


Preschool Teachers' Use of Technology in Instructional Environments and their Opinions on Technological Pedagogical Content Knowledge (TPACK)

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Abstract

In the early childhood period, when the foundations of children's academic success are laid the integration of technology in the teaching process and in connection with these educational competencies are of great importance. In the digital age where education cannot be separated from technology, preschool teachers need appropriate pedagogical approaches that will bring the subject area together with technology. In this case, the TPACK (Technological Pedagogical Content Knowledge) model which is a guiding model for teachers comes to the fore. The aim of this study is to reveal the use of technology by preschool teachers and their use of technology in the teaching process and to try to determine the perceptions of preschool teachers about their TPACK competencies in the context of various factors. The participants of the study consist of 14 preschool teachers working in a kindergarden in Gaziantep. As a data collection tool, a semi-structured interview form created by the researchers was used and the data were tried to be interpreted with content and descriptive analysis methods. As a result of the study, the current situation of preschool teachers regarding the use of technology was revealed with detailed descriptive analyzes. In addition, according to the findings obtained because of the content analysis it was determined that the TPACK perceptions of preschool teachers were generally shaped in the dimension of pedagogical content knowledge. Finally, it was concluded that the use of TPACK in the teaching process had many positive effects.

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INTRODUCTION

Today, developing and changing new technologies have not only made our lives easier, but have also led to great changes in all areas of our lives. In the century we live in, simply keeping up with these changes and using existing technologies is not enough to progress both individually and socially. In the millennium age, where a new technological development is likely to change our lives completely, the only way to be among the developed societies is to raise technology literate, productive generations. Considering these, it has become a necessity for countries to change their own policies in order to train qualified manpower that can keep up with the needs of the age. In order to meet this need, education systems that will prepare future generations for the new world conditions should be created (Şimşek, Demir, Bağçeci & Kinay, 2013).

Education has a dominant role in catching development by keeping up with the requirements of the age. Performing this task in the best way depends on making the best use of technology (Şimşek, Özdamar, Becit, Kılıçer, Akbulut & Yıldırım, 2008). The way to benefit from technology in the most effective and efficient way is through the development of the competencies of teachers, who are seen as the preparers and organizers of the teaching process (Aygün, Uzun & Atasoy, 2016). The most important factor that increases the qualifications of teachers is the teacher training process (Azar, 2011). In this context, according to the outstanding new learning model NETP, teachers should be better trained to use technology in innovative ways and new arrangements should be made in teacher training (Lux, 2010). This model reveals that in order for students to use technology well, they need teachers who can use it well (Şimşek, Demir, Bağçeci & Kinay, 2013).

The International Society for Technology in Education (ISTE) defines teachers' qualifications as "being technology literate, using technology in lectures, encouraging students to use technology, arranging the learning environment in such a way that students can access and use technology, cooperating with colleagues through online environments for their professional development and sharing their teaching experience" (ISTE, 2012). Similarly, the Ministry of National Education (2006) has determined some qualifications related to information and communication technologies (MEB, 2006). Considering these, teachers are now expected to have not only field and pedagogical knowledge and competencies, but also technological knowledge and competencies.

There are some misconceptions from the past about integrating technology into education. "Technology integration", which is simply called "using technological tools and equipment in education", is actually "a complex and multidimensional process that requires the consideration of different administrative, educational and theoretical variables" (Yurdakul, 2011). Yalın et al. (2007), on the other hand, define technology integration as "making use of technology in a way that includes education and training environments, education infrastructure and curricula". In order for technology to be successfully integrated into education, it is necessary to have sufficient knowledge of pedagogy, content and technology (Jang & Tsai, 2011).

When the literature is examined, it can be seen that there are some technology integration models and approaches that can effectively and efficiently integrate technology into the education process. These models and approaches have been included in the literature based on the process of integration of technology into education and the elements of this process. It is seen that some of them

deal with the integration of technology in education in the context of school, instructor and socio-cultural context, while others deal with the interaction of the elements in the process with each other. These approaches and models can be listed as follows (Muzman & Usluel, 2011):

- Five-Stage Model for Computer Technology Integration (Toledo, 2005)
- Systemic Planning Model for ICT Integration (Wang & Woo, 2007)
- Generic Model of Pedagogy, Social Interaction and Technology (Wang, 2008)
- E- capacity Model (Vanderlinde & Break, 2010)
- Concentric Circles Model (Tounder, Valcke & Break, 2008)
- 5 W 1 H Unified Integration Model (Haşlaman, Mumcu & Usluel, 2008)
- Activity System Model (Demiraslan & Usluel, 2006)
- Technology Integration Planning Model (Roblyer, 2006)

One of the most up-to-date approaches to the integration of technology into education is the "Technological Pedagogical Content Knowledge (TPACK)" approach, which is the subject of the current study. This approach was put forward by Punya Mishra and Matthew Koehler from in 2006 and was translated into Turkish as "Technopedagogical education (Çoklar, Kılıçer & Odabaşı, 2007) approach" and brought to the literature. Shulman emphasized in 1986 that in educator training, pedagogical and content knowledge should be given at the same time. On the other hand, Koehler and Mishra (2008) presented a model that includes technology knowledge in addition to Shulman's pedagogical and content knowledge (Şimşek, Demir, Bağçeci & Kinay, 2013).

The potential for change that technology has and the powerful changes it creates in classrooms are the biggest factors in adding the technology dimension to this approach. According to this approach, technologies deemed appropriate should be presented in an integrated manner in accordance with the context, content and pedagogy of the course (Mishra & Koehler, 2006; Koehler & Mishra, 2008). The TPACK (Technopedagogical content knowledge) model consists of three basic components: pedagogy, content and technology; and three sub-components consisting of their intersections (Kaya & Yazıcı, 2019). The intersection of all components constitutes technopedagogical content knowledge (Mishra & Koehler, 2006). These basic components can be briefly explained as follows (Koehler & Mishra, 2008; Mishra & Koehler, 2006):

Technological Knowledge: It is the knowledge of using old technologies such as pen, paper, chalk and new technologies such as computer, internet, digital video and video.

Pedagogical Knowledge: It is all kinds of knowledge related to the planning, execution and evaluation of the teaching process.

Content Knowledge: It is the knowledge of the content in which the teaching is carried out.

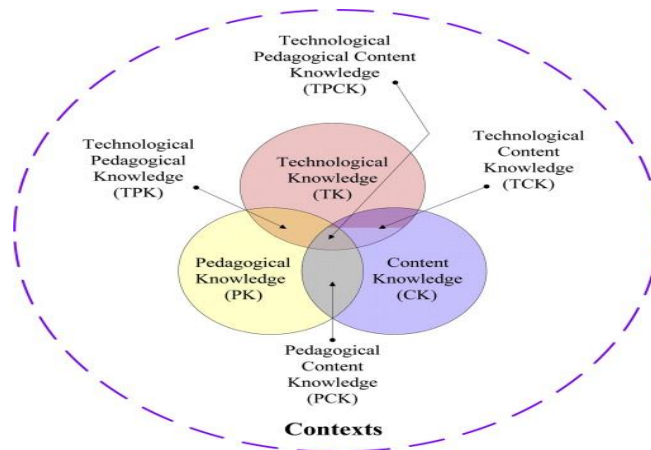
Technological Pedagogical Knowledge: It is a combination of teaching profession knowledge and technological knowledge. In summary, it is the knowledge about which technologies will be used in teaching processes.

Technological Content Knowledge: It is the knowledge that is a combination of technological and content knowledge. In other words, it is the technological knowledge chosen in accordance with the content and students' learning.

Pedagogical Content Knowledge: It is the knowledge that consists of the intersection of pedagogical and content knowledge. In short, it can be defined as the use of teaching methods that are effective in teaching a certain field/content.

Technological Pedagogical Content Knowledge: It is the comprehensive knowledge consisting of a combination of pedagogical, content, and technological knowledge. It is explained as the use of appropriate technologies that will increase the quality of teaching during the planning, execution, and evaluation stages of the process while teaching the subject area (Kabakçı- Yurdakul, Odabaşı, Kılıçer, Çoklar, Birinci & Kurt, 2014). TPACK model is shown in Figure 1.

Figure 1: TPACK Model (Koehler & Mishra, 2008)



TPACK Model (Figure 1) is an integration model based on teachers' competencies. The most comprehensive study on teachers' qualifications and performance indicators in the literature is the study of "Creating Technopedagogical Education Based Teacher Competencies in terms of National Standards" conducted by Kabakçı-Yurdakul et al. In this study, a total of 6 competence areas were determined based on the opinions of the field experts: (1) designing the teaching process, (2) conducting the teaching process, (3) being open to innovations, (4) complying with ethical issues, (5) problem solving, and (6) specializing in the field. Within the framework of these fields, a total of 20 competencies and 120 performance indicators defining these competencies were achieved (Kabakçı-Yurdakul, Odabaşı, Kılıçer, Çoklar, Birinci & Kurt, 2014).

