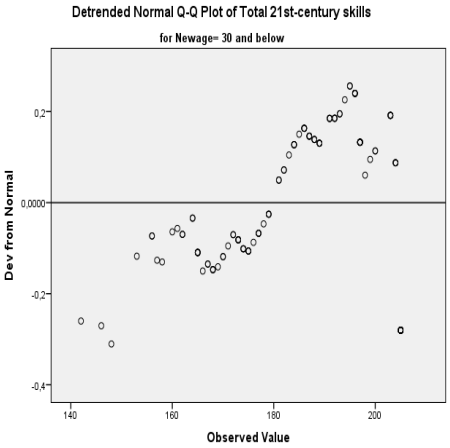


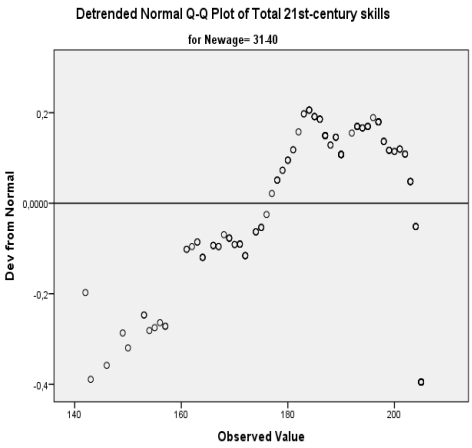

Histogram
for Newage= 41 and above
Mean = 180,68
Std. Dev. = 16,423
N = 97
Frequency
Total 21st-century skills

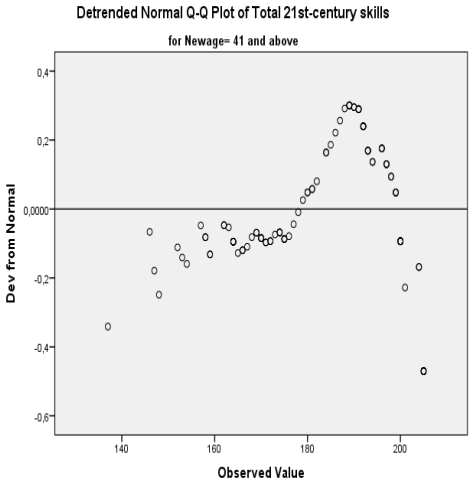

Normal Q-Q Plot of Total 21st-century skills
for Newage= 30 and below
Expected Normal
Observed Value

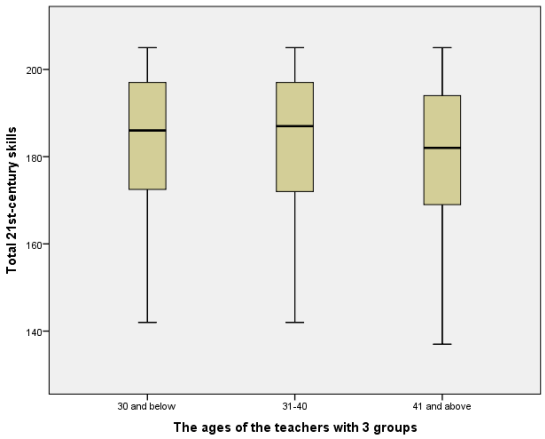

Normal Q-Q Plot of Total 21st-century skills
for Newage= 31-40
Expected Normal
Observed Value


Normal Q-Q Plot of Total 21st-century skills
for Newage= 41 and above
Expected Normal
Observed Value


Detrended Normal Q-Q Plot of Total 21st-century skills
for Newage= 30 and below
Dev from Normal
Observed Value


Detrended Normal Q-Q Plot of Total 21st-century skills
for Newage= 31-40
Dev from Normal
Observed Value





The Normal Distribution of the Total 21st-century Skills Regarding Years of Experience

Descriptives

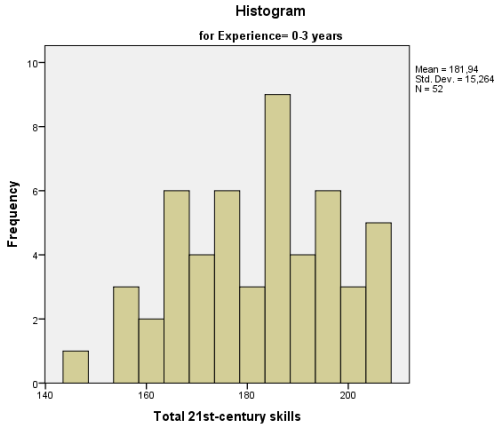
	The year of experience of teachers		Statistic	Std. Error
Total 21st-century skills	0-3 years	Mean	181,94	2,117
		5% Trimmed Mean	182,32	
		Skewness	-,213	,330
		Kurtosis	-,780	,650
	4-7 years	Mean	184,51	2,087
		5% Trimmed Mean	185,52	
		Skewness	-,670	,287
		Kurtosis	-,548	,566
	8+ years	Mean	183,18	,969
		5% Trimmed Mean	183,88	
		Skewness	-,509	,151
		Kurtosis	-,526	,301

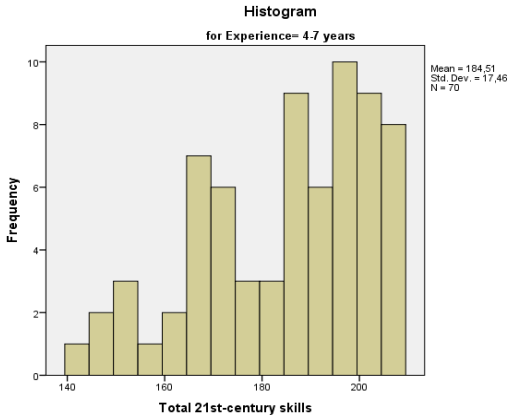
Tests of Normality

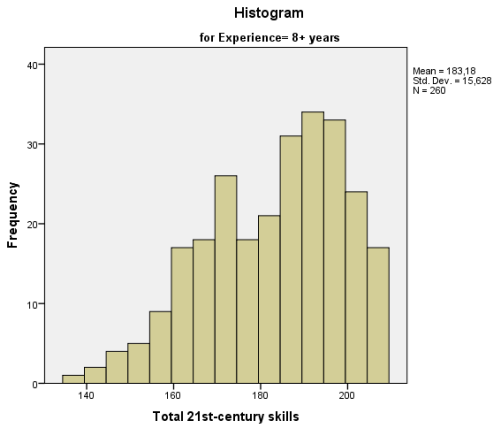
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	The years of experience	Statistic	df	Sig.	Statistic	df	Sig.
Total 21st-century skills	0-3 years	,091	52	,200*	,966	52	,139
	4-7 years	,122	70	,012	,919	70	,000
	8+ years	,091	260	,000	,954	260	,000

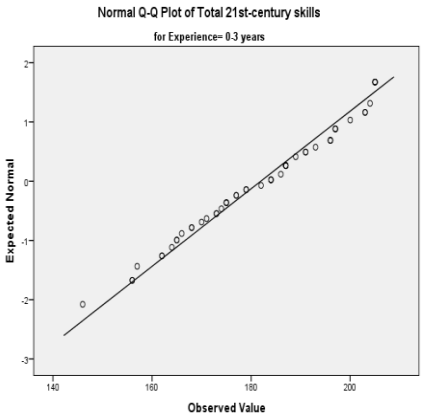
*. This is a lower bound of the true significance.

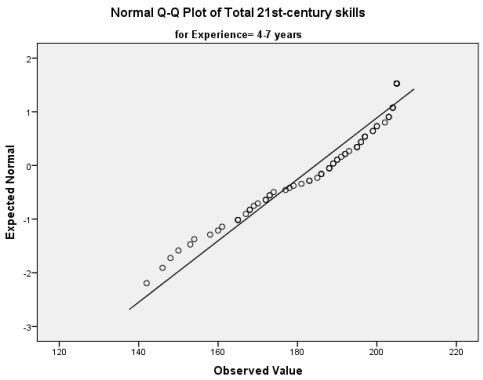
a. Lilliefors Significance Correction

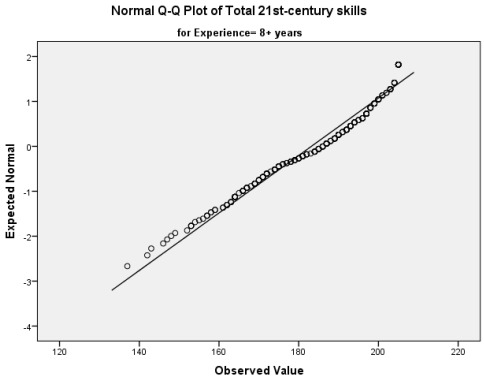

Histogram
for Experience= 0-3 years
Mean = 181,94
Std. Dev. = 15,264
N = 52
Frequency
Total 21st-century skills

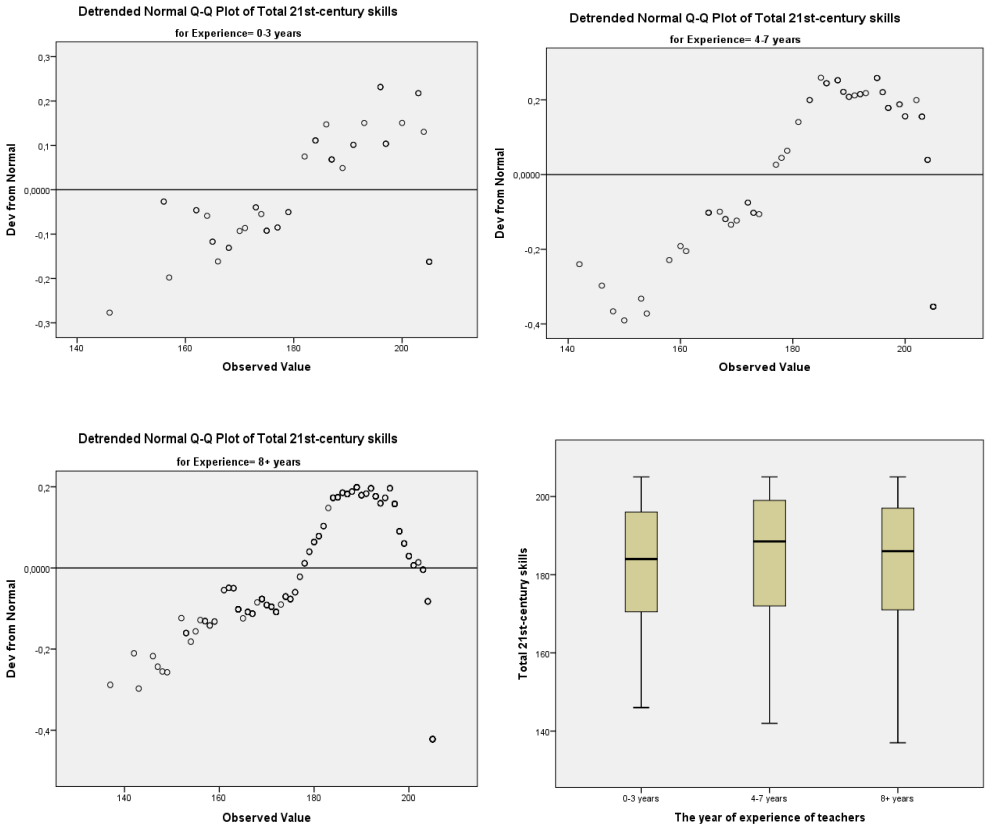

Histogram
for Experience= 4-7 years
Mean = 184,51
Std. Dev. = 17,46
N = 70
Frequency
Total 21st-century skills


Histogram
for Experience= 8+ years
Mean = 183,18
Std. Dev. = 15,628
N = 260
Frequency
Total 21st-century skills


Normal Q-Q Plot of Total 21st-century skills
for Experience= 0-3 years
Expected Normal
Observed Value


Normal Q-Q Plot of Total 21st-century skills
for Experience= 4-7 years
Expected Normal
Observed Value


Normal Q-Q Plot of Total 21st-century skills
for Experience= 8+ years
Expected Normal
Observed Value



The Normal Distribution of the Total 21st-century Skills Regarding Education Level

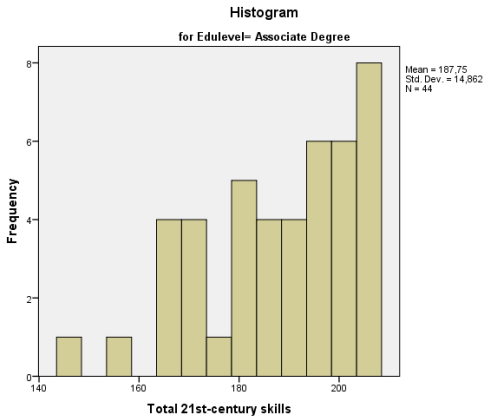
Descriptives

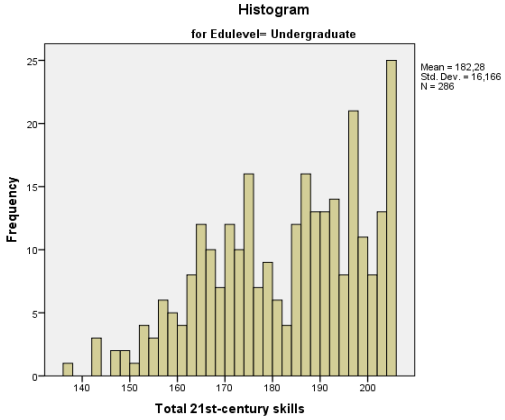
	The education level of teachers		Statistic	Std. Error
Total 21st-century skills	Associate Degree	Mean	187,75	2,241
		5% Trimmed Mean	188,74	
		Skewness	-,788	,357
		Kurtosis	-,024	,702
	Undergraduate	Mean	182,28	,956
		5% Trimmed Mean	182,93	
		Skewness	-,424	,144
		Kurtosis	-,704	,287
	Master	Mean	184,79	2,047
		5% Trimmed Mean	185,67	
		Skewness	-,703	,330
		Kurtosis	,135	,650

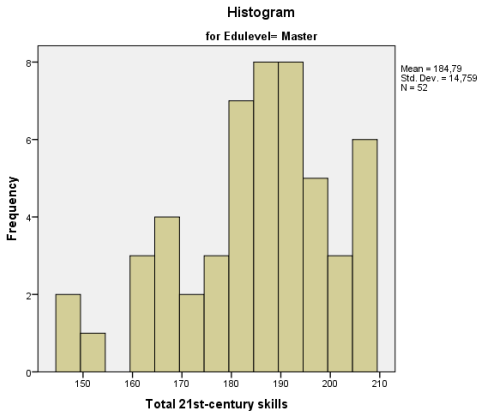
Tests of Normality

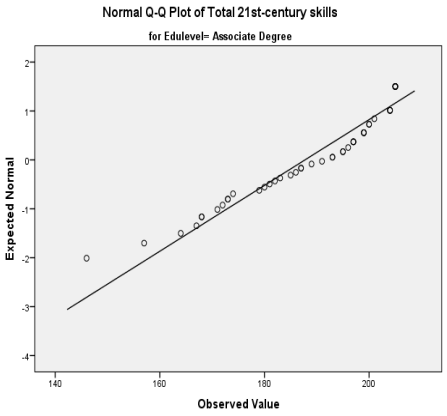
	The education level of teachers	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Total 21st-century skills	Associate Degree	,142	44	,027	,918	44	,004
	Undergraduate	,091	286	,000	,955	286	,000
	Master	,113	52	,093	,944	52	,016

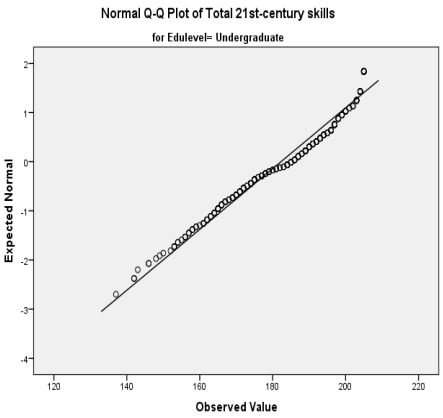
a. Lilliefors Significance Correction

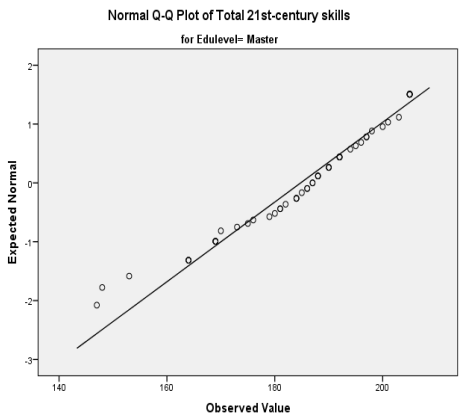


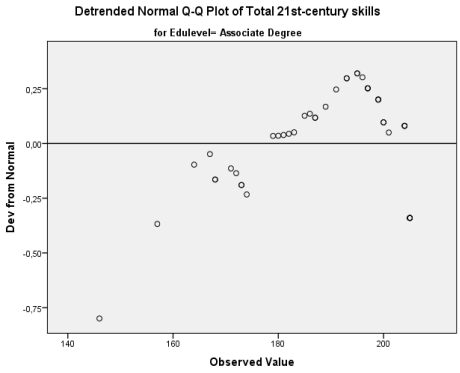


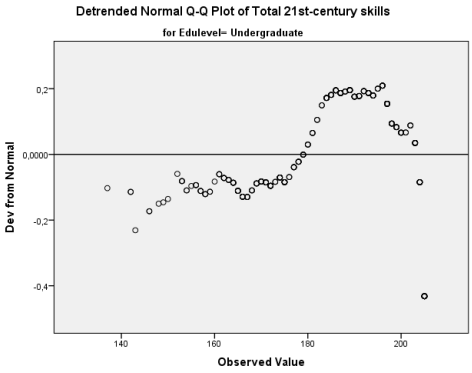


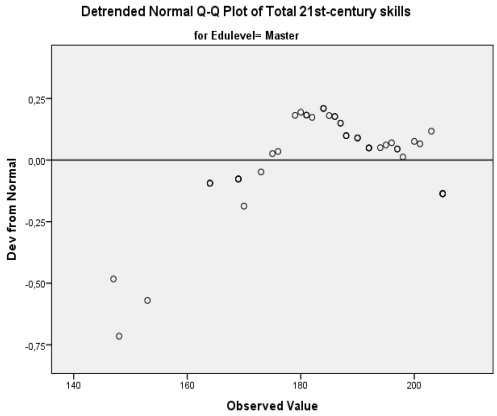


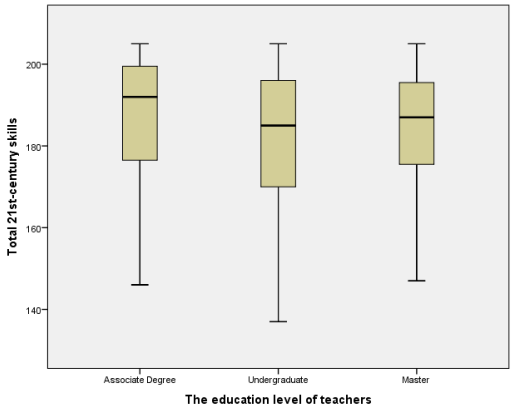












The Normal Distribution of the Total 21st-century Skills Regarding Training Attendance

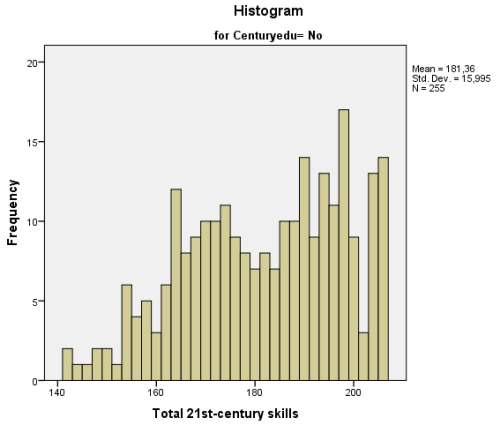
Descriptives

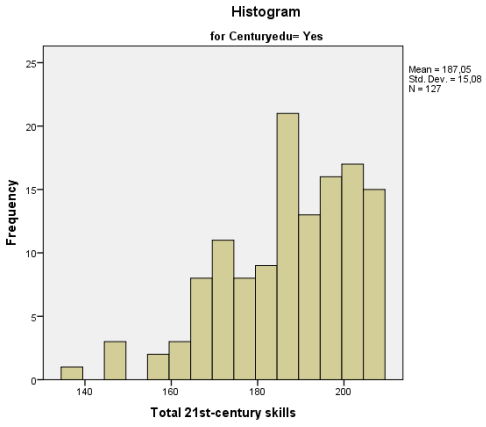
	21st-century skills education		Statistic	Std. Error
Total 21st-century skills	No	Mean	181,36	1,002
		5% Trimmed Mean	181,88	
		Skewness	-,332	,153
		Kurtosis	-,837	,304
	Yes	Mean	187,05	1,338
		5% Trimmed Mean	188,15	
		Skewness	-,888	,215
		Kurtosis	,473	,427

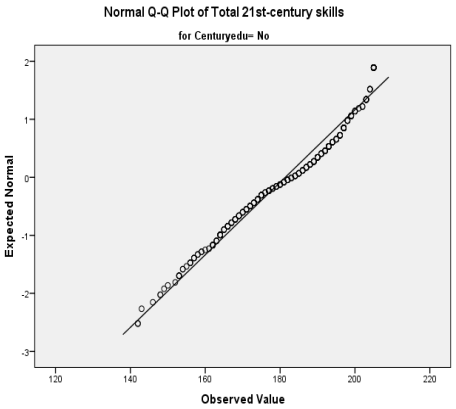
Tests of Normality

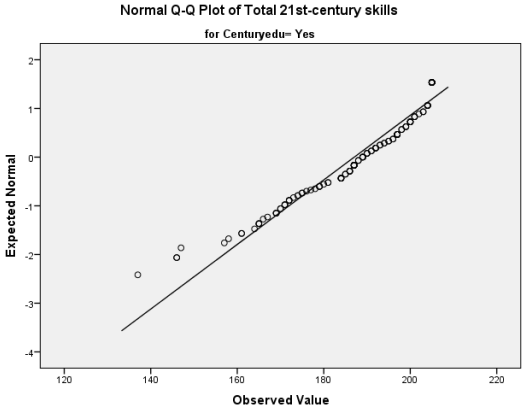
	21st-century skills education	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Total 21st-century skills	No	,087	255	,000	,960	255	,000
	Yes	,117	127	,000	,922	127	,000

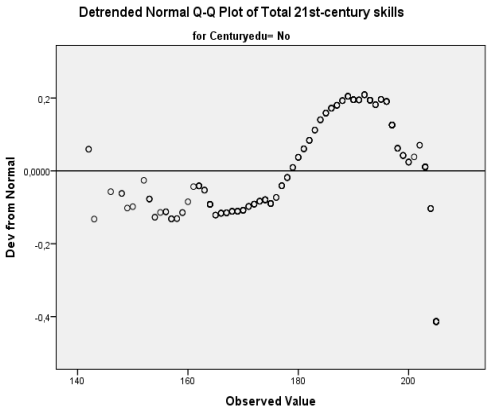
a. Lilliefors Significance Correction

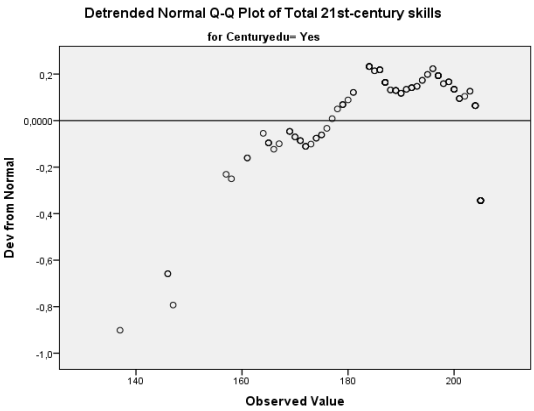


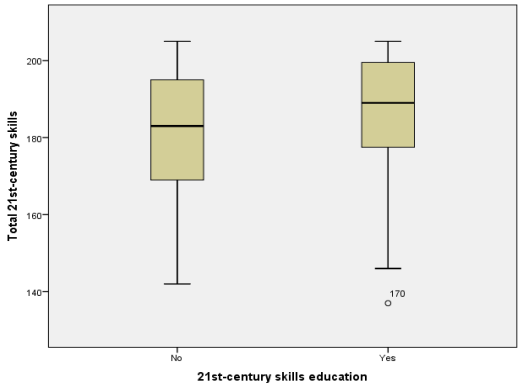












The Normal Distribution of the Total TPACK Level

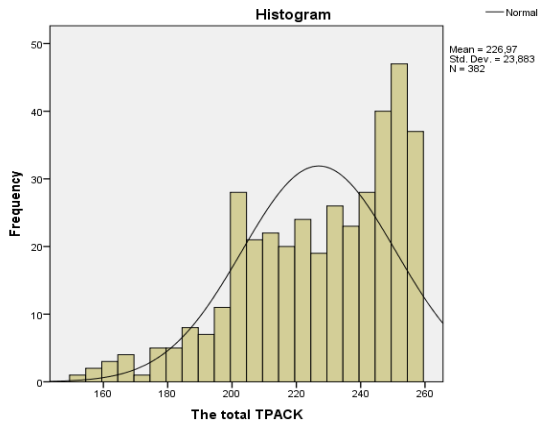
Descriptives

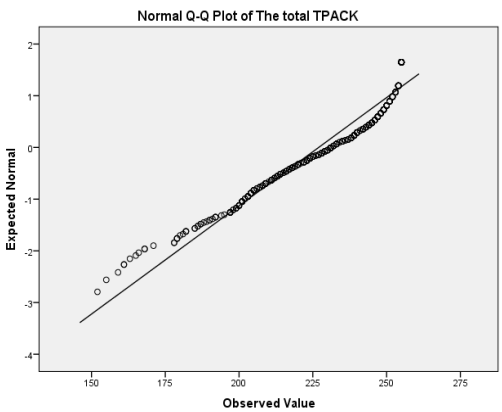
			Statistic	Std. Error
The total TPACK	Mean		226,97	1,222
	95% Confidence Interval for Mean	Lower Bound	224,57	
		Upper Bound	229,37	
	5% Trimmed Mean		228,59	
	Skewness		-,739	,125
	Kurtosis		-,130	,249

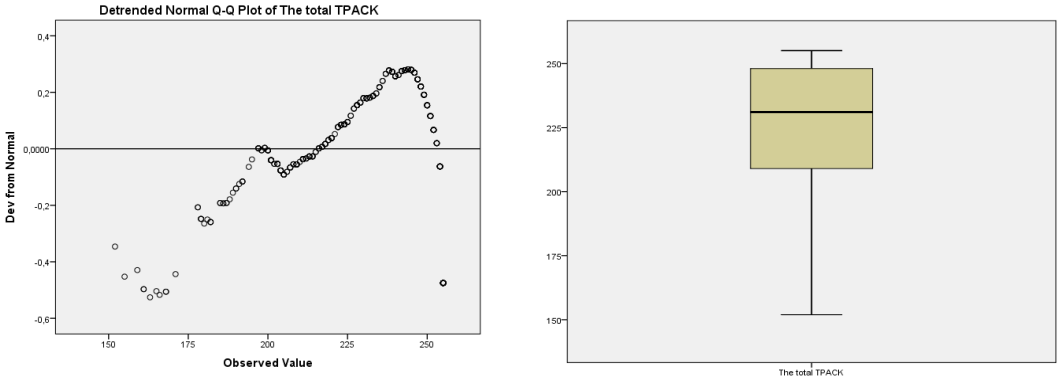
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
The total TPACK	,120	382	,000	,922	382	,000

a. Lilliefors Significance Correction







The Normal Distribution of the Total TPACK Level Regarding Age

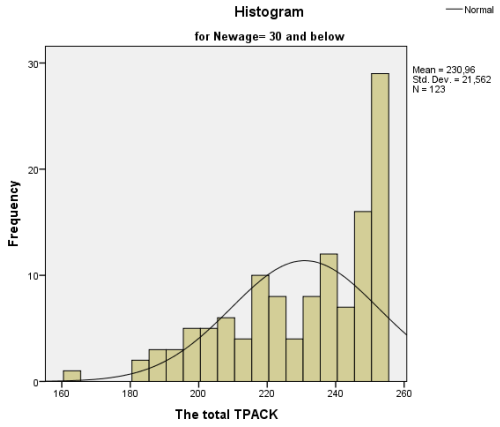
Descriptives

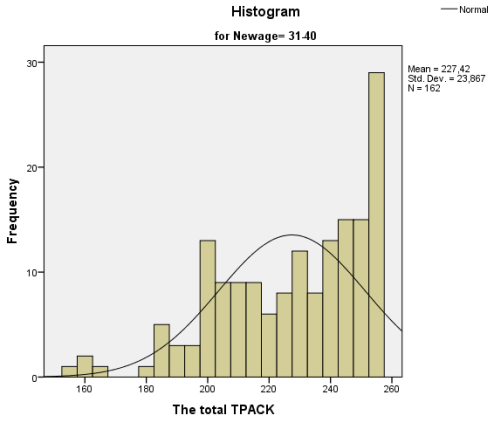
	The age groups		Statistic	Std. Error
The total TPACK	30 and below	Mean	230,96	1,944
		5% Trimmed Mean	232,32	
		Skewness	-,769	,218
		Kurtosis	-,271	,433
	31-40	Mean	227,42	1,875
		5% Trimmed Mean	228,95	
		Skewness	-,697	,191
		Kurtosis	-,195	,379
	41 and above	Mean	221,15	2,614
		5% Trimmed Mean	222,55	
		Skewness	-,663	,245
		Kurtosis	-,246	,485

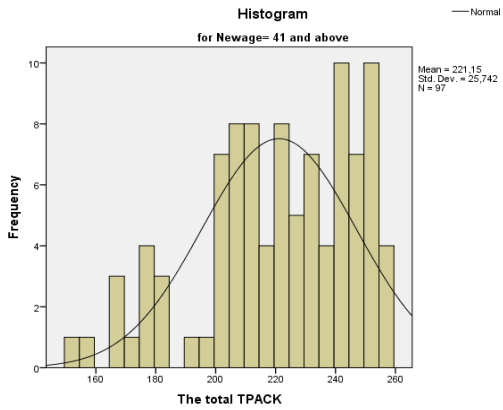
Tests of Normality

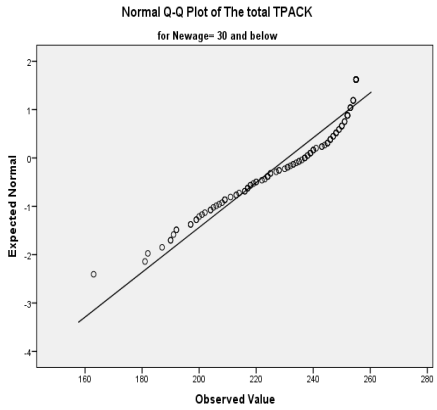
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	The age groups	Statistic	df	Sig.	Statistic	df	Sig.
The total TPACK	30 and below	,133	123	,000	,907	123	,000
	31-40	,124	162	,000	,918	162	,000
	41 and above	,094	97	,033	,937	97	,000

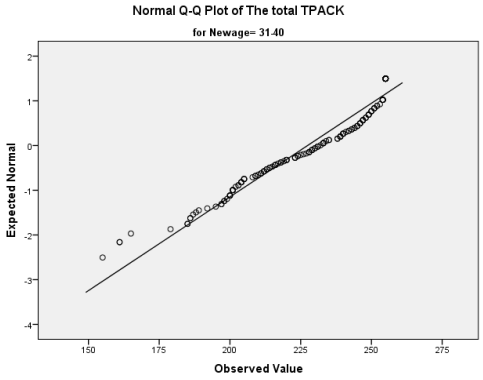
a. Lilliefors Significance Correction

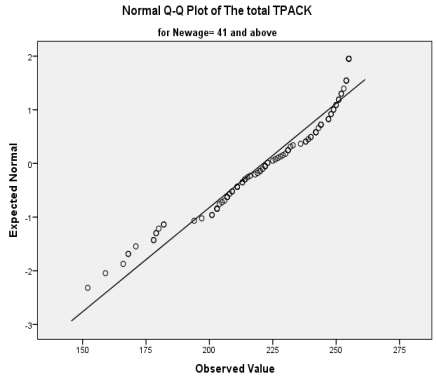

Histogram
for Newage= 30 and below
Normal
Mean = 230.96
Std. Dev. = 21.562
N = 123
Frequency
The total TPACK