It is seen that the competencies that students should have in the century we live in are: "information and technology literacy, communication, critical thinking, flexibility and adaptability, problem-solving, and cooperation (Partnership for 21st Century Skills, 2009). In order for students to gain these competencies, it has become a necessity to have certain competencies in teachers, who are primarily the organizers, planners and evaluators of instruction. There are many studies on these competencies in the literature. However, it has been found that very few studies have been carried out on the TPACK competencies of preschool teachers, which will have great effects on the child's future life. This situation reveals that the importance of using technology in preschool and the skills that preschool teachers should have in the millennium are not understood well. From this point of view, it is considered necessary to integrate technology into education and increase teachers' competence in this area in order to increase the quality of pre-school education and contribute to all development areas of the child.

Preschool teachers, within the framework of their knowledge and expertise in the field of child development, are in a decision-making role on how, when and why the media will be applied, taking into account the individual interests, needs, readiness and socio-cultural environment of children (Clements & Sarama, 2003). It is a known fact that "Digital natives" (Prensky, 2001) living in the digital age and equipped with digital media such as television, phone, computer, tablet, game console spend a lot of time with technology.

Effective adult guidance is the way to ensure that children spend this time quality and productively and to protect them from possible harms of technology. In education, this task should be carried out by teachers who are competent in this subject in the preschool education period, which is the first step in school. In this period, the adult has a guiding role in careful planning, effective implementation, reflection and evaluation, integrating the most appropriate technologies and media into the classroom environment and integrating them with teaching (Singin & Gökbulut, 2020). Fulfilling this role well enough will increase the motivation and readiness of children by making education fun, while providing permanent learning that will have effects on the academic life of the child.

PURPOSE OF THE RESEARCH

In early childhood education, when the foundations of children's academic success are laid, the integration of technology into the teaching process and, in connection with this, educational competencies are of great importance. In the digital age, where education cannot be considered separately from technology, preschool teachers need appropriate pedagogical approaches that will bring together the content with technology. In this case, the TPACK model is recommended as a guiding model for teachers (Singin & Gökbulut, 2020).

When the literature is examined, many studies on TPACK competencies on teachers at various levels of education have been encountered. However, it has been observed that there are very few studies on early childhood education. In this period when children take their first steps into school life, the lack of studies on the use of technology, which is one of the most important elements that will shape learning, and accordingly the technological competence of teachers, is seen as a major deficiency. In order to eliminate this deficiency, it has been tried to reveal preschool teachers' use of technology in the teaching process and to determine their perceptions of TPACK competencies in the context of various factors. For this purpose, the sub-problems of the research were determined as follows:

1. What are the views of preschool teachers about technological knowledge?
 - What is the level of pre-school teachers' ability to use technology?
 - What is the technology-utilization level of preschool teachers in teaching and learning environments?
 - What are the views of preschool teachers about their ability to prepare visual and auditory materials by using ICT in the teaching process?
 - What is the IT-utilization level of preschool teachers?

2. What are the views of preschool teachers about their TPACK competencies?

3. What are the views of preschool teachers on the contribution of their TPACK competencies to the teaching processes?

4. What are the views of preschool teachers on the relationship between their TPACK competencies and different variables in various aspects?

Different aspects of situations such as teachers' and prospective teachers' use of technology in education, their computer literacy and TPACK competencies have been discussed many times in the literature. However, very few studies have been conducted on the TPACK competencies of preschool teachers. This study will show whether preschool teachers in the digital age include technology in their teaching environments and will reveal the current status of their TPACK competencies and guide what needs to be done to develop these competencies.

METHOD

RESEARCH DESIGN

In the present study, the opinions of preschool teachers about their TPACK competencies were taken. The present study is a phenomenological study, as the data in the research are tried to be understood in depth with comprehensive questions within the framework of the preschool teachers' use of technology in the teaching environment, their technological knowledge and TPACK competencies. Phenomenological studies are studies in which information about phenomena is obtained through the experiences of the participants (Creswell, 2007). Phenomenological studies generally aim to reveal and interpret individual perceptions about a phenomenon (Yıldırım & Şimşek, 2021). In this study, the phenomenon of "preschool teachers' perceptions of their TPACK competencies" has been tried to be examined in detail.

PARTICIPANTS

In the study, snowball sampling method was used as it was tried to determine the views of preschool teachers on their perceptions of TPACK competencies. Being a preschool teacher and using technology in teaching and learning environments were taken into consideration as the main criteria in determining the participants. Therefore, preschool teachers having different years of experience participated in the present study. The characteristics of the teachers who participated in the research are given in Table 1.

Table 1. Demographic Information about the Participant Teachers

<i>Participant s</i>	<i>Gender</i>	<i>Age</i>	<i>Years of experien ce</i>	<i>School they work</i>
T1	Female	29	7	İbni Sina Preschool
T2	Female	34	10	İbni Sina Preschool
T3	Female	29	7	İbni Sina Preschool
T4	Male	27	3	İbni Sina Preschool

T5	Female	39	12	Asuman Mustafa Karakoyunlu Preschool
T6	Female	45	12	Asuman Mustafa Karakoyunlu Preschool
T7	Female	45	14	Asuman Mustafa Karakoyunlu Preschool
T8	Female	41	10	Asuman Mustafa Karakoyunlu Preschool
T9	Male	27	3	İşmont Halil Meziyet Primary School
T10	Female	34	7	İşmont Halil Meziyet Primary School
T11	Female	27	3	İşmont Halil Meziyet Primary School
T12	Female	28	4	Nilüfer Mustafa Özyurt Preschool
T13	Female	31	6	Nilüfer Mustafa Özyurt Preschool
T14	Female	26	3	İbni Sina Preschool

DATA COLLECTION

The interview method was used to determine the TPACK competencies of preschool teachers. In the interview method, in-depth questions are asked about a particular subject, and if the answers are not sufficient or the answers are not clearly stated enough, in-depth information is tried to be obtained by asking questions again. This method is frequently preferred by researchers as it is found to be advantageous in this respect (Çepni, 2009). In the current study, a semi-structured interview form prepared by the researchers was used as a data collection tool.

The advantages of semi-structured interview forms are that they eliminate the limitations in tests and questionnaires and provide flexibility to researchers (Yıldırım & Şimşek, 2021). In the study, 12 questions were determined by the researchers. For the content validity of the questions, a preliminary application was made with three preschool teachers. Then, expert opinion was sought on the questions determined and necessary corrections were made on the questions, taking into account the feedback received from them. The semi-structured interview form was re-examined by 2 experts. After the feedback from the experts, the interview questions took their final form and became ready to be implemented. Teachers participated in the research on a voluntary basis. In order to obtain the personal information of the participants, demographic questions were asked to them.

The interview form was applied to 14 teachers working in four different pre-school institutions in Gaziantep in the spring term of the 2021-2022 Academic Year. Before the interview, the participant teachers were informed about the interview form and what should be considered in answering the questions. The interviews were conducted face-to-face by one of the researchers. The interview started with demographic questions, and then moved on to 12-item interview questions. The interview took approximately 25-45 minutes for each teacher. The interviews were recorded by the researcher with a voice recorder. Permission was obtained from the research participants before recording the audio.

DATA ANALYSIS

In the current study, the data obtained as a result of the interview were analyzed with the content analysis method. In content analysis, similar data are brought together within the framework of certain concepts and themes, and are organized and interpreted in a way that the reader can understand (Yıldırım & Şimşek, 2021). During the data analysis process, the answers given by the participants to the questions in the interview form were recorded and converted into written text. Afterwards, data reduction was made by removing data that could not be an answer to the research problems. The researchers analyzed the raw data obtained from the participants in different time periods and created codes to represent similar data and brought these codes together around common themes.

The researchers used the formula developed by Miles and Huberman (1994) to reveal the consensus in their analysis ($\text{Reliability} = \frac{\text{Consensus}}{\text{Consensus} + \text{Disagreement}}$). As a result of applying this formula, it was revealed that the reliability of agreement among researchers was 0.92. This reliability value found is considered as an acceptable level for scientific studies (Miles & Huberman, 1994). One of the researchers is an expert who teaches qualitative data analysis in the field of Educational Sciences, while the others are graduate students who have taken a qualitative data analysis course. One of the graduate students who took a qualitative data course was included in the study as an independent researcher.

The themes and codes obtained as a result of the analysis made by the researchers are given in detail in the findings section. In addition, the codes obtained in the research were supported by direct quotations. The frequency tables of the codes are given below. During the interview, the participants were identified with codes as T1, T2, T3, T4, etc. In the descriptive analysis part, the obtained data were tried to be presented with appropriate models.