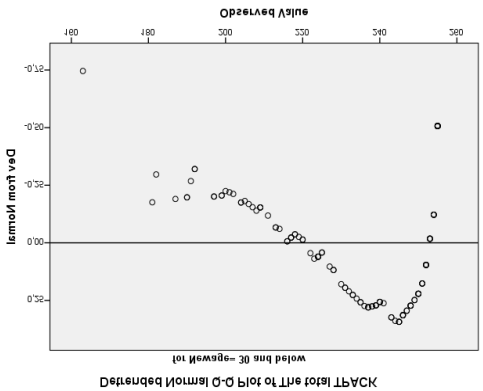

Histogram
for Newage= 31-40
Normal
Mean = 227.42
Std. Dev. = 23.867
N = 162
Frequency
The total TPACK

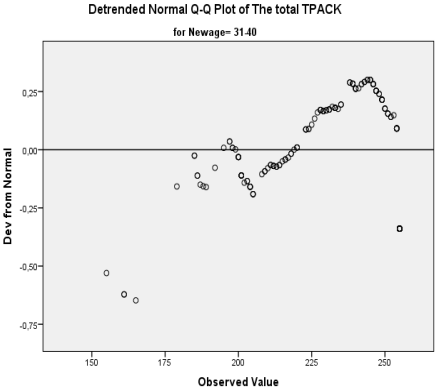

Histogram
for Newage= 41 and above
Normal
Mean = 221.15
Std. Dev. = 25.742
N = 97
Frequency
The total TPACK

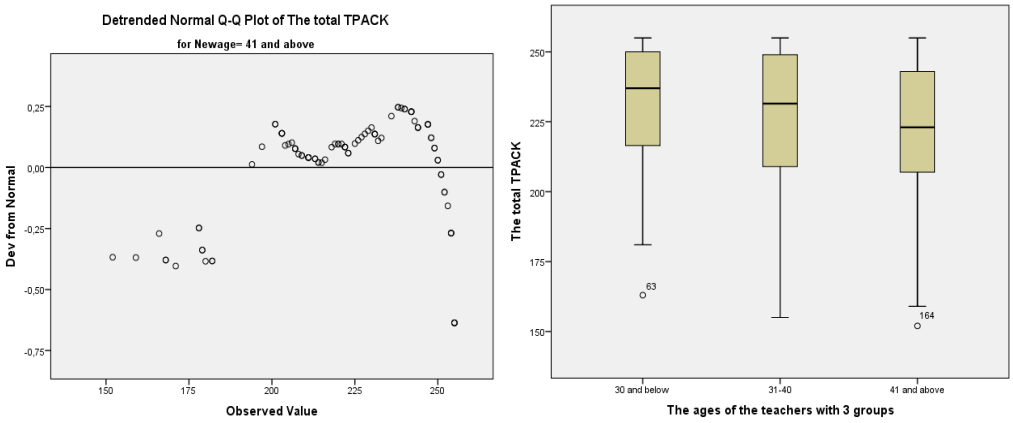

Normal Q-Q Plot of The total TPACK
for Newage= 30 and below
Expected Normal
Observed Value


Normal Q-Q Plot of The total TPACK
for Newage= 31-40
Expected Normal
Observed Value


Normal Q-Q Plot of The total TPACK
for Newage= 41 and above
Expected Normal
Observed Value




Detrended Normal Q-Q Plot of The total TPACK
for Newage= 31-40
Dev from Normal
Observed Value



The Normal Distribution of the Total TPACK Level Regarding Years of Experience

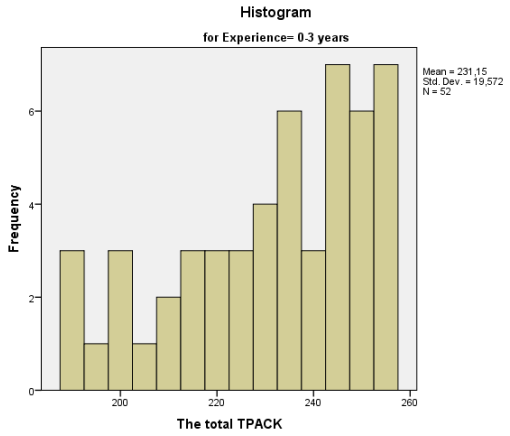
Descriptives

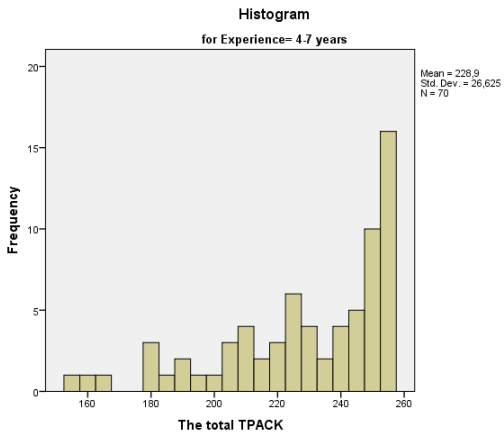
	The year of experience of teachers		Statistic	Std. Error
The total TPACK	0-3 years	Mean	231,15	2,714
		5% Trimmed Mean	232,09	
		Skewness	-,635	,330
		Kurtosis	-,718	,650
	4-7 years	Mean	228,90	3,182
		5% Trimmed Mean	231,14	
		Skewness	-,992	,287
		Kurtosis	,210	,566
	8+ years	Mean	225,61	1,479
		5% Trimmed Mean	227,09	
		Skewness	-,648	,151
		Kurtosis	-,260	,301

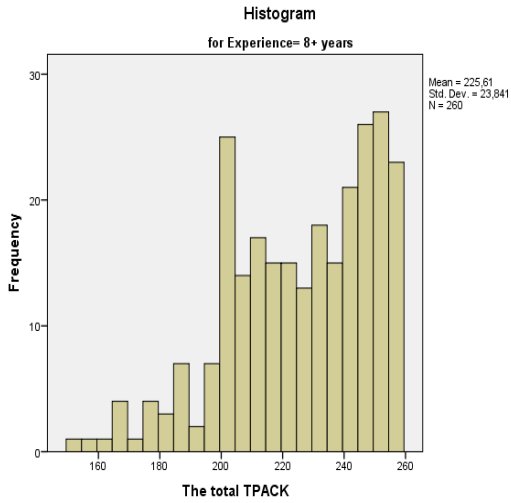
Tests of Normality

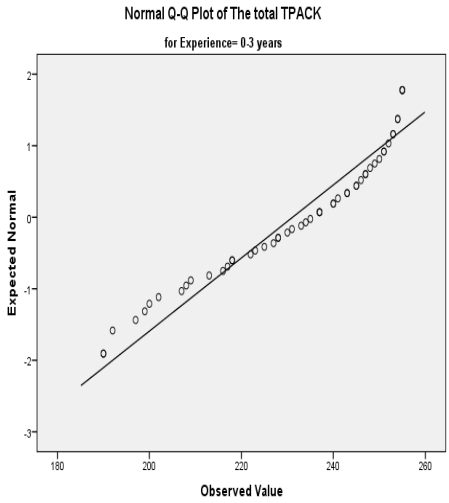
	The year of experience of educators	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
The total TPACK	0-3 years	,117	52	,071	,917	52	,001
	4-7 years	,163	70	,000	,872	70	,000
	8+ years	,114	260	,000	,932	260	,000

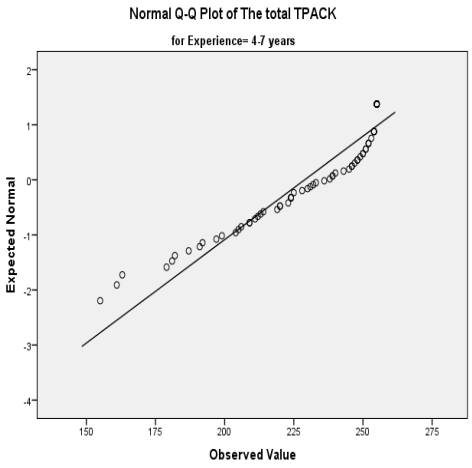
a. Lilliefors Significance Correction

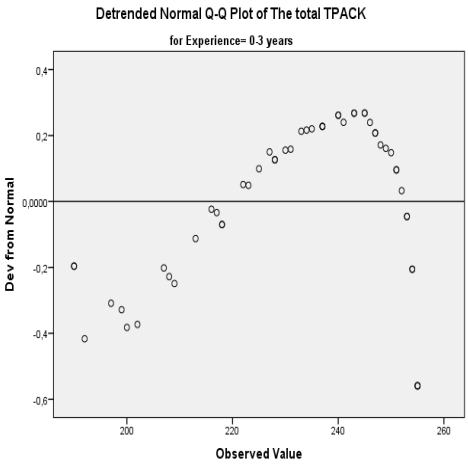

Histogram
for Experience= 0-3 years
Mean = 231,15
Std. Dev. = 19,572
N = 52
Frequency
The total TPACK

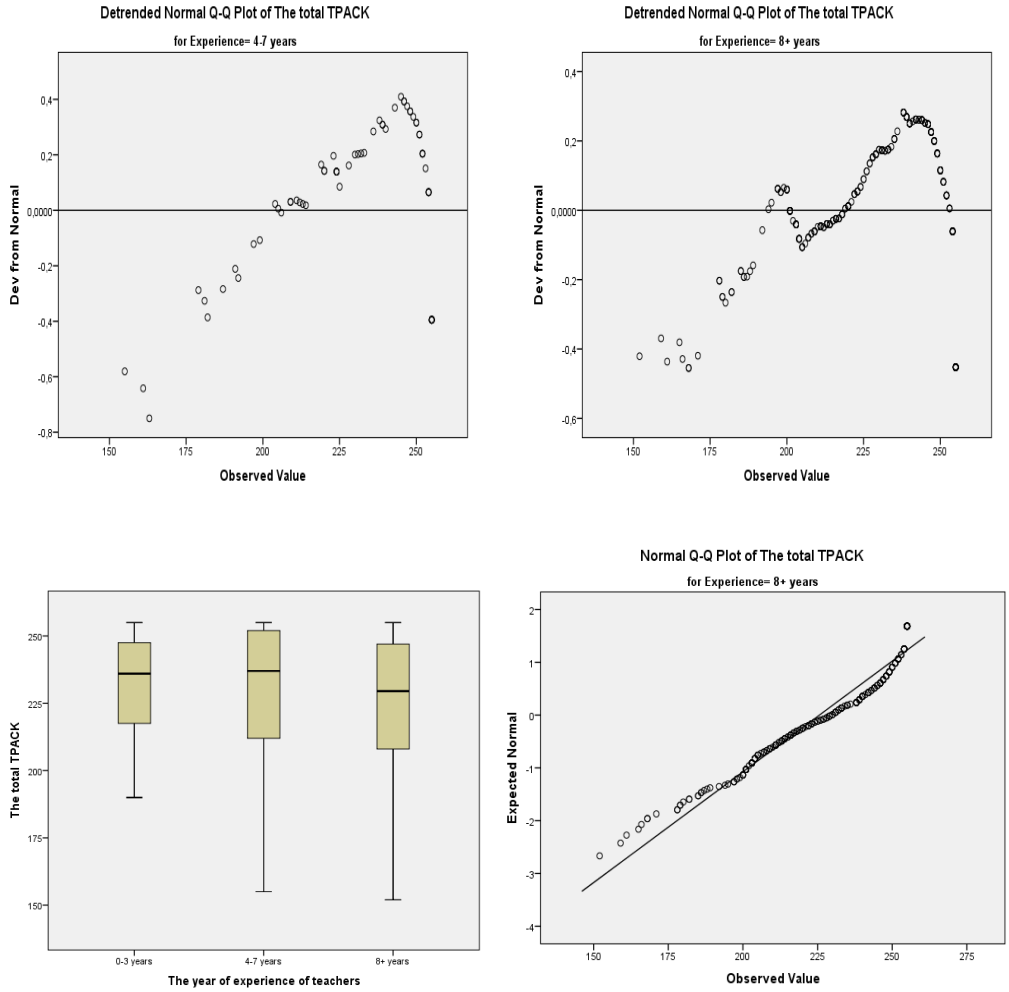

Histogram
for Experience= 4-7 years
Mean = 228,9
Std. Dev. = 26,625
N = 70
Frequency
The total TPACK


Histogram
for Experience= 8+ years
Mean = 225,61
Std. Dev. = 23,841
N = 260
Frequency
The total TPACK


Normal Q-Q Plot of The total TPACK
for Experience= 0-3 years
Expected Normal
Observed Value


Normal Q-Q Plot of The total TPACK
for Experience= 4-7 years
Expected Normal
Observed Value


Detrended Normal Q-Q Plot of The total TPACK
for Experience= 0-3 years
Dev from Normal
Observed Value



The Normal Distribution of the Total TPACK Level Regarding Education Level

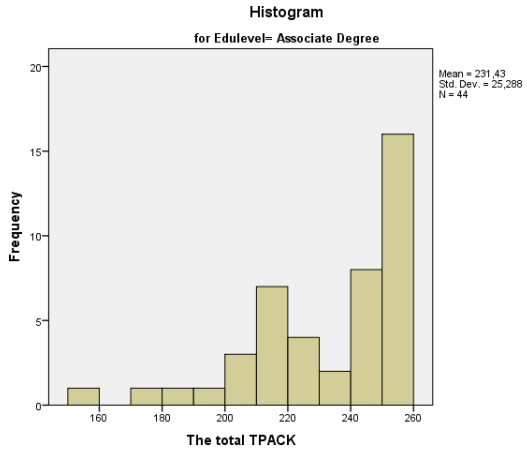
Descriptives

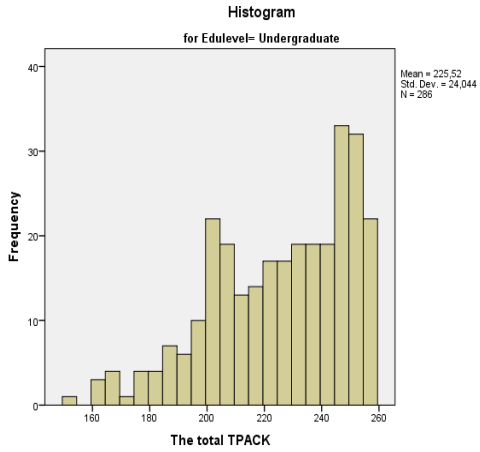
	The education level of educators		Statistic	Std. Error
The total TPACK	Associate Degree	Mean	231,43	3,812
		5% Trimmed Mean	233,66	
		Skewness	-1,085	,357
		Kurtosis	,649	,702
	Undergraduate	Mean	225,52	1,422
		5% Trimmed Mean	227,00	
		Skewness	-,661	,144
		Kurtosis	-,324	,287
	Master	Mean	231,13	2,925
		5% Trimmed Mean	232,68	
		Skewness	-,950	,330
		Kurtosis	1,132	,650

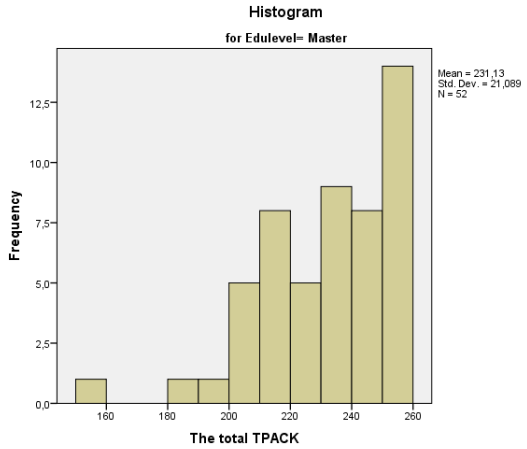
Tests of Normality

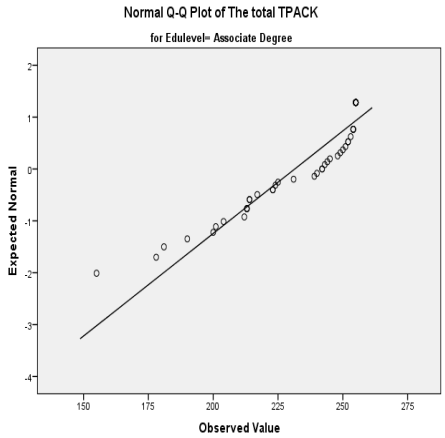
	The education level of educators	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
The total TPACK	Associate Degree	,186	44	,001	,856	44	,000
	Undergraduate	,111	286	,000	,930	286	,000
	Master	,129	52	,031	,910	52	,001

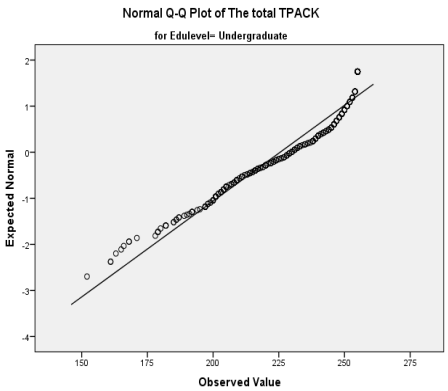
a. Lilliefors Significance Correction

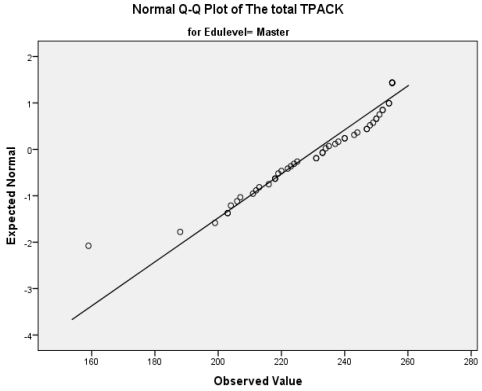


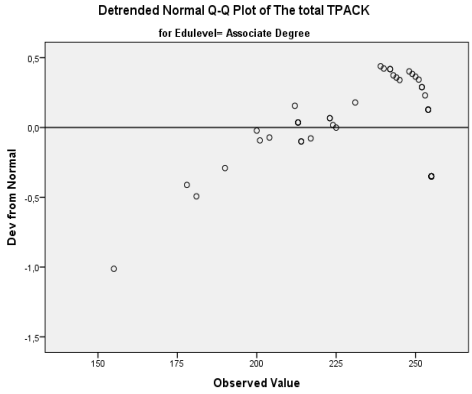


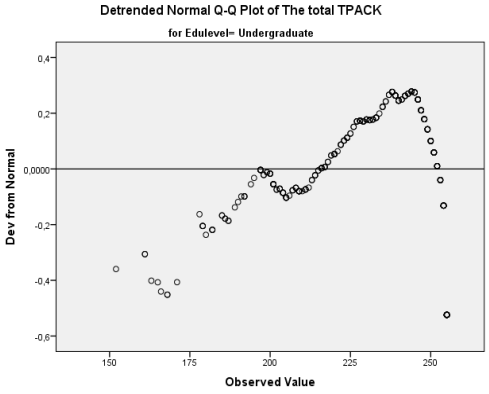


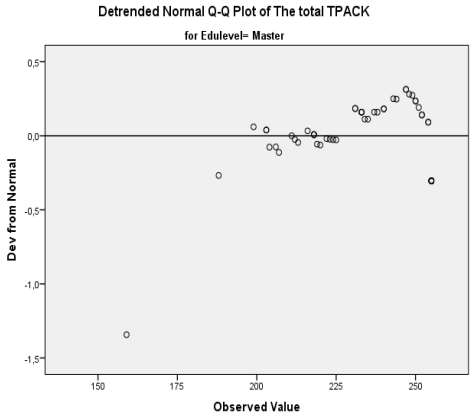


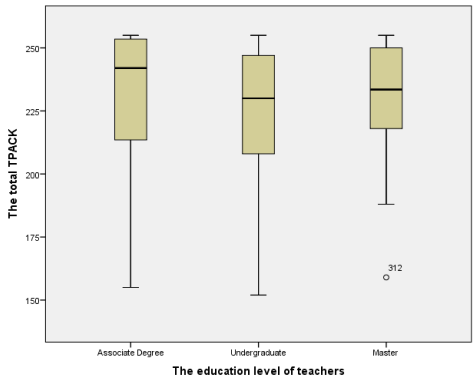












The Normal Distribution of the Total TPACK Level Regarding Training Attendance

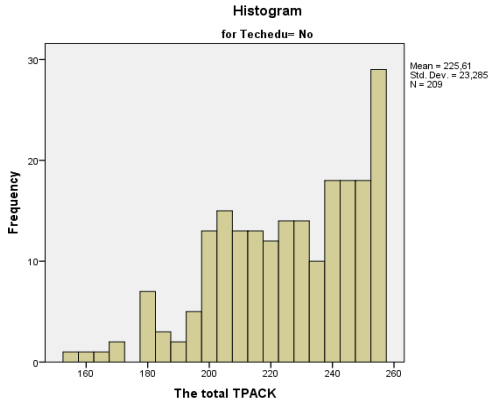
Descriptives

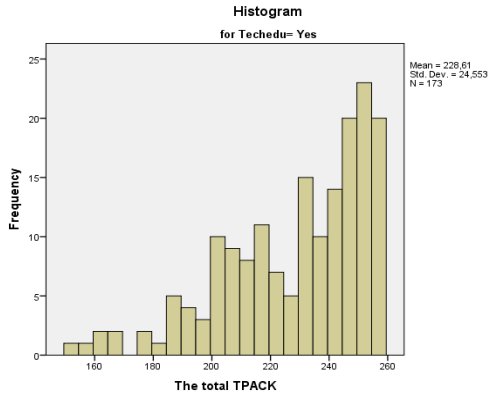
	Technology education		Statistic	Std. Error
The total TPACK	No	Mean	225,61	1,611
		5% Trimmed Mean	226,94	
		Skewness	-,586	,168
		Kurtosis	-,336	,335
	Yes	Mean	228,61	1,867
		5% Trimmed Mean	230,57	
		Skewness	-,930	,185
		Kurtosis	,200	,367

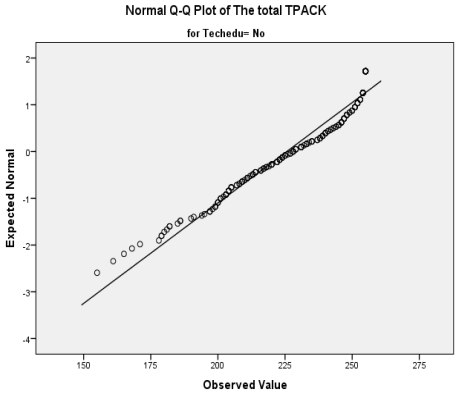
Tests of Normality

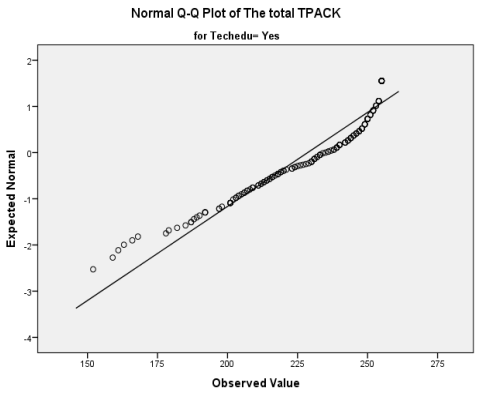
	Technology education	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
The total TPACK	No	,103	209	,000	,939	209	,000
	Yes	,141	173	,000	,896	173	,000

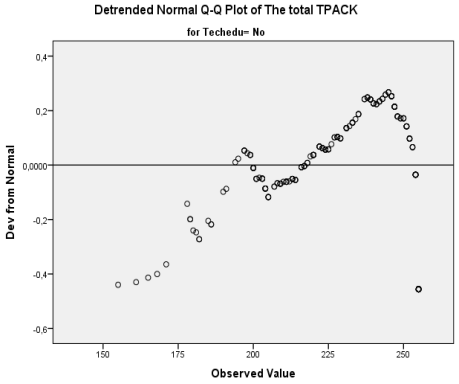
a. Lilliefors Significance Correction

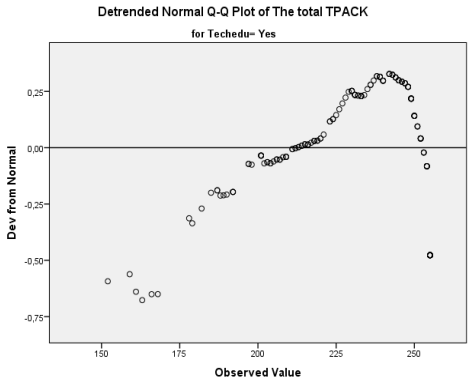


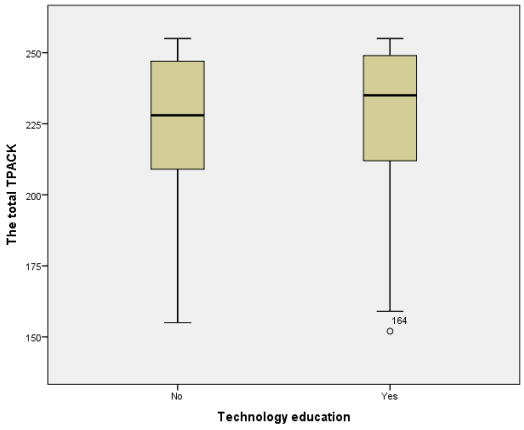












The Normal Distribution of the sub-groups of 21st-century Skills

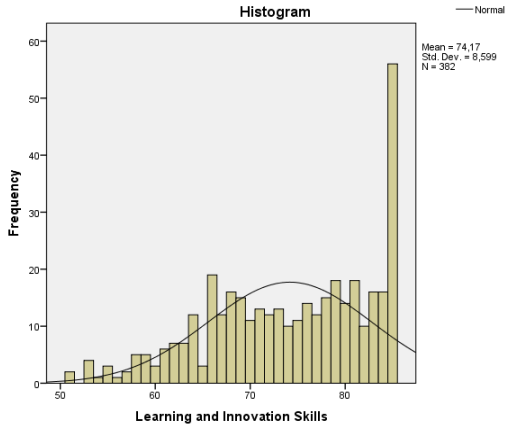
Descriptives

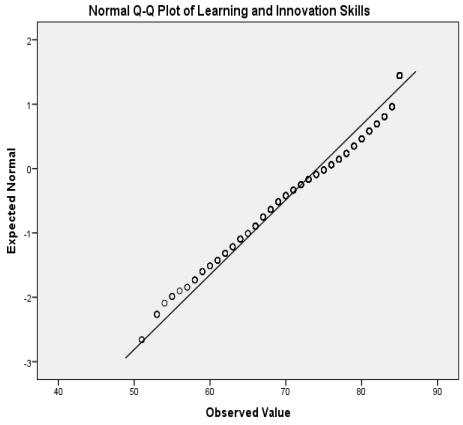
		Statistic	Std. Error
Learning and Innovation Skills	Mean	74,17	,440
	5% Trimmed Mean	74,61	
	Skewness	-,476	,125
	Kurtosis	-,667	,249
Life and Career Skills	Mean	73,04	,294
	5% Trimmed Mean	73,40	
	Skewness	-,822	,125
	Kurtosis	,220	,249
Information, Media and Technology Skills	Mean	36,04	,205
	5% Trimmed Mean	36,36	
	Skewness	-,827	,125
	Kurtosis	-,215	,249

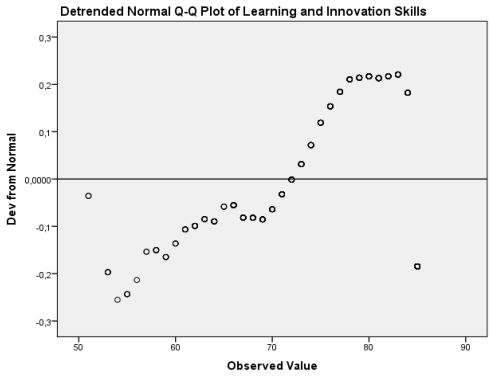
Tests of Normality

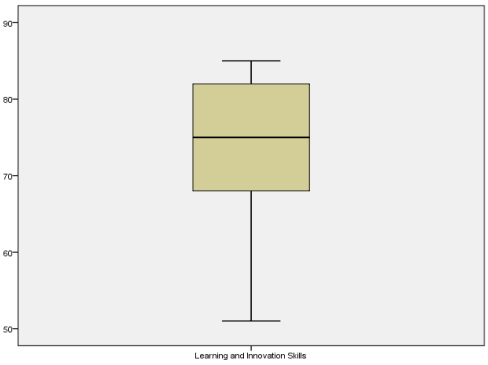
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Learning and Innovation Skills	,104	382	,000	,939	382	,000
Life and Career Skills	,137	382	,000	,925	382	,000
Information, Media and Technology Skills	,180	382	,000	,873	382	,000

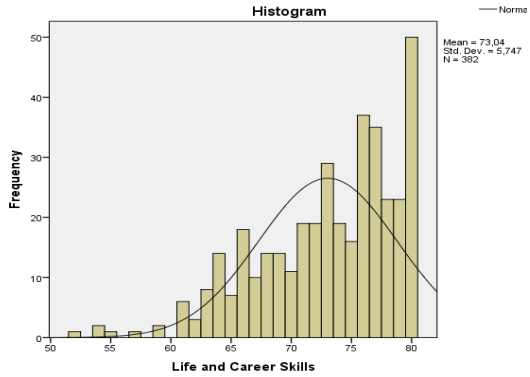
a. Lilliefors Significance Correction

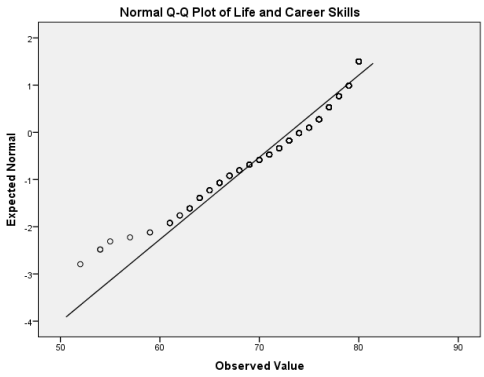

Histogram
Normal
Mean = 74,17
Std. Dev. = 8,599
N = 382
Frequency
Learning and Innovation Skills

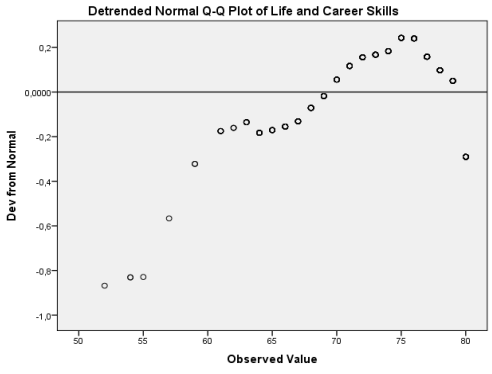

Normal Q-Q Plot of Learning and Innovation Skills
Expected Normal
Observed Value

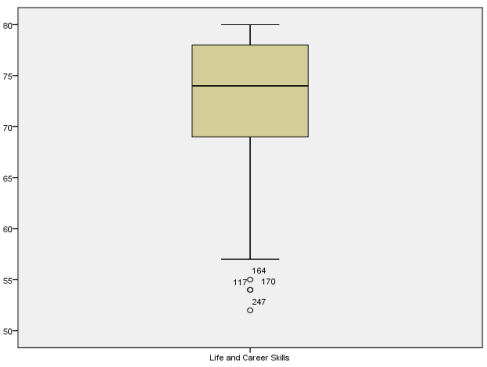

Detrended Normal Q-Q Plot of Learning and Innovation Skills
Dev from Normal
Observed Value

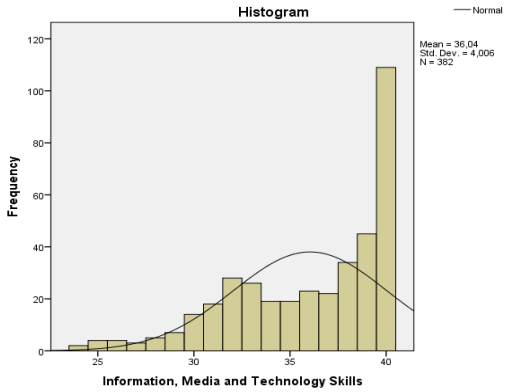

Learning and Innovation Skills

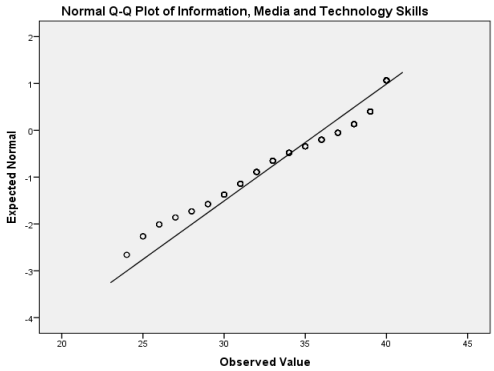

Histogram
Norma
Mean = 73,04
Std. Dev. = 5,747
N = 382
Frequency
Life and Career Skills