VALIDITY AND RELIABILITY

In order for qualitative research to be valid and reliable, it must have features such as being credible, transferable, consistent and verifiable (Denzin & Lincon, 1994). Investigator triangulation was used to ensure the credibility of the study. In investigator triangulation, data is collected, analyzed and interpreted by more than one investigator (Yıldırım & Şimşek, 2021). During the evaluation of the data in the study, the opinions of different researchers were consulted. Participants were selected from among volunteer teachers in order to increase the reliability of the research. In the dimension of the verifiability of the research, the data were recorded in writing and arranged in a way that would enable re-examination. In order to ensure the validity of the research, it was stated that the researchers should pay attention to be free from their prejudices. At the same time, validity-enhancing techniques such as investigator triangulation were used.

RESULTS

In this part of the research, the findings obtained from the preschool teachers' use of technology in the teaching process and their views on their TPACK competencies are presented together with the themes created. The findings obtained in the descriptive analysis dimension of the study were presented with graphics and maps, with the aim of making the findings more understandable by the readers. The topics covered in the descriptive analysis are as follows:

1) the level of preschool teachers' ability to use technology, 2) the technology-utilization level of preschool teachers in teaching and learning environments, 3) The technological tools that preschool teachers consider necessary and currently use in teaching environments, 4) Preschool teachers' perceptions of their ability to prepare audio and visual materials using their TPACK competencies, 5) Preschool teachers' perceptions of the effect of various variables (Gender - years of experience) on their TPACK competencies, 6) Preschool teachers' perceptions of the relationship between their TPACK competencies and personal innovativeness and professional self-efficacy, 7) Preschool teachers' perceptions of their TPACK competencies in different contexts.

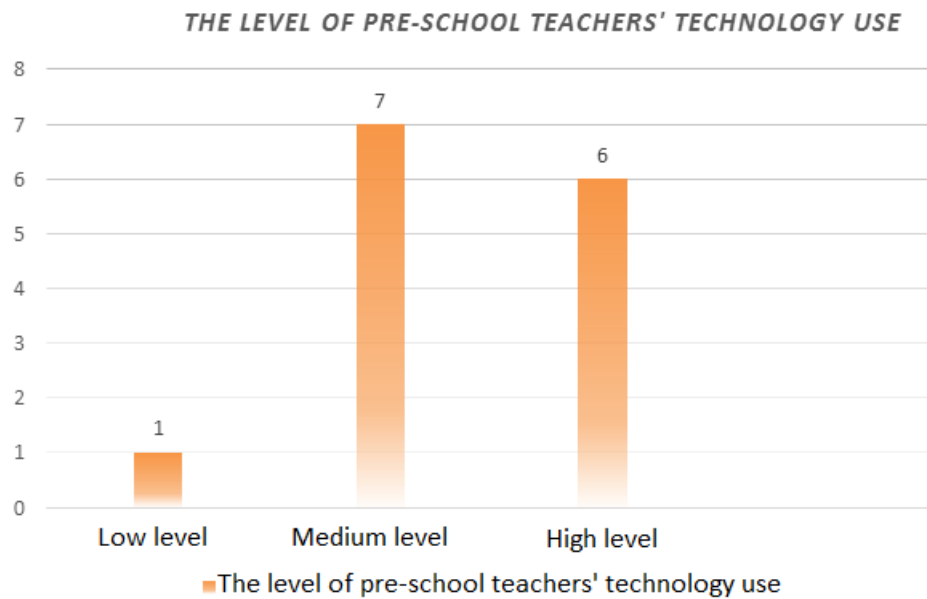
The data obtained during the research process were discussed under 2 themes as a result of content analysis. These themes are as follows: 1) Preschool teachers' definitions, meanings, and perceptions of technopedagogical content knowledge, 2) Preschool teachers' perceptions of the effect of Technopedagogical Content Knowledge (TPACK) on the teaching process. The findings obtained within the scope of the research are presented in detail under the titles of descriptive analysis and content analysis.

RESULTS OF DESCRIPTIVE ANALYSIS

In this part of the current study, interpretations of preschool teachers' use of technology in the teaching process and their TPACK competencies in various aspects and their relations with different variables are discussed. Accordingly, the answers given to the interview questions suitable for descriptive analysis were modeled with the Canva (2022) program in order to increase clarity. The analysis was examined in detail under the following headings:

1) the level of preschool teachers' ability to use technology, 2) the technology-utilization level of preschool teachers in teaching and learning environments, 3) The technological tools that preschool teachers consider necessary and currently use in teaching environments, 4) Preschool teachers' perceptions of their ability to prepare audio and visual materials using their TPACK competencies, 5) Preschool teachers' perceptions of the effect of various variables (Gender - years of experience) on their TPACK competencies, 6) Preschool teachers' perceptions of the relationship between their TPACK competencies and personal innovativeness and professional self-efficacy, 7) Preschool teachers' perceptions of their TPACK competencies in different contexts.

Figure 2: *The Level of Pre-School Teachers' Ability to Use Technology*



As may be understood from Figure 2, the majority of preschool teachers stated that they perceive that they benefit from technology at a moderate level. Considering the comments of these teachers, it was concluded that they had difficulty in following the developing technology because it was developing rapidly and that they could not see their level as sufficient because they were constantly trying to improve themselves. The opinions of some teachers who perceive themselves as moderate in using technology are as follows:

T6: *"In my opinion, the level of technology use cannot be determined, because technology is constantly developing and changing, using technology is related to how much you want to improve yourself. I really want to improve myself. In other words, when you say that you use technology at the highest level, it is understood that you are not like that. Did I say "enough" to the answer to every question? I didn't say, I can't say, and when I say that, I think that my curiosity is over, but I'm trying to discover everything. If you want me to tell you a level, I can say "medium level", I can say that I can use technology when I need it."*

Six of the pre-school teachers participating in the research describe themselves as having a high level of using technology. All of the teachers who think that they use technology at a high level stated that they use technology almost every day, and they also said that they follow technology closely and try to keep up with it. The opinions of some teachers who say that they are at a high level of using technology are as follows:

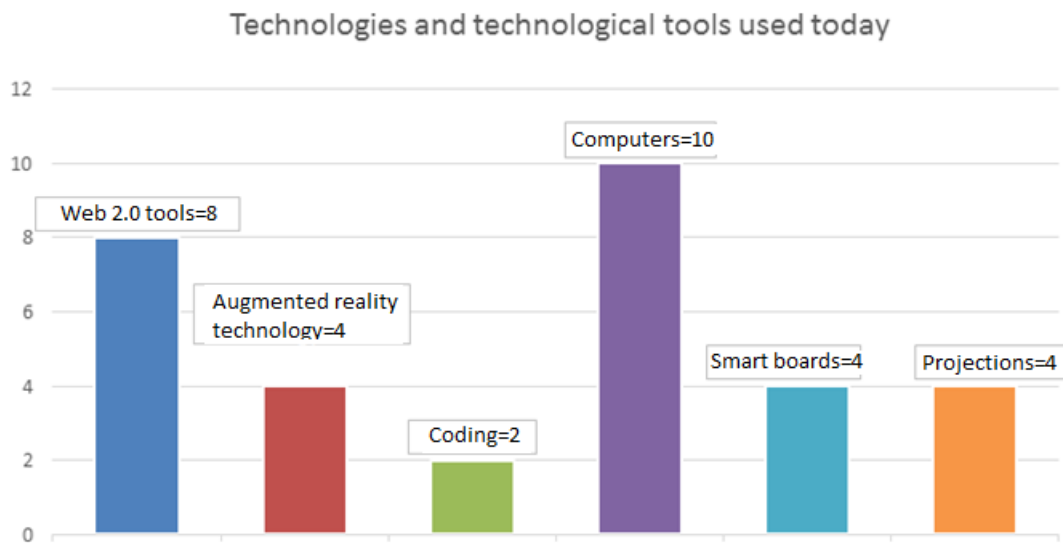
T4: *"I think I use technology at a high level. I use technologies such as computers, tablets, phones. I try to use technology by especially adapting to children so that they can learn more efficiently. And I think I can use it."*

T13: *"If we evaluate it out of five, I can describe myself as four or four and a half. Technology is an area that has been the focus of my attention since I was little. Currently, it is a field that has become very easy to blend with education and training. So I consider myself sufficient in this regard."*

Finally, only one of the teachers participating in the research considers himself inadequate in making use of technology. He also stated that he has no practical opportunity to use technology as the reason for his low use of technology. The views of the teacher who perceives that they are at a low level in using technology are as follows:

T7: *"I don't use technology enough. It is based on this: we always put it in the background because we do not use it much or we have incomplete information. But if I use technology constantly or gain experience in that field and apply the technology in the classroom, I can use it. But something that I do once in a while doesn't always come easy to me, it's not enough."*

Figure 3: Technologies and technological tools used today



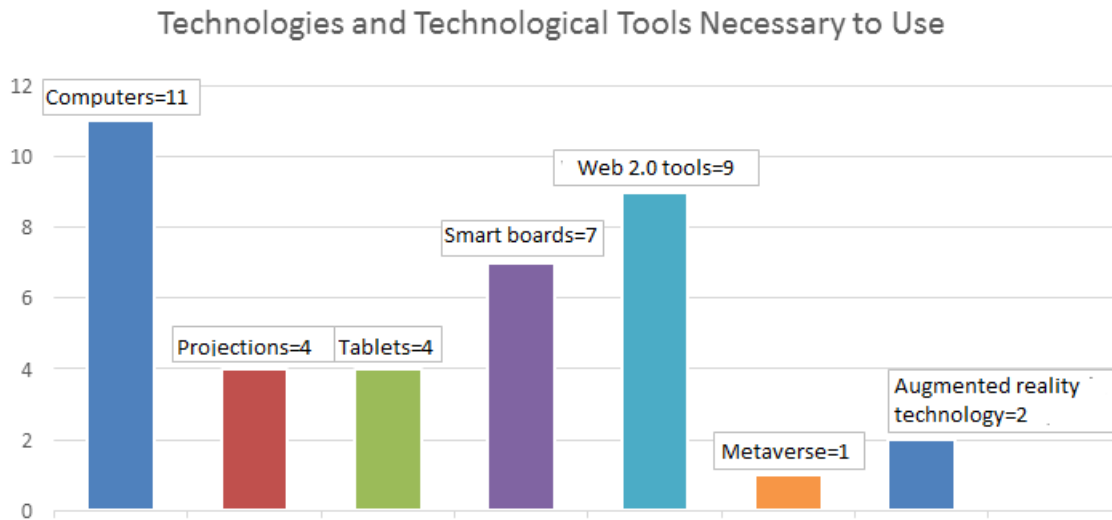
According to Figure 3, the technological tools that preschool teachers currently use in the teaching process are computers (56%), smart boards (22%) and projection devices (22%). On the other hand, the technologies currently used by the participants in the teaching process are Web 2.0 tools (57%), augmented reality technology (29%) and coding (14%). Preschool teachers' views on currently used technological tools and technologies are as follows:

T5: *"We use projectors, computers and phones in our classroom."*

T10: *"I think that the visual and auditory senses of preschool children are very important. In this regard, smart boards provide us a lot of benefits. I use the smart board to embody abstract concepts."*

T4: *"I use "wordpal" from web 2.0 tools. Besides, I use "canva", "wokiie" and "augmented reality" from time to time. I prefer them mostly because they are simple and suitable for children."*

T6: *"I use "Quiver" (augmented reality technology) in the art activity, I use the augmented reality application that shows our body while teaching bones. There are very good augmented reality applications related to the visual of Atatürk and museum visits on certain days and weeks. I use them."*

Figure 4: Technologies and Technological Tools Necessary to Use

In the context of including technological tools in the teaching process, the distribution of technological tools and technologies that preschool teachers consider necessary to be used in learning environments is shown with the help of graphics in Figure 4. As can be seen from the graph, the technologies and technological tools that the participants consider necessary are: Web 2.0 tools (63%), augmented reality technology (14%), metaverse technology (7%), computers (42%), smart boards (27%), projection devices (16%) and tablets (14%). Preschool teachers' views on the technologies and technological tools they deem necessary are as follows:

T2: *“There may be tablets that children can only use in preschool. The teacher can show an activity on the board and the children can do it themselves. The smart board is also very useful for them to participate in activities. I think we can better adapt them to education with Web 2.0 tools and different applications.”*

T13: *“Computer, cinevision, smart board... Especially smart board should definitely be used in the classroom... For example, if there is a smart board suitable for their size, they can use it on their own.”*

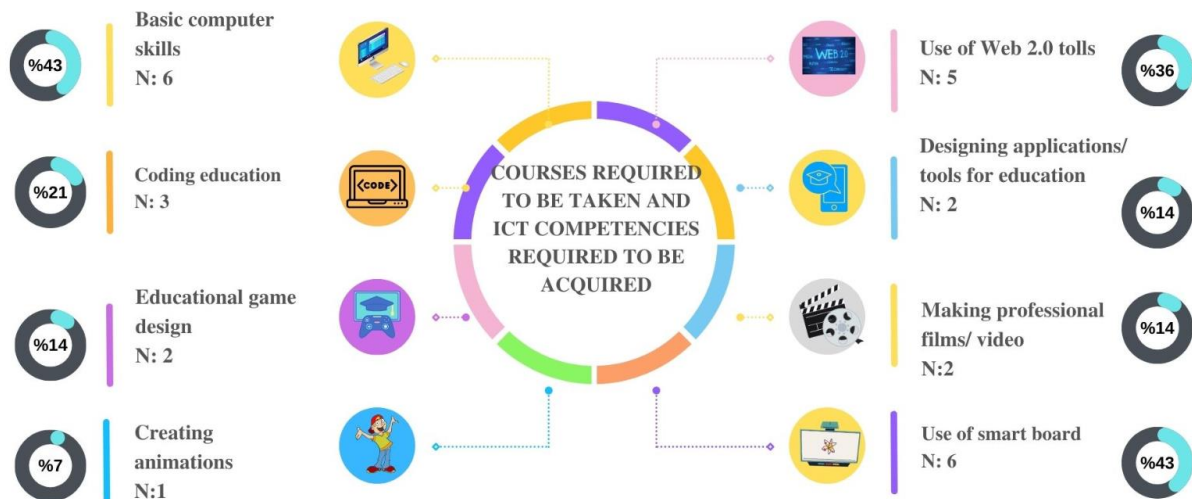
T11: *“It is necessary to use smart boards, computers and projectors that appeal to children more visually and soundly and enable them to understand the subjects more.”*

T4: *“Metaverse is a current issue. We don't know how effective it will be, how useful it will be, but we have to keep up with the millennium.”*

The courses that preschool teachers consider necessary regarding the use of technology in teaching and the ICT competencies they consider necessary are shown in detail in Figure 5. According to the findings obtained from the statements of the participants, the trainings that preschool teachers consider necessary are as follows: Use of Web 2.0 tools (36%) and coding education (21%). In addition, according to the participants, the ICT competencies that preschool teachers should acquire are as

follows: Basic computer skills (43%), smart board usage skills (43%), educational game design skills (14%), professional film-video preparation skills (14%), the ability to design educational applications/ tools (14%), and the ability to create animations (7%).

Figure 5: Courses and ICT competencies that preschool teachers deem necessary regarding the use of technology in teaching



The opinions of preschool teachers about the courses they deem necessary regarding the use of technology in education and the ICT competencies they deem necessary to be acquired are as follows:

T7: "I would like to take a course on Web 2.0 tools. I would like to fully use the computer and know from A to Z."

T3: "I would like to take a course on the use of smart boards. There may also be courses on topics such as computer use or virtual reality. The use of virtual reality in classrooms can be very costly, but there are many activities for children that we can use during the day. We can also take a course on this subject."

T5: "I would like to take a detailed and hands-on course about Web 2.0 tools. All teachers should be able to use basic computer skills, coding and augmented reality."

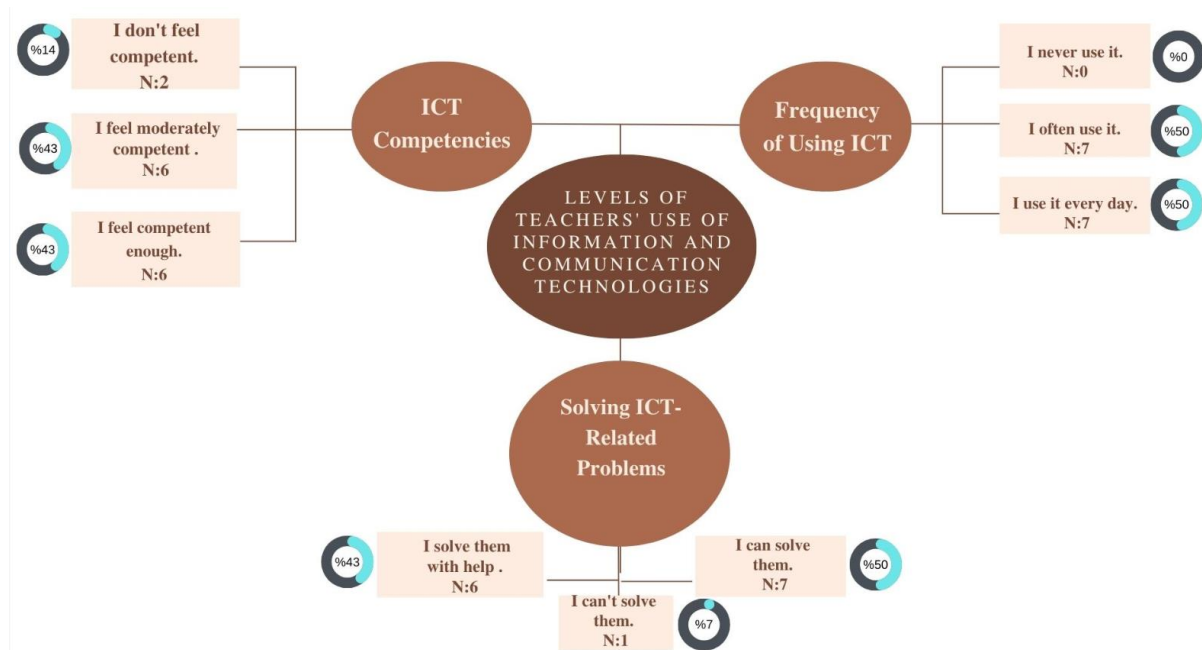
T12: "Teachers should take a course in using the smart board so that they can teach their lessons better."