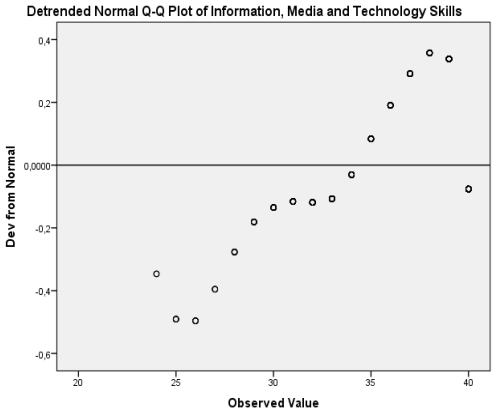

Normal Q-Q Plot of Life and Career Skills
Expected Normal
Observed Value

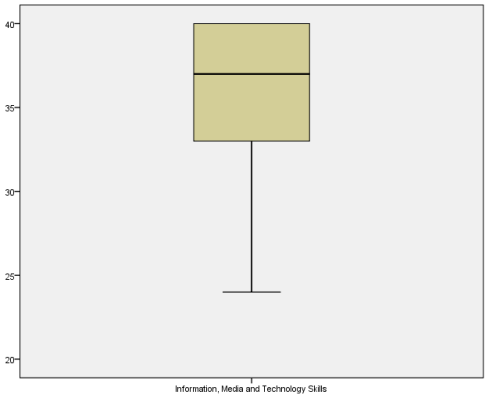

Detrended Normal Q-Q Plot of Life and Career Skills
Dev from Normal
Observed Value


164
117
170
247
Life and Career Skills

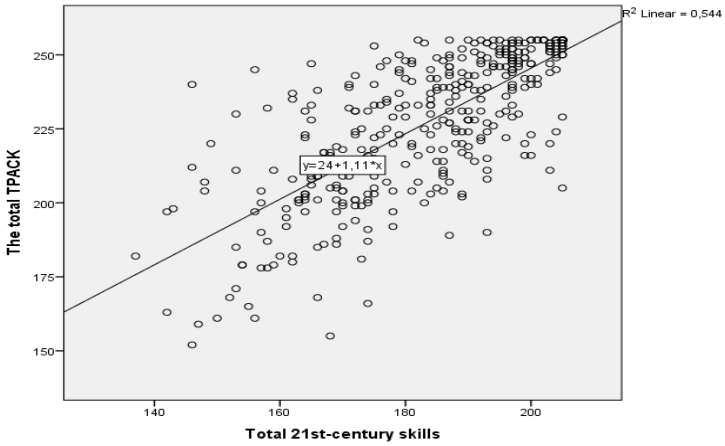




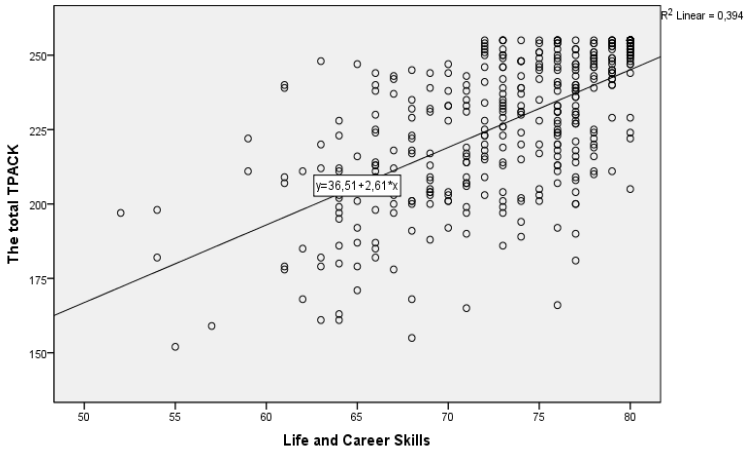


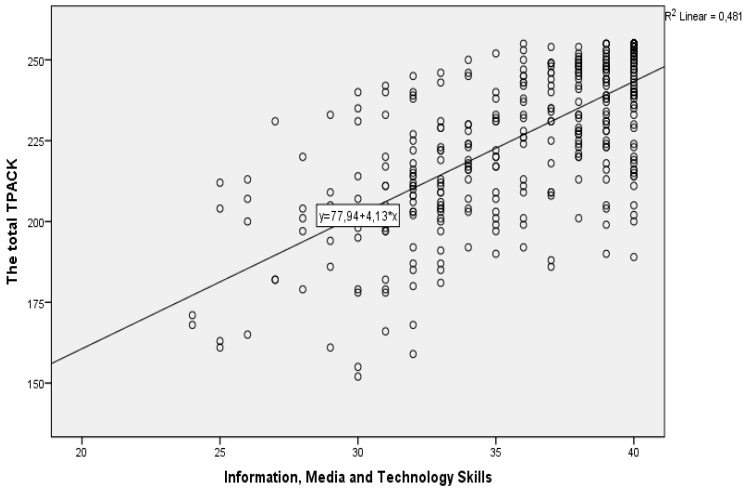


Linearity and Homoscedasticity




R² Linear = 0,387
y=98,9+1,73*x
The total TPACK
Learning and Innovation Skills


R² Linear = 0,394
y=36,51+2,61*x
The total TPACK
Life and Career Skills


R² Linear = 0,481
y=77,94+4,13*x
The total TPACK
Information, Media and Technology Skills

H. ANALYSIS OF THE MAIN STUDY

ANALYSIS OF THE FIRST RESEARCH QUESTION

Comparison of the Total Score of 21st-Century Skills Regarding Age and Years of Experience of In-Service Early Childhood Educators

Descriptive Statistics

Dependent Variable: Total 21st-century skills

The age	The years of experience	Mean	SD	N
30 and below	0-3 years	181,48	15,333	50
	4-7 years	184,89	16,582	56
	8+ years	187,82	13,455	17
	Total	183,91	15,720	123
31-40	0-3 years	193,50	9,192	2
	4-7 years	181,77	21,595	13
	8+ years	184,39	15,154	147
	Total	184,30	15,656	162
41 and above	4-7 years	199,00	.	1
	8+ years	180,49	16,400	96
	Total	180,68	16,423	97
Total	0-3 years	181,94	15,264	52
	4-7 years	184,51	17,460	70
	8+ years	183,18	15,628	260
	Total	183,25	15,904	382

Levene's Test of Equality of Error Variances[a]

F	df1	df2	Sig.
1,635	7	374	,124

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Newage + Experience + Newage * Experience

Tests of Between-Subjects Effects

Dependent Variable: Total 21st-century skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2074,148[a]	7	296,307	1,175	,316	,022
Intercept	970931,757	1	970931,757	3850,770	,000	,911
Age	140,613	2	70,307	,279	,757	,001
Experience	201,383	2	100,691	,399	,671	,002
Age * Experience	823,071	3	274,357	1,088	,354	,009
Error	94300,221	374	252,140			
Total	12924699,000	382				
Corrected Total	96374,369	381				

a. R Squared = ,022 (Adjusted R Squared = ,003)

Comparison of the Total Score of 21st-Century Skills Regarding the Education Level and Training Attendance of In-Service Early Childhood Educators

Descriptive Statistics

Dependent Variable: Total 21st-century skills

The education level	21st-century skills education	Mean	SD	N
Associate Degree	No	186,42	13,140	31
	Yes	190,92	18,558	13
	Total	187,75	14,862	44
Undergraduate	No	180,54	16,451	197
	Yes	186,13	14,896	89
	Total	182,28	16,166	286
Master	No	181,56	14,983	27
	Yes	188,28	13,972	25
	Total	184,79	14,759	52
Total	No	181,36	15,995	255
	Yes	187,05	15,080	127
	Total	183,25	15,904	382

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Total 21st-century skills

F	df1	df2	Sig.
1,992	5	376	,079

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Edulevel + Centuryedu + Edulevel * Centuryedu

Tests of Between-Subjects Effects

Dependent Variable: Total 21st-century skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3970,926[a]	5	794,185	3,232	,007	,041
Intercept	6125874,805	1	6125874,805	24926,873	,000	,985
Edulevel	940,663	2	470,331	1,914	,149	,010
Centuryedu	1396,865	1	1396,865	5,684	,018	,015
Edulevel * Centuryedu	27,228	2	13,614	,055	,946	,000
Error	92403,443	376	245,754			
Total	12924699,000	382				
Corrected Total	96374,369	381				

a. R Squared = ,041 (Adjusted R Squared = ,028)

Pairwise Comparisons

Dependent Variable: Total 21st-century skills

(I) 21st-century skills education	(J) 21st-century skills education	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
No	Yes	-5,607*	2,352	,018	-10,231	-,983
Yes	No	5,607*	2,352	,018	,983	10,231

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Intercoder Reliability

ReCal 0.1 Alpha for 2 Coders
results for file "21st Century Skills Training- Yes No intercoding.csv"

File size:	220 bytes
N columns:	2
N variables:	1
N coders per variable:	2

	Percent Agreement	Scott's Pi	Cohen's Kappa	Krippendorff's Alpha (nominal)	N Agreements	N Disagreements	N Cases	N Decisions
Variable 1 (cols 1 & 2)	86.4%	0.795	0.796	0.798	38	6	44	88

ANALYSIS OF THE SECOND RESEARCH QUESTION

Comparison of the Total TPACK Score Regarding Age and Years of Experience of In-Service Early Childhood Educators

Descriptive Statistics

Dependent Variable: The total TPACK

The years of experience	The age	Mean	SD	N
0-3 years	30 and below	230,60	19,759	50
	31-40	245,00	2,828	2
	Total	231,15	19,572	52
4-7 years	30 and below	229,79	24,119	56
	31-40	223,38	36,505	13
	41 and above	251,00	.	1
	Total	228,90	26,625	70
8+ years	30 and below	235,88	17,853	17
	31-40	227,54	22,647	147
	41 and above	220,84	25,694	96
	Total	225,61	23,841	260
Total	30 and below	230,96	21,562	123
	31-40	227,42	23,867	162
	41 and above	221,15	25,742	97
	Total	226,97	23,883	382

Levene's Test of Equality of Error Variances[a]

F	df1	df2	Sig.
2,786	7	374	,008

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Experience + Newage + Experience * Newage

Tests of Between-Subjects Effects

Dependent Variable: The total TPACK

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7498,152[a]	7	1071,165	1,909	,067	,035
Intercept	1516464,604	1	1516464,604	2703,049	,000	,878
Experience	888,722	2	444,361	,792	,454	,004
Age	174,873	2	87,436	,156	,856	,001
Experience * Age	2003,637	3	667,879	1,190	,313	,009
Error	209821,471	374	561,020			
Total	19895950,000	382				
Corrected Total	217319,623	381				

a. R Squared = ,035 (Adjusted R Squared = ,016)

Comparison of the Total TPACK Score Regarding Education Level and Training Attendance of In-Service Early Childhood Educators

Descriptive Statistics

Dependent Variable: The total TPACK

The education level	Technology education	Mean	Std. Deviation	N
Associate Degree	No	228,85	25,209	27
	Yes	235,53	25,630	17
	Total	231,43	25,288	44
Undergraduate	No	224,28	23,791	158
	Yes	227,05	24,359	128
	Total	225,52	24,044	286
Master	No	230,67	16,428	24
	Yes	231,54	24,694	28
	Total	231,13	21,089	52
Total	No	225,61	23,285	209
	Yes	228,61	24,553	173
	Total	226,97	23,883	382

Levene's Test of Equality of Error Variances[a]

Dependent Variable: The total TPACK

F	df1	df2	Sig.
1,185	5	376	,316

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Edulevel + Techedu + Edulevel * Techedu

Tests of Between-Subjects Effects

Dependent Variable: The total TPACK

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3392,882[a]	5	678,576	1,193	,312	,016
Intercept	10132567,210	1	10132567,210	17809,112	,000	,979
Edulevel	2486,948	2	1243,474	2,186	,114	,011
Techedu	567,980	1	567,980	,998	,318	,003
Edulevel * Techedu	203,197	2	101,598	,179	,837	,001
Error	213926,741	376	568,954			
Total	19895950,000	382				
Corrected Total	217319,623	381				

a. R Squared = ,016 (Adjusted R Squared = ,003)

Intercoder Reliability

ReCal 0.1 Alpha for 2 Coders
results for file "Technology related Training- Yes No intercoding.csv"

File size:	145 bytes
N columns:	2
N variables:	1
N coders per variable:	2

	Percent Agreement	Scott's Pi	Cohen's Kappa	Krippendorff's Alpha (nominal)	N Agreements	N Disagreements	N Cases	N Decisions
Variable 1 (cols 1 & 2)	93.1%	0.905	0.906	0.907	27	2	29	58

ANALYSIS OF THE THIRD RESEARCH QUESTION

Correlations

			The total TPACK	Learning and Innovation Skills	Life and Career Skills	Total 21st-century skills
Spearman's rho	The total TPACK	Correlation Coefficient	1,000	,654**	,641**	,753**
		Sig. (2-tailed)	.	,000	,000	,000
		N	382	382	382	382
	Learning and Innovation Skills	Correlation Coefficient	,654**	1,000	,710**	,925**
		Sig. (2-tailed)	,000	.	,000	,000
		N	382	382	382	382
	Life and Career Skills	Correlation Coefficient	,641**	,710**	1,000	,881**
		Sig. (2-tailed)	,000	,000	.	,000
		N	382	382	382	382
	Total 21st-century skills	Correlation Coefficient	,753**	,925**	,881**	1,000
		Sig. (2-tailed)	,000	,000	,000	.
		N	382	382	382	382

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

Correlations

		The total TPACK
Information, Media and Technology Skills	Pearson Correlation	,694**
	Sig. (2-tailed)	,000
	N	382

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

I. THE NEW VERSION OF 21ST CENTURY SKILLS SCALE

	21. YÜZYIL BECERİLERİ ÖZYETERLİK ALGISI ÖLÇEĞİ	Her zaman	Sık sık	Bazen	Nadiren	Hiçbir zaman
Öğrenme ve Yenilenme Becerileri						
1	Karşılaştığım sorunların çözümüne yönelik özgün fikirler geliştiririm.	5	4	3	2	1
2	Yaşamımda özgün fikirler oluşturmak için farklı düşünme tekniklerini (beyin fırtınası, altı şapkalı düşünme) kullanırım.	5	4	3	2	1
3	Bir problemi sonuca ulaştırmak için farklı çözüm yolları denerim.	5	4	3	2	1
4	Bütün- parça arasında alışılmışın dışında ilişkiler kurarım.	5	4	3	2	1
5	Problemlerin çözümü için hayal gücümü kullanırım.	5	4	3	2	1
6	Yeni fikirleri analiz ederek değerlendiririm.	5	4	3	2	1
7	Bir konuya ilişkin düşüncelerin farklı boyutlarını anlamaya çalışırım.	5	4	3	2	1
8	Problemi çözerken farklı bakış açılarını belirlemek için sorular sorarım.	5	4	3	2	1
9	Problemlere çözüm üretmek için sabırlı bir biçimde çalışırım.	5	4	3	2	1
10	Bir iddiayı sorgulayarak görüşün dayandığı temel dayanakları araştırırım.	5	4	3	2	1
11	Karşılaştığım problemleri çözmek için akıl yürütme yollarını kullanırım	5	4	3	2	1
12	Problemlerin çözümünde bütün-parça arasındaki ilişkileri analiz ederim.	5	4	3	2	1
13	Farklı bakış açılarını değerlendiririm.	5	4	3	2	1
14	Bilgi ve argümanlar arasında ilişkiler kurarak sentezlerim.	5	4	3	2	1
15	Sonuçlara bilgileri analiz ederek ulaşırım.	5	4	3	2	1
16	Edindiğim bilgiyi farklı yollarla (yazılı, sözlü gibi) diğerleriyle paylaşırım.	5	4	3	2	1
17	Yeteneklerimi geliştirmek için girişimde bulunurum.	5	4	3	2	1
Yaşam ve Kariyer Becerileri						
18	Diğerlerinin bir konu üzerindeki düşüncelerini dinlerim.	5	4	3	2	1
19	Etkili iletişim becerilerine sahibim.	5	4	3	2	1
20	Grup çalışmalarında etkin bir biçimde çalışabilme becerisine sahibim.	5	4	3	2	1
21	Grup üyeleriyle uyumlu bir biçimde çalışırım.	5	4	3	2	1
22	Grup çalışmalarında sorumluluk üstlenirim.	5	4	3	2	1
23	Grup çalışmalarında bireysel katkılara değer veririm.	5	4	3	2	1
24	Başkalarının önerilerine dayalı olarak fikirlerimi değiştirme konusunda esneğimdir.	5	4	3	2	1
25	Yaşamımdaki farklı rollere (arkadaş, vatandaş, ekonomik, güç, aile üyesi) uyum sağlarım.	5	4	3	2	1
26	Yeni durumlara uyum sağlamada rahat değilimdir.	5	4	3	2	1
27	Eleştirilere açığımdır.	5	4	3	2	1
28	Sorunlara çözüm üretmek için farklı bakış açılarını önemserim.	5	4	3	2	1
29	Öğrenmenin yaşam boyu devam eden bir süreç olduğunu bilirim.	5	4	3	2	1
30	Gelecekteki olayları tahmin etmek için geçmiş deneyimlerinden yararlanırım.	5	4	3	2	1
31	Ne zaman konuşup ne zaman dinlemem gerektiğini bilirim.	5	4	3	2	1
32	Başkalarıyla iletişimimde saygılıyımdır.	5	4	3	2	1
33	Farklı kültürlere saygı duyarım.	5	4	3	2	1
Bilgi, Medya ve Teknoloji Becerileri						
34	Diğerleriyle iletişim kurmak için medya ve teknolojiyi etkin kullanırım.	5	4	3	2	1
35	Medyadaki mesajların hangi amaçlara yönelik olarak yapılandırıldığını bilirim.	5	4	3	2	1
36	Medyanın bireylerin düşüncelerini yönlendirmede etkili olduğunu bilirim.	5	4	3	2	1
37	Bilgi edinmede uygun medya araçlarını kullanırım.	5	4	3	2	1
38	Farklı medya araçlarını kullanırım.	5	4	3	2	1
39	Bilgiye ulaşmada teknolojik araçları kullanırım.	5	4	3	2	1
40	Bilgiyi analiz ederken teknolojik araçları kullanırım.	5	4	3	2	1
41	Bilgi paylaşımında sosyal ağları kullanırım.	5	4	3	2	1