T8: "Coding training should be taken. Computer use course can be taken."

Preschool teachers' use of ICT in the teaching process is discussed under 3 headings. It can be seen in Figure 6. These are: frequency of use of ICT by the participants, their competencies about ICT and problem solving about ICT. According to the findings regarding the frequency of using ICT, 50% of

the participants stated that they used ICT frequently during the teaching process, while the other 50% stated that they used it every day. There was no teacher among the participants who stated that they would never use ICT.

Figure 6: Levels of preschool teachers' use of ICT in teaching process



The opinions expressed about the frequency of using ICT are as follows:

T6: *"I love projects; I often use ICT in projects. Especially in the early years of school, I use ICT to attract children's attention and increase their love of school. I often use applications that will stop children from crying in those periods. I constantly use ICT in projects, shows, on certain days and weeks, in everything."*

T9: *"I think the computer is efficient because it appeals to both visual and auditory senses of children. That's why I prefer to use it often."*

T3: *"In the daily plans we used this year, it includes the song to be taught for every day, the educational video to watch, the game to play, everything. We even watch the game we are going to play on the video so that it is not missing and we do not play it wrong. That's why we absolutely use information and communication technologies every day."*

Considering the competence perceptions of preschool teachers regarding the use of ICT in the teaching process, it was concluded that 43% of the participants felt competent enough, 43% felt moderately competent, and 14% did not feel competent. The expressions of pre-school teachers regarding their perception of competence about ICT are as follows:

T3: *"I only know the parts that I think will work for me. I mean, I never thought to open the computer, do some research, examine the programs. We had an information technology course at university. In that lesson, they taught us as much as we could use Word programs in general. I wouldn't say I'm good in general. I can say that I can use a computer at an intermediate level. I know enough to be useful to me."*

T8: *"I focused on this issue more since home education was started during the pandemic period. I started to wonder more about applications. I took courses on this. Then I developed myself. I think I'm fine with that."*

T1: *"I think I am very deficient in the use of ICT. Because there is so much we really need to know. I can be better. I find myself inadequate in this regard."*

The last dimension of benefiting from ICT is the problem-solving skills of preschool teachers about ICT. According to the findings, 50% of the participants have the perception that they can solve the problems about ICT, while 43% of them stated that they can solve these problems with help. In addition, 7% of the participants stated that they could not solve the problems about ICT. The statements of the participants regarding their problem solving skills about ICT are as follows:

T7: *"I can't say I'm at a very good level. Now everything has changed a lot, technology has developed a lot. When there is a technical problem, I can never solve it."*

T13: *"When I encounter a technology-related problem, when I can't do something... it's not that hard to research it on the internet and solve it. I can solve this problem with the help of Google, YouTube and dictionaries, thinking that there are people who have experienced this problem before me."*

T4: *"When I encounter any technical problem, I can solve it."*

In this part of the study, comments on the relationship between different variables and various aspects of TPACK competencies of preschool teachers are discussed. Accordingly, the answers given to the interview questions suitable for descriptive analysis were examined in detail under the following headings: 1) Preschool teachers' perceptions of their ability to prepare visual and auditory materials using TPACK competencies, which are a combination of pedagogical knowledge, content knowledge and technological knowledge, 2) Preschool teachers' various perceptions of the effect of variables (gender - years of experience) on TPACK competencies, 3) Preschool teachers' perceptions of the relationship between TPACK competencies and personal innovativeness and professional self-efficacy, 4) Preschool teachers' perceptions of the state of TPACK competencies in different contexts.

Figure 7: Preschool Teachers' Perceptions on Visual and Auditory Material Preparation Skills Using TPACK Competencies



According to the findings obtained from the opinions of pre-school teachers on their ability to prepare audio-visual materials using their TPACK competencies, the participants have the following skills: Making collage-puzzle-poster works (57%), preparing teaching materials (36%), preparing and presenting slides (36%), creating a children's book - voicing it (36%), adding sounds to children's words / creating songs (29%) , making animations- cartoons- videos- games (29%), making cartoons-voicing him (21%) and creating a virtual exhibition (7%). The statements of preschool teachers regarding their ability to prepare audio-visual materials using their TPACK competencies are as follows:

T6: *"I love gamification. I also like to use Web 2.0 tools. We pour our plans into the Minecraft game, children learn while playing the game. I use minecraft to teach numbers, coding, and math. To create a story, we take pictures with the children and create cartoons with them."*

T4: *"I mostly make use of the computer by voicing myself or drawing three-dimensional figures for children in stories that I cannot access from sources. I prepared a book in the form of animation. Because I am a male, I prefer to talk about special topics such as child abuse or self-care skills using "voki"."*

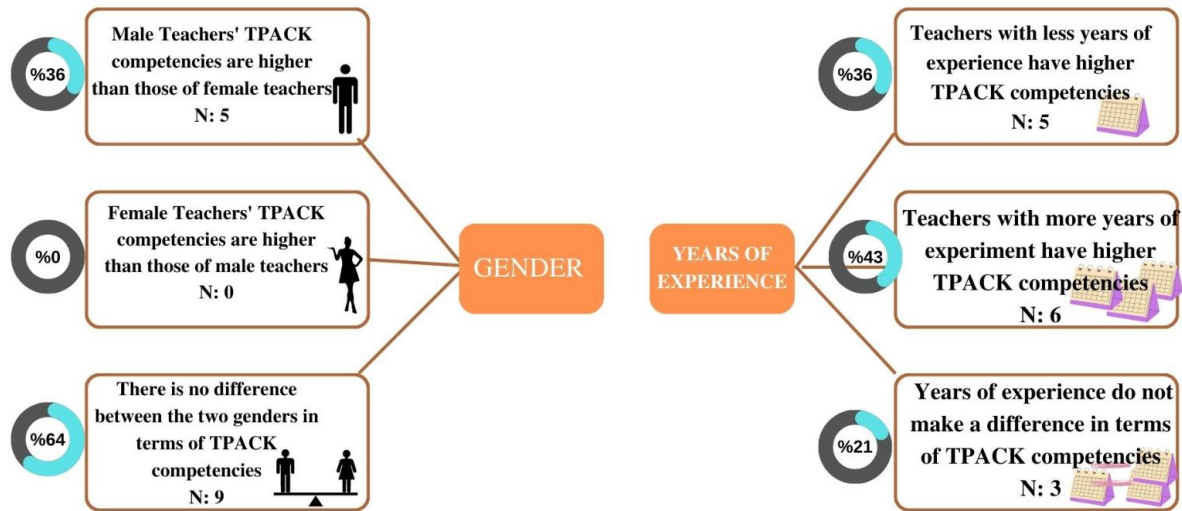
T2: *"As part of a project, we took a picture with the children and turned it into a puzzle in the "Jigsaw" application. We also used book creation apps in our project."*

T3: *"I can take videos and photos of children separately and make video collages and photo collages."*

T1: *"Each child said a sentence on the subject of recycling and we combined these words with the "autorap" program and made a song."*

T13: *"I can prepare materials using information and communication technologies. I have already received trainings on this from EBA (Educational informatics network that schools in Turkey can use). I can prepare materials using sound and visuals by gamifying the concepts."*

Figure 8: Preschool Teachers' Perceptions of the Effect of Various Variables on TPACK Competencies



According to the views of preschool teachers on the effects of different variables on TPACK competencies, the findings were tried to be presented on the basis of gender and years of experience. Accordingly, the data obtained in terms of gender, which is the first dimension of these variables, were gathered around three views. While some of the participants have the perception that male teachers' TPACK competencies are higher than female teachers (36%), the majority of them have the perception that there is no difference (64%) between the two genders in terms of TPACK competencies. From these interviews, no information was obtained regarding the opinion that female teachers' TPACK competencies are higher than male teachers (0%). The statements of preschool teachers about the effect of gender variable on TPACK competencies are as follows:

T2: "Male teachers may be better at using computers than females. As they are better at using computers, they can use them more in education as well. Females also need to do some research. Other than the smart board and the phone, there are those who sometimes have difficulty using even some basic computer programs."

T3: "As male teachers are more interested in computers and computer games, they can be more experienced in this regard. If children will be told something on the smart board or a game will be played on the computer, they may be better than women. Because males are interested, they can be one step ahead."

T8: "I don't think gender has any effect. Those kinds of things are about interest."

T9: "I don't think gender will make a difference in this regard."

T13: "Actually, I don't think gender has much effect. I think the use of technology is more about interest."

T7: "I think it depends on the will of the person, not on the gender, it depends on his/her self-development in the field. I don't think these competencies have anything to do with gender."

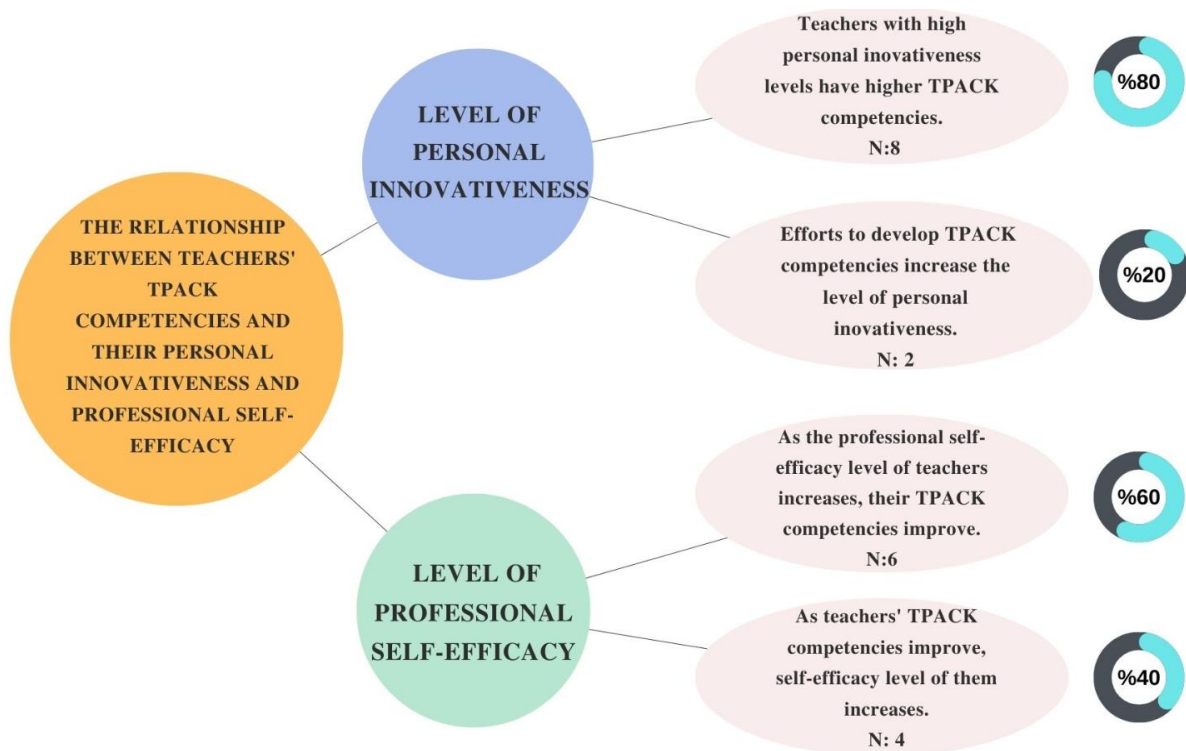
The statements of preschool teachers about the effect of the variable of years of experience on TPACK competencies are as follows:

T9: *“I think that as the years of teachers’ experience increase, their technopedagogical content knowledge competencies also increase. As the years of experience increase, the more you are constantly in the business, the more this increases.”*

T6: *“Teachers’ years of experience affect their TPACK competencies. When you graduate from university, you first try to get to know the class; you try to learn the child and the parent. In the next process, you also activate your TPACK skills by getting to know the class.”*

T10: *“The year of experience is definitely very effective. Because when I compare my early years with my current years, I see a big difference. In other words, I used to be confused about what to do when the sound of the computer was low, but now I think I can solve simple problems. I think that as the years of experience increase, technopedagogical content knowledge proficiency increases as well.”*

Figure 9: Preschool Teachers’ Perceptions of the Relationship between TPACK Competencies and their Personal Innovativeness and Professional Self-Efficacy



One of the aims to be obtained from the questions prepared for descriptive analysis is to reveal the perceptions of preschool teachers about the relationship between their TPACK competencies and their personal innovativeness and professional self-efficacy. Accordingly, the statements about the

relationship between personal innovativeness level and TPACK competencies were gathered around two views. While most of the participants have the perception that if the personal innovativeness level of the teachers is high, their TPACK competencies are high (80%); Those who have the perception that the effort spent to improve their TPACK competencies increase the level of personal innovativeness (20%) also presented a different perspective on the relationship between the two concepts. The statements of preschool teachers regarding the perceptions of the relationship between TPACK competencies and personal innovativeness levels are as follows:

T10: *"I think that if we develop ourselves and be open to innovations with the development of technology, of course, our technopedagogical competence will increase."*

T13: *"I think there is definitely a positive relationship between the two. In any case, keeping up with the world requires being open to innovation. While thinking about what I can add to myself, I also add something to my profession. In other words, there is a positive relationship between being open to innovation and TPACK competencies."*

T14: *"There is definitely a parallel relationship. An innovative teacher is eager to research technological innovations. As TPACK proficiency increases, the innovativeness level of the teacher also increases."*

T5: *"My experience in both pedagogical and technological fields is increasing. I am researching what I see related to technology, I think about how I can apply it to children in my classroom. This increases my innovation."*

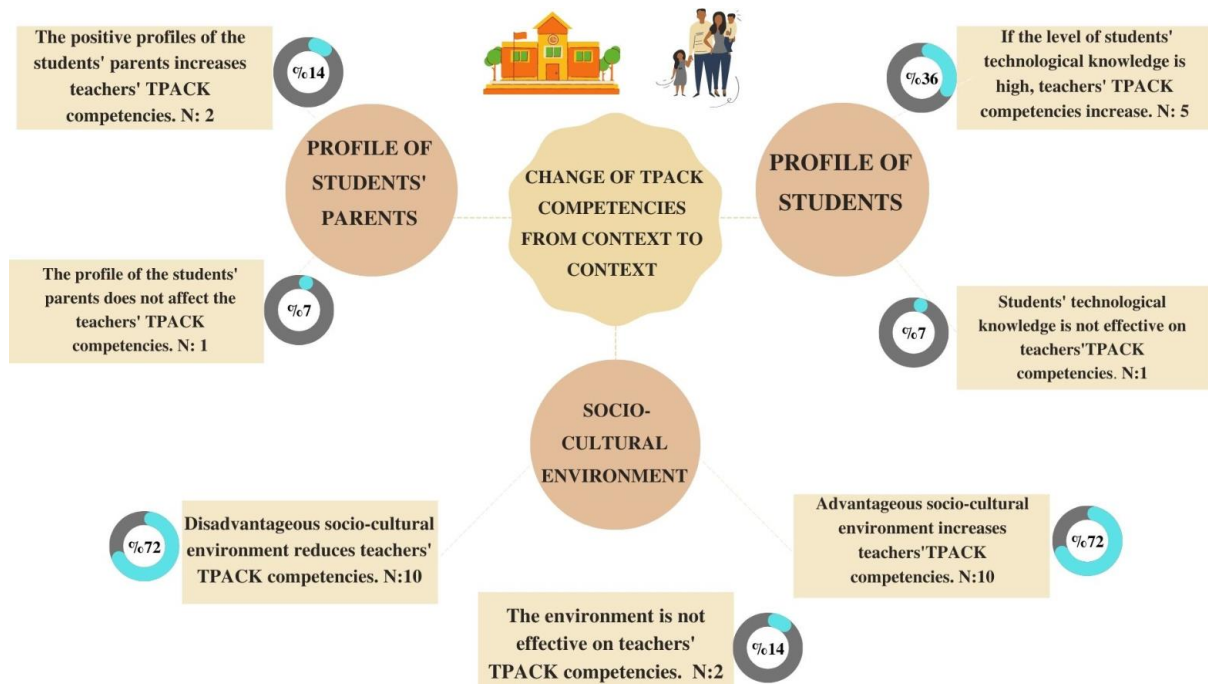
The statements about the relationship between professional self-efficacy and TPACK competencies were gathered around two views. While the majority of the participants stated that the increase in professional self-efficacy will increase their TPACK competencies (60%), the majority of the teachers (40%) think that TPACK competencies will increase their professional self-efficacy. The statements of preschool teachers regarding the perception of the relationship between TPACK competencies and professional self-efficacy are as follows:

T1: *"If a person wants to do different things all the time, to bring different things to the educational environment or to do something that children have not seen before, it is related to professional competence. Thus, the teacher gains more professional satisfaction."*

T12: *"I consider myself sufficient in my profession. I have been a preschool teacher for 8 years. This also increases my technopedagogical competencies."*

T9: *"I think there is a positive correlation between these two. So if one increases, I think the other will increase as well."*

Figure 10: *Preschool Teachers' Perceptions on the Change of TPACK Competencies from Context to Context*