J. TURKISH SUMMARY / TÜRKÇE ÖZET

GİRİŞ

Tarih boyunca teknoloji, insanların hayatlarına farklı yönler vererek önemli bir yere sahip olmuştur (Younes & Al-Zoubi, 2015). Fakat, 21. yüzyılda teknolojik gelişmeler önceki dönemlere göre daha hızlı olmaya başlamıştır (Marope, 2017). Hızla gelişen ve değişen teknoloji nedeniyle Dünya'daki yeni gereksinimlerine uyum sağlayabilmek için insanların düşünme, yaşama ve çalışma biçimlerinin değişmesi gerekmektedir (Ekonomik İşbirliği ve Kalkınma Örgütü [OECD], 2005; Griffin, Care & McGaw, 2012). Dünya Ekonomik Forumu (WEF), bugün ilkokula başlayan çocukların yüzde 65'inin henüz mevcut olmayan bir işte çalışacağının altını çizmektedir (2016).

Eğer çocukları geleceğe hazırlamak istiyorsak, ekolojik sistemin tüm kademeleri değişime hazırlıklı olmalıdır, çünkü çocuklar bu sistemin merkezinde yer alır. Ekolojik Sistem Yaklaşımı'na göre okulların teknolojik altyapılarının desteklenmesi, politik ve eğitimsel politikaların hazırlanması, öğretmenlerin bilgi ve yeteneklerinin artırılması gerekmektedir (Herselman, Botha, Mayindi & Reid, 2018).

21. yüzyılda modern dünyanın taleplerini yerine getirmek için insanlar çeşitli yetkinliklere ihtiyaç duyarken, eğitim çocukları karmaşık ve zorlu bir dünyaya hazırlamak için hayati bir role sahiptir (OECD, 2005; OECD, 2018a). Bu nedenle eğitim sisteminin mevcut küresel koşullara uyarlanması gerekir (OECD, 2005; Wang, 2012; Marope, 2017). Eğitim sisteminin düzenlemesinde öğretmenler, eğitimsel yeniliklerde lider olarak tanınmaktadır. Çocukları mevcut bilgi, deneyim ve yeni becerileriyle desteklemeleri oldukça önemlidirler (Lee & Reigeluth, 1994; OECD, 2018b). Bundan yola çıkarak öğretmenlerin 21. yüzyıl bilgi, beceri ve teknolojik pedagojik alan bilgisini (TPACK) geliştirilmelidir. Böylece, öğrencilerinin şu anda gelişen dünyaya uyum sağlaması için 21. yüzyıl becerileri ve dijital yeterlilikler kazanmaya teşvik etmeye hazır olabilirler (American Association of Colleges for Teacher Education [AACTE] & Partnership for 21st Century Skills [P21], 2010).

Desteklenen çocuklar da sosyal yaşamlarında sorumlu, yararlı ve aktif vatandaşlar ve özellikle ilerideki iş hayatı için yetkin bireyler olabilirler (OECD, 2018a).

Erken çocukluk döneminde, çocukların beyin kapasitesi yetişkinlerin beyin kapasitesinden yaklaşık iki kat daha fazladır. Bu nedenle bu dönem de edinilen deneyimler çocukları ileride dünyanın taleplerini yerine getirme konusunda hazırlamak için kritik bir dönemdir ve bu deneyimlerin beyinlerinin gelişiminde de büyük etkisi vardır (Millî Eğitim Bakanlığı [MEB], 2013; Tuncer, 2015; BattelleForKids, 2019d). Okul öncesi döneminin bireyler için değerli zamanlar olduğu düşünüldüğünde (MEB, 2013; Tuncer, 2015), küçük çocukların erken yaşlarda gerekli becerileri kazanmalarını desteklemek ailelerinin, öğretmenlerinin, okullarının ve politikacıların sorumluluğundadır (MEB, 2013; BattelleForKids, 2019d).

Türkiye'deki okul öncesi müfredatı çocukların bazı 21. yüzyıl becerilerine vurgu yapmaktadır ve okul öncesi öğretmenleri, küçük çocukların eğitiminde bu becerileri kazanmalarını teşvik eden ana faktörlerden biridir (MEB, 2013). Ata-Aktürk, Demircan, Şenyurt ve Çetin (2017) Türkiye'de erken çocukluk eğitiminin küçük çocukların 21. yüzyıla ait yaratıcılık, eleştirel düşünme, problem çözme, kendini ifade etme ve kendiliğinden bir işe başlama gibi bazı temel becerilerini desteklediğine dikkat çekmiştir.

21. yüzyıl becerileri üzerine hazırlanmış çeşitli çerçeveler bulunmaktadır. Ancak bu çalışmada, 21. Yüzyıl Öğrenimi için Ortaklık (P21) projesinin oluşturduğu çerçeve, okul öncesi eğitimine özel vurgu yapması nedeniyle ana çerçeve olarak kullanılmıştır (BattelleForKids, 2019c). P21 projesinde, entegre ve kolektif bir yapıya sahip bir 21. yüzyıl öğrenme çerçevesi oluşturulmuştur. Bu çerçeve başarılı bir günlük yaşam ve iş hayatı için gereken bilgi ve becerileri içerir (BattelleForKids, 2019b). AACTE & P21 eğitimcilerin 21. yüzyıl becerilerine sahip olması gerektiğini belirtirken (2010), P21 küçük çocuklarla çalışan öğretmenlerin de 21. yüzyıl becerilerini çocukların öğrenme programlarına entegre etmeleri gerektiğini vurgulamaktadır (BattelleForKids, 2019c; BattelleForKids, 2019d). P21 çerçevesinde, 21. yüzyıl için temel yetkinlikler alt faktörlere ayrılmıştır. Bunlar: Öğrenme ve Yenilik Becerileri; Bilgi, Medya ve

Teknoloji Becerileri; Yaşam ve Kariyer Becerileri (BattelleForKids, 2019a; BattelleForKids, 2019b; Trilling and Fadel, 2009).

- Öğrenme ve Yenilik Becerileri, insanların 21. yüzyıldaki karmaşık yaşamlarına ayak uydurmalarına yardımcı olur. Bunlar yaratıcılık, eleştirel düşünme becerileri ve problem çözme becerileri, iletişim ve iş birliği becerileri ile ilgilidir.
- Yaşam ve Kariyer Becerileri, kendi kendini yönetme becerileri, liderlik, sosyal ve kültürler arası beceriler, esneklik, sorumluluk, uyum ve ayrıca yenilikçi ve üretken olmayı içerir. İnsanların işlerine ve sosyal çevrelerine uyum sağlamaları için önemlidir.
- Bilgi, Medya ve Teknoloji Becerileri, bilgi okuryazarlığı, medya okuryazarlığı ve BİT (Bilgi ve İletişim Teknolojisi) okuryazarlığını içerir.

Bilgi, medya ve teknoloji becerileri, 21. yüzyıl öğrenimi için P21 çerçevesinde önemli bir yere sahiptir (BattelleForKids, 2019a). Son yıllarda eğitimciler, değişen çevrelerine ayak uydurmak ve öğrencilerinin hızla gelişen dünyanın taleplerine adapte olmasını destekleme konusunda teknolojiye ihtiyaç duydukları için teknolojiyi sıklıkla kullanmaya başladılar (Mishra & Koehler, 2006; Blackwell, Lauricella & Wartella, 2016; Shafie, Majid & Ismail, 2019; Altun, 2019). Bu nedenle öğretmenlerin teknolojiyi kullanıp kullanmamaları yerine teknolojiyi kullanma şekilleri daha çok önemli kazandı (Mishra & Koehler, 2006; Blackwell, Lauricella & Wartella, 2016). Teknolojiyi eğitime entegre etmek öğretimin daha karmaşık ve çok boyutlu bir yapıya sahip olmasına yol açtığı savunulmaktadır (Voogt & McKenney, 2017; Altun, 2019). Bu karmaşıklıktan yola çıkarak Mishra ve Koehler (2006), teknolojiyi eğitime entegre etmek için Teknolojik Pedagojik Alan Bilgisi (TPAB) çerçevesini geliştirmiştir. TPAB, teknolojiyi eğitim sürecine dahil etme de öğretmenlerin becerileri, yeterlilikleri ve rolleriyle ilgili teorik bir çerçeve oluşturur (Koehler & Mishra, 2009).

TPAB, öğretmenlerin mesleki gelişimlerini destekleyerek etkili bir şekilde öğretmek için eğitim teknolojilerinin Pedagojik Alan Bilgisi (PAB) ile nasıl etkileşime girdiğinin anlaşılmasına yardımcı olan bir çerçevedir. (Mishra ve Koehler, 2006).

TPAB, pedagoji bilgisi, alan bilgisi ve teknoloji bilgisi olarak adlandırılan üç temel bileşenin etkileşimleriyle oluşur. TPAB öğretmenlerin konuları teknoloji kullanarak ve öğrencilerin gelişim düzeylerini, ilgi alanlarını ve öğretim ortamını dikkate alarak anlamlı bir öğrenme ve öğretme süreci oluşturmasıdır. Bununla birlikte, TPAB çerçevesinde, hızla gelişen teknoloji nedeniyle teknolojiyi tanımlamak için genel bir tanım kullanılmıştır (Koehler ve Mishra, 2009). Bu çalışmada da kapsayıcı olmak amacıyla aynı şekilde devam ettirilecektir.

Eğitimcilerin 21. yüzyıl becerilerinin ve TPAB'sinin geliştirilmesi için hizmet öncesi ve hizmet içi eğitimler önemli bir yere sahiptir. Teo, Unwin, Scherer ve Gardiner (2021), teknolojik gelişmelerin diğer sistemler kadar eğitim sistemini de etkilediğine ve eğitimcilerin değişen eğitim taleplerini karşılayabilmeleri için mesleki gelişim programlarının bu iyileştirmeye uyarlanması gerektiğine dikkat çekmiştir. Bozkurt (2020), literatür incelendiğinde eğitimcilerin 21. yy becerilerinin nasıl destekleneceğine dair kapsamlı bir araştırma veya proje bulunmadığını belirtmiştir. Ayrıca Teo ve diğerleri (2021), içinde bulunduğumuz yüzyıl için oldukça kritik bir konu olmasına rağmen, üniversitelerdeki eğitim programlarının okul öncesi öğretmen adaylarını 21. yüzyıl becerilerini artırma konusunda nasıl desteklediği hakkında çok az bilgi olduğunu belirterek benzer noktalara değinmiştir.

21. yüzyıl becerilerine yönelik eğitimlerin yanı sıra TPAB eğitimlerinin de nitelikli eğitimcilere sahip olabilmek açısından önemli olduğu vurgulanmıştır. Ancak uygun mesleki eğitim programlarının geliştirilmesi için bu konunun ayrıntılı olarak ele alınması gerekmektedir (Kaya ve Yılayaz, 2013). Bayrak ve Bayrak (2021), hizmet içi eğitim programlarının içeriğinin yetersiz olması nedeniyle geliştirilmesi gerektiğini belirterek bu noktayı desteklemiştir.

Sonuç olarak, bu iki konu eğitimcilerin gelişimi için oldukça önemlidir, ancak eğitimcilerin beceri ve bilgilerinin geliştirmesi için daha fazla araştırmaya ihtiyaç duyulmaktadır. 21. yüzyıl becerilerin sahip, teknolojiyi eğitime entegre etmeyi bilen eğitimcilere sahip olmanın önemi düşünüldüğünde, bu çalışma ön çalışma ve ilişkisel çalışma olarak yapılmıştır.

Amaç

Bu çalışmanın amacı okul öncesi öğretmenlerinin 21. yüzyıl becerilerine ve teknolojik pedagojik alan bilgisine (TPAB) ilişkin genel özelliklerini ilceleyen bir ön çalışma yapmak ve 21. yüzyıl becerileri ile TPAB arasındaki potansiyel ilişkiyi incelemektir.

Araştırmanın Önemi

Son dönemler de teknoloji önceki zamanlara göre daha hızlı gelişmeye başladı (Marope, 2017). Gelişen teknoloji ile birlikte, insanların düşünme, yaşama ve çalışma yöntemlerinin değişmesi gerekmektedir (Griffin, Care & McGaw, 2012; OECD, 2005). Bireyler, hızla değişen dünyanın taleplerini karşılayabilecek yeterlilikte olmalıdırlar. Bu nedenle öğretmenlerin yetenekleri son derece önemlidir çünkü öğrencileri karmaşık dünyaya ve bilinmeyen geleceğe hazırlayacak kişiler onlardır (WEF, 2016; Shafie, Majid & Ismail, 2019). Eğer çocuklar çağın koşulları için gerekli bilgi ve becerilerle desteklenirlerse, çoğu işi insanlar yerine yapan ve ileri teknolojiye sahip buluşlarla yerleri doldurulamayacak seviye de yeteneklere sahip olabilirler (Shafie, Majid & Ismail, 2019).

Öğretmenler eğitimsel değişikliklerin yapılmasında lider olarak görülmektedir (Lee & Reigeluth, 1994). Öğretmenler yeterli 21. yüzyıl bilgi ve becerisine sahip değilse, öğrencilerinin 21. yüzyıldaki gelişimini destekleyemezler (Subramaniam, 2013; Voogt & McKenney, 2017; Valtonen, Sointu, Kukkonen, Kontkanen, Lambert & Mäkitalo-Siegl, 2017; Shafie, Majid & İsmail, 2019). Bu nedenle, öğretmenlerin mevcut yetenekleri ile çocukları desteklemek için ihtiyaç duydukları beceriler arasındaki fark incelenmelidir (Lee ve Reigeluth, 1994). Bu araştırmanın sonuçlarıyla öğretmenlerin 21. yüzyıl becerileri hakkında kendilerini nasıl değerlendirdikleri tespit edilebilir ve öğretmenlerin kendilerini eksik hissettiği beceriler bu doğrultuda desteklenebilir. Ayrıca 21. yüzyıl eğitimcilerinin yaş, deneyim yılı, eğitim düzeyi ve eğitime katılımlarının becerileri arasında bir fark oluşturup oluşturmadığı incelenmiştir. Bu konuyla ilgili daha önce yapılmış az sayıda çalışma vardır, bu nedenle bu çalışma, eğitimcilerin 21. yüzyıl becerileri konusunda daha detaylı araştırmalar için bir başlangıç adımı sağlamak amacıyla bir ön çalışma olarak

yapılmıştır. Bu şekilde, çocukları bilinmeyen geleceğe hazırlamak için daha yetenekli öğretmenlere sahip olabiliriz. Benner ve Hatch'in (2010) belirttiği gibi, öğretmenler bu becerileri kendileri kazanmalıdır ki daha sonra öğrencilerini 21. yüzyıl becerilerini geliştirmek için erken yaşlardan itibaren desteklemelerini bekleyebilelim.