Finally, the perceptions of pre-school teachers regarding the situation of TPACK competencies in different contexts were tried to be discussed in terms of socio-cultural environment, parent profile and student profile. According to the findings obtained from the statements of the participants, the relationship between the sociocultural environment and TPACK competencies was gathered around three views. Majority of the participants have perceptions that the disadvantaged sociocultural environment decreases their TPACK competencies (72%) and the advantageous sociocultural environment increases their TPACK competencies (72%). These findings reveal that the majority of preschool teachers have the perception that there is a positive correlational relationship between the sociocultural environment and the TPACK competencies of the teacher. The statements of preschool teachers about the relationship between the sociocultural environment and their TPACK competencies are as follows:

T14: *"I think that the sociocultural environment affects teachers' TPACK competencies. If the environment offers negative conditions in this regard, teachers also give up their idealism after a while. But if the environment pushes teachers to improve, of course, teachers also take care to develop themselves more and present their knowledge in the classroom environment."*

T4: *"If the socio-cultural environment is positive, it motivates me. It encourages me to learn new things. But if it is negative, it causes me to count and even go backwards at the point where I am. If the environment is positive, it positively affects my technopedagogical content knowledge competencies. If the environment is negative, it affects it negatively."*

T11: *"If the socio-cultural environment is good, expectations are high. Since parents have high expectations, I also improve myself. This will have a positive effect on my technopedagogical competencies."*

Most of the teachers did not express their views on the relationship between the parent profile and the teacher's TPACK competencies. While two of the three teachers who gave their opinions stated that the positive profile of the parents increased their TPACK competencies, only one teacher said that the parent profile did not affect their TPACK competencies. The opinions of these teachers are as follows:

T6: *"If the parent profile is good and the parents use technology, the teachers also advance by putting something on their knowledge. If the parent profile is good, they want the teacher to be the same, they trigger the teacher. Teachers force themselves to improve. This increases teachers' technopedagogical content knowledge competencies. If the parent profile is bad, it decreases the TPACK competencies of the teachers."*

T13: *"The fact that the parents know technology definitely leads to a better place in mutual exchange of education and training. Or, the fact that the parents use technology correctly means that they teach this to their children as well."*

T7: *"I think that the profile of the parents does not affect the TPACK competencies of the teachers. If the teacher is knowledgeable about technology he can present it to the parents."*

The relationship between the student profile and the teacher's TPACK competencies was interpreted by teachers as similar to other contexts. While the majority of the participants have the perception that the technological knowledge of the students increases the TPACK competencies of the teachers (36%), one participant has the perception that the student profile has no effect on the TPACK competencies of the teachers. The statements of preschool teachers about the relationship between student profile and their TPACK competencies are as follows:

T6: *"Students who have been brought up in a good environment and know how to use technology are sometimes better than teachers in this regard. For this reason, students who grew up in a good environment also affect teachers' TPACK knowledge positively. In the disadvantaged environment, I think our level of using technology would be a little lower."*

T1: *"The socio-cultural environment and the presence of students with a high socio-cultural level or parents with a high level of education, of course, positively affect the teaching process."*

T5: *"If the school is in a good neighborhood, sometimes the children in the class are very successful. If you work in a different district, sometimes the child's previous knowledge is insufficient. You set your level accordingly. But you give more to the child who comes socio-culturally equipped, it encourages you as well. In other words, the more developed the socio-cultural environment, the more technopedagogical content knowledge competencies develop."*

RESULTS OF CONTENT ANALYSIS

Preschool teachers' TPACK perceptions and holistic effects of TPACK competencies in the teaching environment are presented below in tables containing themes and codes in accordance with the content analysis.

Table 2. Theme 1: *Definitions and Perceptions of Preschool Teachers on Technopedagogical Content Knowledge*

Categories	Codes	Frequency	Percentage (%)	Quotes
Technological Knowledge (TK)	- Knowledge of technology	2(T11- T12)	14	T12: <i>"I define it as the process of developing oneself with technology."</i>
Technological Pedagogical Knowledge	- The use of technology by blending it with pedagogy in the education process	6(T4-T7-T2-T5-T1-T9)	42	T9: <i>"Synthesizing education and technology, using them together and using technology to make education better."</i>
Technological Content Knowledge	- Use of technology in the content	4(T3-T6-T8-T10)	28	T8: <i>"We are going further by adding technology to our content, I can describe it like this. Because we take things that are only in theory to a higher level by adding technology."</i>
Technological Pedagogical Content Knowledge	-Blending of technological, pedagogical and content knowledge concepts	2(T13- T14)	14	T14: <i>"We can say that it is the adaptation of technological findings to education. We already give pedagogical information to children with our content knowledge, but this is something from the past to the present. In other words, we can say that we have brought technology into our classroom with the introduction of technology into our lives today."</i>
Total		14	100	

As stated in the Table 2, it is seen that preschool teachers have a perception of interpreting the definition of the concept of TPACK by combining the elements that make up this concept in different ways. Participants perceive the concept of Technopedagogical Content Knowledge (TPACK) within the framework of definitions related to the following themes: technological content knowledge (28%), technological pedagogical knowledge (28%), technological pedagogical content knowledge (14%), technology knowledge (14%), and pedagogical knowledge (28%). It is understood from these findings that most of the preschool teachers defined the concept of TPACK as the use of technology in the field. This concept is actually the definition of "technological content knowledge". In addition, 28% of the teachers defined the concept of TPACK as the use of technology with pedagogical knowledge in general. In addition, teachers who define the concept of TPACK as the use of technology knowledge, pedagogical knowledge and content knowledge together constitute only 14% of the majority. Some statements from preschool teachers are given below:

T1: *"It is the combination of both pedagogical and technological knowledge."*

T2: "It is to combine and use technology with activities in the daily plan."

T9: "It means synthesizing education and technology, using them together and using technology to make education better."

T14: "We can say that it is the adaptation of technological findings to education. We already give pedagogical information to children with our field knowledge, but this is something from the past to the present. In other words, we can say that we have brought technology into our classroom with the introduction of technology into our lives today."

T12: "I would define it as the process of developing oneself with technology."

T8: "We are going further by adding technology to our field; I can describe it like this. Because we take things that are only in theory to a higher level by including technology."

Table 3. Theme 2: *Preschool Teachers' Perceptions of the Impact of TPACK, which is a combination of Pedagogical Knowledge, Content Knowledge, and Technology Knowledge, on the Teaching Process*

Categories	Codes	Frequency	Percentage (%)	Quotes
Contributions to the student in terms of cognitive dimension	- Providing permanent and meaningful learning	7 (T1- T3- T5-T6-T7- T12-T14)	50	T1: "...when you support the lesson with various visual materials, the forgetting rate of children decreases even more, that is, using visual materials provides permanent learning."
	- Helping to embody abstract concepts	4 (T7- T10- T13)	28	T13: "This helps us more in teaching abstract concepts."
	- Providing active learning	3 (T7- T12- T13)	21	T12: "While teaching something on the smart board, children learn by explaining it to their friends, by doing and experiencing."
	- Addressing all areas of development	3 (T2- T5- T6)	21	T5: "It attracts children both cognitively and emotionally."
Contributions to the student in terms of affective dimension	- Attracting attention	10 (T1- T2- T3- T4- T5- T6- T7- T8- T9- T13)	70	T13: "When we go beyond traditional activities and use them in lessons, it attracts more attention of children."
	- Increasing interaction	5 (T5- T6- T7- T12- T13)	35	T5: "It allows interaction when used in game and chat."

	- Increasing selfconfidence	2 (T12 - T13)	14	T13: <i>"Children's self-confidence increases because they think they are teaching the teacher something."</i>
	- Increasing curiosity and motivation	2 (T6- T13)	14	T6: <i>"It arouses curiosity. For example, when I give QR codes, children are curious, even their parents are curious."</i>
Contributions to the teachers	- Making the work easier	7 (T4- T5- T7- T8 -T9 -T10 - T13)	50	T13: <i>"It makes our job much easier."</i>
	- Contributing to personal and professional development	6 (T6- T10- T11 - T12 -T13 -T14)	42	T6: <i>"It obliges teachers to keep up with today's technologies and constantly renew themselves."</i>
Contributions to the teaching process	- Making the teaching process fun	3 (T5- T7- T13)	21	T7: <i>"I think they learn faster, they enjoy more, it makes the learning process fun."</i>
	- Ensuring being economical (Time- labor- money)	2 (T3- T11)	14	T3: <i>"If technology is always in the classroom, I don't need to carry concrete materials and spend time while teaching some concepts. In my opinion, it is both time-saving and more economical."</i>
	- Providing visual and auditory diversity- richness	7 (T4- T5- T8- T9- T10- T11- T14)	50	T9: <i>"I think it is more efficient to appeal to both visual and auditory senses of children."</i>

Looking at the Table 3, according to the views of preschool teachers, the effects of using technology knowledge, pedagogical knowledge and content knowledge together in the teaching process can be examined in 4 categories. These can be listed as follows: Contributions to the student in terms of cognitive dimension, contributions to the student in terms of affective dimension, contributions to the teacher and contributions to the teaching process.