Yeni nesil teknolojiyle iç içe büyüyor ve yaşamları boyunca buna bağlı olacaklar. Bu nedenle öğretmenler sadece geleneksel yöntemler kullanmak yerine dijital dünyayı da eğitime entegre etmelidirler (Ferrari, Punie & Redecker, 2012). Araştırmalar, öğretmenlerin teknolojiyi günlük yaşamlarında kullanabildiklerini göstermektedir. Yine de eğitim ve öğretimin karmaşık bir süreç olması nedeniyle öğretmenler teknolojiyi eğitim sürecine entegre ederken bazı zorluklar yaşayabilmektedirler (Koehler & Mishra, 2009; Altun, 2019; Voogt, Tilya & van den Akker, 2009; Liang, Chai, Koh, Yang & Tsai, 2013; Voogt & McKenney, 2017). Bu nedenle öğretmenlerin teknolojiyi eğitime nasıl entegre ettikleri, öğretmenlerin teknoloji hakkında bildiklerinden daha fazla önem kazanıyor. Jones ve Moreland (2004), eğitimcilerin TPB'si ile öğrencilerin başarısı arasında pozitif bir ilişki olduğunu belirtmişlerdir. Dolayısıyla bu kavramı biraz genişlettiğimizde bu bizi öğretmenlerin TPAB'sine yönlendiriyor (Koehler & Mishra, 2009; Blackwell, Lauricella & Wartella, 2016).

Bu çalışma okul öncesi öğretmenlerinin TPAB seviyelerini nasıl değerlendirdikleri araştırılarak, öğretmenlerin teknolojiyi eğitime dahil etme konusunda yaş, deneyim, eğitim seviyesi ve alınan dersler veya hizmet içi eğitimlere göre kendilerini nasıl değerlendirdiklerini görme fırsatı sunmaktadır. Bu nedenle bu çalışma sonuçları öğretmenleri destekleyerek eğitim sürecinde teknolojinin kullanımını artırmak için kullanılabilir.

Ayrıca, literatür incelendiğinde, çalışan okul öncesi öğretmenlerinin 21. yüzyıl becerileri ile ilgili çalışmaların azlığı dikkat çekmektedir. Bu çalışmadan toplanan verilerle, okul öncesi öğretmenlerinin 21. yüzyıl becerilerinin yaş, deneyim, eğitim seviyesi ve alınan dersler veya hizmet içi eğitimlere göre nasıl değerlendirdiğini görülmektedir. Ayrıca öğretmen adayları için geliştirilen 21. yüzyıl becerileri ölçeğini çalışan okul öncesi öğretmenleri için uyarlayarak literatüre katkı sağlamıştır.

Hem 21. yüzyıl becerileri hem de öğretmenlerin TPAB'si, çocukları gelecekte karşılaşacakları zorlu yaşam koşullarıyla başa çıkmaya hazırlamak için çok önemlidir (AACTE & P21, 2010; Valtonen ve arkadaşları, 2017). Fakat, çok az araştırmacı, 21. yüzyıl becerileri ile Teknolojik pedagojik alan bilgisi (TPAB) arasındaki ilişki kurarak bu iki konuyu içeren çalışma yürütmüştür. Bazı araştırmalar sadece aralarında önemli bir tür ilişki olduğunu ima etmiştir. Valtonen ve arkadaşları (2017), öğretmenlerin 21. yüzyıl becerilerini TPAB'ne nasıl entegre edeceklerini öğrenmeleri gerektiğini, çünkü teknolojinin çocukları 21. yüzyıl becerilerini geliştirmeleri için destekleyebileceğini ve TPAB'in pedagojik bileşeninin 21. yüzyılla bağlantılı olduğunu vurgulayarak TPAB'inin ve 21. yüzyıl becerilerinin birleştirilmesine odaklanmıştır. Ayrıca, WEF (2015) eğitim teknolojisinin çocukların 21. yüzyıl becerilerini kazanmalarını desteklemek için mükemmel bir yardımcı olabileceğini belirtmektedir. Bunların yanı sıra, genel olarak araştırmalar, teknolojiyle ilgili becerilerin 21. yüzyıl becerilerinin özü olduğunu ve çocukların eğitimi için gerekli olduğunu vurgulamaktadır (Ferrari, Punie & Redecker, 2012; Karakoyun & Lindberg 2020).

Öte yandan, bu çalışmalar öğretmenlerin 21. yüzyıl becerilerinin ve alt gruplarının TPAB ile nasıl bağlantılı olduğunu göstermemektedir. Bu çalışma, özellikle okul öncesi öğretmenlerinin 21. yüzyıl becerileri (Öğrenme ve yenilik becerileri; Yaşam ve kariyer becerileri; Bilgi, medya ve teknoloji becerileri) ile TPAB arasında herhangi bir ilişki olup olmadığı hakkında bir araştırma sağlayacaktır. Bunlar çocukları geleceğe hazırlamak için öğretmenleri destekleyen iki önemli konudur. Bu çalışma, öğretmenlerin eğitim sürecinde teknoloji becerilerine ek olarak diğer tüm 21. yüzyıl becerilerini nasıl kullandıklarını görmemize yardımcı olabilir. Bundan sonraki çalışmalarda öğretmenlerin mesleki gelişimleri aralarındaki ilişkiye göre yönlendirilebilir. Ayrıca, bu çalışma, öğretmenlerin 21. yüzyıl becerileri ve TPAB'sinin daha iyi entegrasyonu için farklı ölçekler oluşturmak için gelecekteki çalışmalarında aradaki ilişkiye odaklanmaları için insanlara ilham verebilir.

YÖNTEM

Araştırma Soruları

R.Q.1. Okul Öncesi Öğretmenlerinin 21. yüzyıl becerileri nedir?

1.1. Okul Öncesi Öğretmenlerinin 21. yüzyıl becerilerinde yaşa göre farklılık var mıdır?

1.2. Okul Öncesi Öğretmenlerinin 21. yüzyıl becerilerinde deneyimine göre farklılık var mıdır?

1.3. Okul Öncesi Öğretmenlerinin 21. yüzyıl becerilerinde eğitim düzeyine göre farklılık var mıdır?

1.4. Okul Öncesi Öğretmenlerinin 21. yüzyıl becerilerine ilişkin eğitimlere katılımları bakımından 21. yüzyıl becerileri arasında bir fark var mıdır?

R.Q.2. Okul Öncesi Öğretmenlerinin TPAB düzeyleri nedir?

2.1. Okul Öncesi Öğretmenlerinin TPAB düzeylerinde yaşa göre farklılık var mıdır?

2.2. Okul Öncesi Öğretmenlerinin TPAB düzeylerinde deneyime göre farklılık var mıdır?

2.3. Okul Öncesi Öğretmenlerinin TPAB düzeylerinde eğitim düzeyine göre farklılık var mıdır?

2.4. Okul Öncesi Öğretmenlerinin eğitimde teknoloji kullanımına ilişkin eğitimlere katılmaları bakımından TPAB düzeylerinde farklılık var mıdır?

R.Q.3. Okul Öncesi Öğretmenlerinin 21. yüzyıl becerileri (Öğrenme ve Yenilik Becerileri; Yaşam ve Kariyer Becerileri; Bilgi, Medya ve Teknoloji Becerileri) ile TPAB'si arasında bir ilişki var mı?

3.1. Okul Öncesi Öğretmenlerinin 21. yüzyıl becerileri ile TPAB'si arasında herhangi bir ilişki var mı?

3.2. Okul Öncesi Öğretmenlerinin 21. yüzyıl becerilerinin alt faktörleri ile TPAB'leri arasında bir ilişki var mıdır?

3.2.1. Okul Öncesi Öğretmenlerinin Öğrenme ve Yenilik Becerileri ile TPAB arasında herhangi bir ilişki var mıdır?

3.2.2. Okul Öncesi Öğretmenlerinin Yaşam ve Kariyer Becerileri ile TPAB arasında bir ilişki var mıdır?
3.2.3. Okul Öncesi Öğretmenlerinin Bilgi, Medya ve Teknoloji Becerileri ile TPAB arasında herhangi bir ilişki var mıdır?

Araştırmanın Modeli

Bu araştırma, okul öncesi öğretmenlerinin 21. yüzyıl becerileri ve TPAB düzeylerini genel olarak incelemeye ve aralarındaki ilişkiyi keşfetmeye yönelik yapılmış nicel bir çalışmadır. Bu doğrultu da betimsel ön çalışma ve ilişkisel araştırma yöntemleri kullanılmıştır. Veriler aynı anda üç farklı veri toplama aracı ile okul öncesi öğretmenlerinden toplanarak gerçekleştirilmiştir.

Veri Toplama Araçları

Araştırma verileri araştırmacı tarafından geliştirilen Demografik Bilgi Formu, 2016 yılında Anagün, Atalay, Kılıç ve Yaşar tarafından geliştirilen 21. Yüzyıl Becerileri Özyeterlik Algısı Ölçeği ve 2014 yılında Horzum, Akgün ve Öztürk tarafından geliştirilen Teknolojik Pedagojik Alan Bilgisi Ölçeği aracılığıyla toplanılacaktır.

Pilot Çalışma

Bu pilot çalışmada uygun (elverişlilik) örnekleme yöntemi kullanılarak katılımcılar seçilmiştir. Veriler çevrimiçi bir platform aracılığıyla toplanmıştır. Bu yöntemin kullanılmasının nedeni ise Covid-19 pandemi koşullarıdır. Araştırmacı, kısa sürede çok sayıda öğretmenden veri toplamak için Ankara'daki öğretmen sayısı fazla olan okullarla iletişim kurmuştur.

Bu çalışmada öğretmen adaylarıyla geliştirilen 21. Yüzyıl Becerileri ölçeği okul öncesi öğretmenleri için uyarlanmıştır. Pilot çalışma verileri, 2021-2022 eğitim-öğretim yılı güz döneminde Ankara'da görev yapan 200 öğretmenden toplanmıştır. Araştırmada hem özel okullardan hem de devlet okullarından öğretmenler yer almıştır.

Pilot çalışmada 21. Yüzyıl Becerileri ölçeğinin geçerliliğini ve güvenilirliğini doğrulamak için Açıklayıcı Faktör Analizi, Doğrulayıcı Faktör Analizi ve Cronbach Alfa testi kullanılmıştır. Bulgular, 21. yüzyıl Becerileri ölçeğinin yapısal modelinin, Madde17'i çıkardıktan ve Madde18' in alt grubunda bir değişiklik yaptıktan sonra okul öncesi öğretmenleri için iyi bir uygunluk düzeyine sahip olduğunu göstermiştir. Yenilenen 21. Yüzyıl Becerileri ölçeğinin geçerlilik ve güvenirliliği onaylanmıştır.

TPAB Ölçeği'nin geçerlik ve güvenirliğini kanıtlamak için Doğrulayıcı Faktör Analizi, ikinci düzey Doğrulayıcı Faktör Analizi, Cronbach Alpha testi ve faktör ilişkilendirmesi için Pearson korelasyonu yapılmıştır. Pilot çalışmanın sonuçları, TPAB Ölçeğinin geçerli ve güvenilir olduğunu göstermiştir.

Ana Çalışmanın Veri Toplama Süreci

Bu çalışmanın evreni Ankara, İstanbul ve İzmir'deki çalışan okul öncesi öğretmenleridir. Ana araştırma verileri 2021-2022 eğitim-öğretim yılı bahar döneminde Ankara, İstanbul ve İzmir'de görev yapan okul öncesi öğretmenlerinden toplanmıştır.

Bu çalışmada uygun (elverişlilik) örnekleme yöntemi kullanılmıştır. Bu yöntemin kullanılmasının nedeni ise pandemi (Covid-19) koşullarında yüz yüze veri toplama konusunda yaşanılan sorunlardır. Araştırmacı, hızlı bir şekilde veri toplamak için çok sayıda öğretmene sahip okullarla iletişim kurmaya özen göstermiştir. Ancak öğretmen sayısı fazla olan okullardan istenilen sayıda veri toplanamadığı için bazı okullar rastgele aranarak veri toplama süreci mümkün olan en kısa sürede sonlandırılmıştır. Araştırma sonunda 410 okul öncesi öğretmeninden veri toplanmıştır. Araştırmaya hem özel okullardan hem de devlet okullarından öğretmenler katılmıştır.

21. Yüzyıl Becerileri Ölçeği ve TPAB ölçeğinden elde edilen veri setinde herhangi bir giriş hatası ve aykırı değer olup olmadığını görmek için ana çalışma verileri kontrol edilmiştir. Hata düzeltme, eksik değerler, tek değişkenli ve çok değişkenli aykırı değerler ve normallik incelenerek tüm veri setlerinin doğruluğu için veri tarama işlemi uygulandıktan sonra 382 veri ile analizlerin devam etmesine karar verilmiştir.

Ana Çalışma Analiz Yöntemleri

Bu çalışmada nicel ve nitel veri analizleri kullanılmıştır. Nicel araştırma kısmında veri analizi için geliştirilen SPSS programı kullanılacaktır. Ölçeklerden elde edilen veriler parametrik (İki Yönlü ANOVA, Korelasyon) veya parametrik olmayan teknikler yardımıyla analiz edilmiştir.

Nicel veri analizine ek olarak, okul öncesi öğretmenlerinin 21. yüzyıl becerileri ve eğitimde teknoloji kullanımı ile ilgili aldıkları bir ders veya eğitim hakkındaki cevaplarını analiz etmek için içerik analizi uygulanmıştır. Bu çalışmada öğretmenlerin 21. yüzyıl becerilerine yönelik aldıkları eğitim ile ilgili verdikleri cevaplar araştırmacı tarafından 21. yüzyıl becerilerinin alt faktörlerine göre kategorize edilmiştir. Ayrıca araştırmacı, öğretmenlerin eğitimde teknoloji kullanımına yönelik aldığı eğitime ilişkin yanıtlarını dört gruba ayırmıştır (Dijital farkındalık, Kodlama, Uzaktan eğitim ve Temel teknolojik bilgiler).

İçerik analizinin güvenirliği test etmek için açık uçlu sorulara verilen cevaplar iki araştırmacı tarafından değerlendirilmiştir. Araştırmacılar yanıtları kodladıktan sonra, kodlar arası güvenirliği hesaplamak için “ReCal” websitesi kullanılmış ve yüzdelik uyuşma ve Cohen'in kappa indeksleri hesaplanmıştır (Freelon, 2010). 21. yüzyıl becerilerine ilişkin eğitimlerle ilgili anlaşma yüzdesi %86,4 ve Cohen'in kappa değeri 0.796'dir.

Ayrıca, eğitimde teknoloji kullanımına ilişkin eğitimlerle ilgili anlaşma yüzdesi %93,1 iken Cohen'in kappa değeri 0,906'dır. Lombard, Snyder-Duch ve Bracken (2017) katsayı puanının .80'den yüksek olması durumunda genel olarak kabul edilebilir olduğunu vurgulamıştır ama .70 de bazı keşif çalışmaları için uygun kabul edilebilir. Bu durum göz önünde bulundurularak bu çalışmada kodlar arası güvenirlik sağlanmıştır.

BULGULAR

Araştırma Sonuçları

Öncelikle ana çalışmanın varsayımları test edilmiştir. Varsayımların sonucuna göre veri analizlerinde parametrik veya parametrik olmayan yöntemler kullanılmıştır. Öğretmenlerin çoğu 21. yüzyıl becerileri veya teknolojisi ile ilgili herhangi bir eğitime katılmadıklarını belirtmişlerdir. Her bir ölçekten alınan puanlar incelendiğinde, çoğu katılımcının kendi 21. yüzyıl becerilerini ve teknolojik pedagojik alan bilgilerini alınabilecek en yüksek puanlarına yakın olarak değerlendirdiği görülmüştür.

Birinci Araştırma Sorusunun Analiz Sonuçları

Öğretmenlerin 21. yüzyıl becerileri toplam puanlarındaki yaş ve deneyime göre farklılıkları araştırmak için iki yönlü ANOVA yapılmıştır. Katılımcılar yaşlarına göre üç gruba (Grup 1: <30, Grup 2: 31-40, Grup 3: 41>) ve deneyimlerine göre üç gruba (Grup a: 0-3, Grup b: 4-7 ve Grup c: 8+) ayrılmıştır. Yaş ve deneyim arasındaki etkileşim etkisi, $p < .05$ düzeyinde istatistiksel olarak anlamlı değildir: [$F (3, 374) = 1.088$, $p=.354$]. Ayrıca, yaşın ana etkisi $p < .05$ düzeyinde anlamlı değildir: [$F (2, 374) = .279$, $p=.757$]. Öğretmenlerin deneyimi incelendiğinde de $p < .05$ düzeyinde istatistiksel olarak anlamlı bir ana etki bulunmamıştır: [$F (2, 374) = .399$, $p=.671$]. Bu sonuçlara göre 30 yaş ve altı (Ort.=183.91, SS= 15.72), 31-40 yaş (Ort=184.30, SS= 15.656) ve 41 yaş ve üstü (Ort=180.68, SS= 16.423) için puan ortalamaları birbirinden önemli ölçüde farklı değildir. Ayrıca 0-3 yıl deneyim (Ort=181.94, SS= 15.26), 4-7 yıl deneyim (Ort=184.51, SS= 17.46) ve 8+ yıl deneyim (Ort=183.18, SS= 15.63) birbirinden önemli ölçüde farklı değildir.

Öğretmenlerin eğitim düzeyi ve 21 yüzyıl becerileri üzerine aldıkları eğitimlerin toplam 21. yüzyıl becerilerinde farklılıklara etkisini araştırmak için iki yönlü ANOVA yapılmıştır. Katılımcılar, eğitim düzeylerine göre üç gruba (Grup 1: Önlisans, Grup 2: Lisans ve Grup 3: Yüksek Lisans) ve 21. yüzyıl becerileri ile ilgili herhangi bir eğitime katılıp katılmadıklarına göre iki gruba ayrılmıştır. Eğitim düzeyi ile eğitime katılımları arasındaki etkileşim etkisi, $p < .05$ düzeyinde istatistiksel olarak anlamlı değildir: [F

(2, 376) = .055, p=.946]. Ayrıca eğitim düzeyinin ana etkisi p < .05 düzeyinde anlamlı bulunmamışdır: [F (2, 376) = 1.914, p=.149]. Ancak, eğitime katılım için p < .05 düzeyinde istatistiksel olarak anlamlı bir ana etki görülmüştür: [F (1, 376) = 5.684, p=.018, $\eta p2$ =.015]. Bu sonuçlara göre önlisans (Ort.=187.75, SS= 14.86), lisans (Ort.=182.28, SS= 16.17) ve yüksek lisans (Ort.=184.79, SS= 14.76) puan ortalamalarında önemli bir değişim yoktur. Öte yandan, Tukey HSD testi kullanılarak yapılan post-hoc karşılaştırmasında, 21. yüzyıl becerileri ile ilgili herhangi bir eğitime katılmayan öğretmenler (M= 181.365 SS= 15.995) ile 21. yüzyıl becerileri ile ilgili eğitim alan öğretmenler (M= 187.047, SS= 15.080) arasında anlamlı bir fark olduğunu göstermiştir.

İkinci Araştırma Sorusunun Analiz Sonuçları

Öğretmenlerin yaş ve deneyimlerine göre toplam TPAB puanlarındaki farklılıkları araştırmak için iki yönlü ANOVA yapılmıştır. Katılımcılar yaşlarına göre üç gruba (Grup 1: <30, Grup 2: 31-40, Grup 3: 41>) ve deneyimlerine göre üç gruba (Grup a: 0-3, Grup b: 4-7 ve Grup c: 8+) ayrılmıştır. Levene testi incelendiğinde anlamlılık değerinin (.008) .05'ten küçük olduğu görülmüş ve varyansların homojenliğini ihlal edilmiştir. Bu nedenle, bu analiz için yeni p değeri .01 olarak belirlenmiştir. Yaş ve deneyim arasındaki etkileşim etkisi, p < .01 düzeyinde istatistiksel olarak anlamlı değildir: [F (3, 374) = 1.190, p=.313]. Ayrıca, yaşın ana etkisi p < .01 düzeyinde anlamlı değildir: [F (2, 374) = .156, p=.856]. Deneyim için de p < .01 düzeyinde istatistiksel olarak anlamlı bir ana etki yoktur: [F (2, 374) = .792, p=.454]. Analiz sonuçlarına göre 30 yaş ve altı (Ort.=230.96, SS= 21.56), 31-40 yaş (Ort=227.42, SS= 23.867) ve 41 yaş ve üstü (Ort= 221.15, SS= 25.742) birbirinden anlamlı farklılık göstermemiştir. Ayrıca, 0-3 yıllık deneyim (Ort.=231.15, SS= 19.572), 4-7 yıllık deneyim (Ort=228.90, SS= 26.625) ve 8+ yıllık deneyim (Ort.=225.61, SS= = 23.841) için ortalama puanlar birbirinden önemli ölçüde farklı değildir. Analiz, yaş gruplarının p-değerinin .01'den büyük olduğunu gösterse de Tukey HSD testi kullanılarak yapılan post-hoc karşılaştırması, .01 düzeyinde genç ve yaşlı öğretmenler arasında anlamlı bir fark olduğunu göstermiştir. 30 yaş ve altı öğretmenlerin puanları, 41 yaş ve üstü öğretmenlerin puanlarından anlamlı düzeyde (9.80) daha yüksektir.

Öğretmenlerin eğitim düzeyi ve teknolojinin eğitimde kullanılması ile ilgili eğitimlere katılım açısından toplam TPAB puanlarındaki farklılıkları araştırmak için iki yönlü ANOVA yapılmıştır. Katılımcılar eğitim seviyelerine göre üç gruba (Grup 1: Önlisans, Grup 2: Lisans ve Grup 3: Yüksek Lisans) ve eğitimde teknoloji kullanımı ile ilgili herhangi bir eğitime katılmış ve katılmamış öğretmenler olarak iki gruba ayrılmıştır. Eğitim düzeyi ile teknolojinin eğitimde kullanılması ile ilgili eğitimlere katılım arasındaki etkileşim etkisi, $p < .05$ düzeyinde istatistiksel olarak anlamlı değildir: [$F(2, 376) = .179$, $p=.837$]. Ayrıca eğitim düzeyinin ana etkisi $p < .05$ düzeyinde anlamlı değildir: [$F(2, 376) = 2.186$, $p=.114$]. Teknoloji ile ilgili eğitime katılım için $p < .05$ düzeyinde istatistiksel olarak anlamlı bir ana etki yoktur: [$F(1, 376) = .998$, $p=.318$]. Bu sonuçlara göre önlisans (Ort.=231.43, SS= 25.29), lisans derecesi (Ort.=225.52, SS= 24.04) ve yüksek lisans derecesi (Ort.=231.13, SS= 21.09) için birbirinden önemli ölçüde farklı değildir. Ayrıca eğitimde teknoloji kullanımı ile ilgili herhangi bir eğitime katılmayan öğretmenler (Ort.= 225.61 SS= 23.285) ile eğitimde teknoloji kullanımı konusunda eğitim alan öğretmenlerin (Ort.= 228.61, SS= 24.553) puanları arasında anlamlı bir farklılık bulunmamıştır.

Üçüncü Araştırma Sorusunun Analiz Sonuçları

21. yüzyıl becerileri ile TPAB puanı arasındaki ilişki Spearman Korelasyonu kullanılarak araştırılmıştır. Normallik, doğrusallık ve homoskedastisite varsayımlarının ihlal edilmediğinden emin olmak için ön analiz yapılmıştır. Ancak, homoskedastisite de bir ihlal tespit edilmiştir. Bu nedenle analizde parametrik olmayan yöntem kullanılmıştır. Analizin sonucu, iki değişken arasında büyük pozitif korelasyon olduğunu göstermiştir, rho=.753, N=382, $p <.01$ (iki yönlü hipotez). Yüksek 21. yüzyıl becerileri, yüksek TPAB puanı ile ilişkilendirilmiştir. 21. yüzyıl becerileri, okul öncesi öğretmenlerinin toplam TPAB puanındaki varyansın yaklaşık %56,70'ini açıklamaya yardımcı olmaktadır.

Öğrenme ve Yenilik Becerileri ile TPAB puanı arasındaki ilişki Spearman Korelasyonu kullanılarak araştırılmıştır. Normallik, doğrusallık ve homoskedastisite varsayımlarının ihlal edilmediğinden emin olmak için ön analiz yapılmıştır. Ancak, homoskedastisite de bir ihlal tespit edilmiştir. Bu nedenle analizde parametrik

olmayan yöntem kullanılmıştır. Analizin sonucu, iki değişken arasında büyük pozitif korelasyon olduğunu göstermiştir, rho=.654, N=382, p <.01 (iki yönlü hipotez). Yüksek seviyedeki Öğrenme ve Yenilik Becerilerinin, yüksek TPAB puanı ile ilişkilendirilmiştir. Öğrenme ve Yenilik Becerileri, eğitimcilerin TPAB puanındaki varyansın yaklaşık %42,77'sini açıklamaya yardımcı olmuştur.

Kariyer ve Yaşam Becerileri ile TPAB puanı arasındaki ilişki Spearman Sıra Korelasyonu kullanılarak araştırılmıştır. Normallik, doğrusallık ve homoskedastisite varsayımlarının ihlal edilmediğinden emin olmak için ön analiz yapılmıştır. Ancak, homoskedastisite de bir ihlal tespit edilmiştir. Bu nedenle analizde parametrik olmayan yöntem kullanılmıştır. Analizin sonucu, iki değişken arasında büyük pozitif korelasyon olduğunu göstermiştir, rho=.641, N=382, p <.01 (iki yönlü hipotez). Yüksek Yaşam ve Kariyer Becerileri, yüksek TPAB puanı ile ilişkilendirilmiştir. Yaşam ve Kariyer Becerisi, öğretmenlerin TPAB puanındaki varyansın yaklaşık %41.09'unu açıklamaya yardımcı olmuştur.

Bilgi, Medya ve Teknoloji Becerileri ile TPAB puanı arasındaki ilişki Pearson Korelasyon Katsayısı kullanılarak gösterilmiştir. Normallik, doğrusallık ve homoskedastisitenin ihlal edilmediğinden emin olmak için ön analiz yapılmıştır. Analizin sonucu, iki değişken arasında büyük bir pozitif korelasyon olduğunu göstermiştir, r=.694, N=382, p <.01 (iki yönlü hipotez). Yüksek Bilgi, Medya ve Teknoloji Becerileri, yüksek TPAB puanı ile ilişkilendirilmiştir. Bilgi, Medya ve Teknoloji Becerileri, öğretmenlerin TPAB puanındaki varyansın yaklaşık %48,16'sını açıklamaya yardımcı olmuştur.

TARTIŞMA

Çalışmanın ilk araştırma sorusu, okul öncesi öğretmenlerinin 21. yüzyıl becerileriyle ilgilidir. Öğretmenlerin 21. yüzyıl becerileri yaş, deneyim, eğitim düzeyi ve 21. yüzyıl becerilerine ilişkin eğitime katılımları açısından incelenmiştir. Analiz için iki yönlü ANOVA kullanılmıştır. Bulgular, yaş, deneyim ve eğitim düzeyi açısından 21. yüzyıl becerileri puanlarında istatistiksel olarak anlamlı bir fark olmadığını göstermiştir. Ayrıca, yaş ile deneyim veya eğitim düzeyi ile eğitime katılım arasında herhangi bir

etkileşim etkisi bulunmamıştır. İstatistiksel olarak anlamlı tek fark, 21. yüzyıl becerileri konusunda eğitim almış öğretmenler ile 21. yüzyıl becerileri konusunda herhangi bir eğitime katılmamış öğretmenler arasında tespit edilmiştir.

21. yüzyıl becerileri ile ilgili herhangi bir eğitim alan öğretmenlerin puanları, 21. yüzyıl becerileri ile ilgili herhangi bir eğitime katılmayan öğretmenlerin puanlarından istatistiksel olarak daha yüksek çıkmıştır. Öğrenme ve Yenilik Becerileri (%37.34), Bilgi, Medya ve Teknoloji Becerileri (%31.65), Yaşam ve Kariyer Becerileri (%31.01) ile ilgili alınan derslerin okul öncesi eğitimcilerin 21. Yüzyıl becerilerinde etkili olduğu görülmüştür. STEM eğitimi, Lego eğitimi, Fatih projesi, hikâye anlatımı, drama gibi eğitimlerin çoğu çocuklara kaliteli bir eğitim vermek ve öğretmenlerin eğitim bilgilerini artırmaya yönelik olsa da İşaret dili kursu, kültürel duyarlılık ve yansıtıcı düşünme gibi doğrudan öğretmenlerin kişisel gelişimi için tasarlanmış birkaç kursta öğretmenlerin katıldığını belirttiği eğitimler arasında yer almaktadır. Böylece öğretmenlerin kişisel ve akademik gelişimleri için tasarlanan her iki kursun da onların 21. yüzyıl becerilerini geliştirmelerine yardımcı olduğu ortaya çıkmıştır.

İkinci araştırma sorusu okul öncesi öğretmenlerin TPAB düzeyi ile ilgilidir. Öğretmenlerin TPAB düzeyleri yaş, deneyim, eğitim durumu, teknolojinin eğitimde kullanılması ile ilgili kurs veya hizmet içi eğitim alıp almadıklarına göre incelenmiştir. Analiz için iki yönlü ANOVA kullanılmıştır. Bulgular, yaş, deneyim, eğitim düzeyi ve teknolojiyle ilgili eğitim alınması açısından toplam TPAB puanlarında istatistiksel olarak anlamlı bir farklılık olmadığını göstermiştir. Ayrıca, yaş ile deneyim veya eğitim düzeyi ile eğitime katılım arasında herhangi bir etkileşim etkisi bulunmamıştır. İki yönlü ANOVA'da yaş grupları arasında istatistiksel olarak anlamlı bir fark olmamasına rağmen, post-hoc analizi 30 yaş ve altı öğretmenler ile 41 yaş ve üstü öğretmenler arasında istatistiksel olarak anlamlı bir fark olduğunu göstermiştir. 30 yaş ve altı öğretmenlerin puanları, 41 yaş ve üstü öğretmenlerden önemli düzeyde (9.80) daha yüksektir.

Üçüncü araştırma sorusu, okul öncesi öğretmenlerinin 21. yüzyıl becerileri ile toplam TPAB puanı arasındaki ilişkisi ile ilgilidir. İki değişken arasındaki Pearson Korelasyon Katsayısı (r) veya Spearman Korelasyonu (rho) kullanılarak

araştırılmıştır. Analiz genel olarak 21. yüzyıl becerilerinin ve 21. yüzyıl becerilerinin tüm alt faktörlerinin (Öğrenme ve Yenilik Becerileri; Yaşam ve Kariyer Becerileri; Bilgi, Medya ve Teknoloji Becerileri) TPACK ile büyük oranda pozitif bir ilişkiye sahip olduğunu göstermiştir.

Tüm bu bulgular dikkate alındığında, okul öncesi öğretmenlerinin 21. yüzyıl becerilerinin bir alt faktörünün veya genelinin geliştirmeye teşvik edilmesinin TPAB düzeylerinin yükselmesine yardımcı olacağı ifade edilebilir. TPAB'daki varyansı hangi alt faktörlerin daha fazla açıkladığı incelenerek, Bilgi, Medya ve Teknoloji Becerilerinin (%48.16), Öğrenme ve Yenilik Becerilerinin (%42.77) ve ardından Yaşam ve Kariyer Becerilerinin (%41.09) artırılmasının TPAB'in artmasına yardımcı olabileceği görülmüştür. Dolayısıyla öğretmenlerin 21. Yüzyıl Becerileri (%56.70) desteklenirse TPAB düzeyleri de yükselmektedir. Öte yandan, öğretmenlerin TPAB düzeyi çeşitli eğitimlerle veya başka etkinliklerle desteklenirse 21. yy. becerileri farklı düzeylerde geliştirilebilir.

Hem 21. yüzyıl becerileri hem de öğretmenlerin TPAB'si, çocukları gelecekteki karmaşık yaşam koşullarına hazırlamak için önemlidir (AACTE & P21, 2010; Valtonen ve diğerleri, 2017; Mtebe & Raphael, 2018). Bu araştırmada bu iki değişkenin aralarındaki bağlantının daha net görülmesiyle, okul öncesi öğretmenlerinin daha yetkin bireyler olabilmeleri için aralarındaki ilişkiden yararlanılarak desteklenebilirler. Böylece onlarda öğrencilerinin 21. yüzyılın karmaşık ihtiyaçlarına hazırlıklı olmalarına yardımcı olabilirler.

Çalışmanın Sınırları

Araştırma, bulgularının değerlendirilmesi sürecinde dikkate alınması gereken bazı sınırlılıklara sahiptir.

- Bu çalışmanın katılımcıları, 2021-2022 eğitim öğretim yılında Ankara, İstanbul ve İzmir'de görev yapmakta olan okul öncesi öğretmenleri ile sınırlıdır.
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YAZARIN / AUTHOR

Soyadı / Surname : Cangül
Adı / Name : Hilal Asena
Bölümü / Department : Temel Eğitim, Okul Öncesi Eğitimi / Early Childhood Education

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