According to the opinions of the teachers, the use of TPACK competencies in the teaching process not only provides permanent learning and active participation in the students, but also attracts the attention of the children and increases the interaction between them. Contributions to the teacher can be seen as reducing the workload and facilitating the work in general, as well as contributing to personal and professional development. Finally, when we look at the contributions to the teaching process, making the teaching process fun and providing visual and auditory richness are the most

frequently mentioned expressions, and ensuring being economical is among these contributions. Some statements from preschool teachers are given below:

T5: *“When technology is used in the teaching environment, the information becomes more permanent, the lesson becomes more remarkable. We present verbal explanations visually. Technology makes our job easier. He makes the teaching environment fun. It creates interaction when used in-game and in chat. It appeals to children, both cognitively and affectively.”*

T13: *“When I open a video or image, I also ask them. Then they tell me a cartoon name I don't know. Their self-confidence increases because they think they are teaching me, their teachers, something new.”*

T7: *“I think the child will be happier if technology is adapted to the teaching environment. They learn faster, express themselves more easily, and then they don't get confused when they see the new technologies we use in the classroom. They learn faster and enjoy more. I think technology makes the lesson fun.”*

T3: *“When the activities at school are done only on books and paper, it is not enough, they do not attract the attention of the child enough. At some point, it is necessary to include technology and computers. Technology attracts the attention of the child, enables him to participate in the lesson and provides permanent learning as it supports it visually.”*

DISCUSSION AND CONCLUSION

DISCUSSION

In the discussion part of the study, the findings obtained as a result of the research were interpreted by considering other studies in the literature. However, when we look at the literature, since there are very few studies on the technopedagogical content knowledge of preschool teachers, the results were interpreted by making use of studies in other fields (science, mathematics, classroom teaching, etc.).

The aim of the research is to reveal the pre-school teachers' use of technology, their use of technology in the teaching process and to determine their perceptions of TPACK competencies in the context of various factors. According to the results of the descriptive analysis made according to the answers given to the interview questions of the preschool teachers who participated in the study: It was concluded that the level of using technology of preschool teachers is at a medium level. Considering the opinions of the participants, the difficulties arising from following the rapid changes in technology and the lack of equipment due to the effect of lack of practice, teachers do not feel fully competent and their perception of competence is generally at a medium level.

It has been revealed that the technologies and technological tools that preschool teachers use in the teaching process are computers and Web 2.0 tools. In addition, computers and smart boards are the leading technological tools that they consider necessary to be used in the preschool education process. Afterwards, it was thought that projection equipment and tablets should be used mostly in the teaching process. According to the opinions of the participants, tablets and smart boards are

technological tools that must be used in order to embody preschool education, provide permanent learning and increase interaction. In addition, it is among the results that Web 2.0 tools should be used by every teacher in order to increase the quality of education. Similar to these findings, Halmatov, Okur Akçay, and Ekin (2017) conducted a study with 62 preschool teachers, and it was concluded that the materials used by teachers in their classrooms were as follows: computers, projectors, smart boards, smart phones, TV, speakers and tablet computers. . Looking at the international literature, Simon, Nemeth, and Mcmanis (2013) stated in their study that preschool teachers use technology effectively in their classrooms. According to the results of the research, when the technological devices available in the classrooms are examined, the result is as follows: 95% desktop or laptop computers, 44% smart boards, 37% tablets, 19% e-book readers, 16% smart phones and 6% multi-touch tables. The fact that the technological and economic infrastructure abroad is better causes a difference in the technological tools used in education. When these data are compared with the data of our study, it is seen that the variety of technological tools used in preschool in our country is insufficient.

When the situation of using ICT in the teaching process is examined, it is seen that the majority of pre-school teachers benefit from ICT frequently and every day. In addition, another result is that their perception of competence about ICT is at a moderate level and they have a positive opinion that they can solve the problems that occur in this regard. Korkmaz and Ünsal (2016) in a study in which 76 preschool teachers in Gaziantep and their metaphorical perceptions of the concept of "technology" were examined, determined the frequency of technology use by teachers as follows: 68% of preschool teachers (52% teachers) always use technology. , 26% (20 teachers) use it sometimes, and 5% (4 teachers) do not use technology at all. In the current study, it was concluded that the vast majority of teachers use technology every day and frequently, and no opinion was found that they never used technology. In addition, Kabakçı and Yurdakul (2011) state that an increase in the use of ICT by prospective teachers will also increase their TPACK competencies. Another result obtained in the current study is that teachers feel moderately competent in using ICT. Albion et al. (2010), in their research on technology integration in the teaching process, stated that teacher candidates see themselves as inadequate and with limited competence. In addition, in the present study, it was concluded that pre-school teachers can solve the problems that occur in ICT. Kabadayı (2006), in his study with 160 preschool teachers, revealed that teachers do not have enough motivation to overcome the difficulties they encounter while using technological tools in the classroom. These studies, which contradict the research findings, may enable us to make inferences that the competence of preschool teachers in using ICT has increased with the development of technology. As a matter of fact, Halmatov, Okur Akçay, and Ekin (2017) obtained a result similar to the results of the current study by revealing that most of the teachers feel competent and confident in using technology in teaching environments.

In the preschool period, it is important that the concepts should be taught by concretizing in a way appealing to more than one receptor. However, while the teacher presents new learnings to the children, the activities he/she does should be understandable. Therefore, preschool teachers are expected to develop materials suitable for children's characteristics and to have competence in applying different methods-techniques-strategies while presenting them (MEB, 2006). In this context, in the current study, when the pre-school teachers' preparation of audio-visual materials using their TPACK competencies was examined, it was concluded that the participants mostly made collage-puzzle-poster works. According to the statements of the teachers, the inclusion of such studies in the teaching process with art activities and projects attracts the attention of the students and increases their motivation towards the lesson. In addition to these skills, pre-school teachers can perform

activities such as preparing teaching materials, preparing and presenting slides, creating children's books-voice-overs, creating songs for children, making animation-cartoon-video-games, preparing cartoons-voice-overs, and creating virtual exhibitions. It is one of their ability to create materials that they prepare using their TPACK competencies.

Preschool teachers' perceptions of TPACK competencies are presented in the context of various factors: gender, years of experience, personal innovativeness level, perception of professional self-efficacy, sociocultural environment, parent profile, and student profile. Thus, according to the data obtained from the study, it was concluded that gender did not affect TPACK competencies. These results show parallelism with the results of the study on pre-school teacher candidates' TPACK self-confidence perceptions. Sancar, Konakman, and Yelken (2013) concluded in their studies that gender does not make a significant difference in terms of TPACK self-confidence perceptions. Based on the results of this study and the current study, it can be said that gender is not a factor affecting TPACK competencies. In the opinion of the participants, the increase in years of experience in teaching also increases the TPACK competencies of teachers. According to the statements of the teachers, as a result of the experiences gained in the profession, the TPACK competencies of the teachers with many years of experience have improved more than those of the teachers with less years of experience. In the study of Chuang and Ho (2011) on Taiwanese early childhood teachers, it was concluded that young teachers had better technology knowledge (TK) and older teachers had better pedagogical content knowledge (PCK). In Ilkay (2019)'s study, it was concluded that the TPACK competencies of preschool teachers differ according to the years of experience, and that teachers with 16 years or more seniority can design their lessons using technology better than teachers with less seniority. These results show parallelism with the results of the present study. There is also a study in the literature that contradicts the results obtained in the current study. Önal and Keleş (2013) reached the following conclusion as a result of their interviews with 118 preschool teachers: the variables of gender and years of experience have no effect on teachers' use of technology. Similarly, in the study conducted by Koç (2014) with 214 preschool teachers, it was revealed that the years of experience do not affect the technology use of teachers in the classroom. This situation enables us to reach the conclusion that there is no definite opinion that the majority of preschool teachers will agree on whether the variables of gender and years of experience are fully effective in the development of TPACK competencies.

Another result of the present study is that preschool teachers have perceptions that as their innovativeness levels increase; their TPACK competencies will increase accordingly. In Ilkay (2017)'s thesis study, it was concluded that there is a positive and moderate relationship between individual innovativeness characteristics and TPACK competencies. Similarly, in Özbek's (2014) study, the effect of teachers' innovativeness levels on TPACK competencies was examined, and it was found that there was a positive correlational relationship between individual innovativeness level and TPACK competencies possessed. In addition, it was found that the level of innovation is an important predictor of TPACK. Çuhadar et al. (2013) revealed that the phenomenon of individual innovativeness and technological competencies have a moderately positive relationship. The results of these studies show parallelism with the findings of the current study.

Considering the relationship between TPACK competencies and perception of professional self-efficacy, it is thought that an increase in professional self-efficacy will increase TPACK competencies. Sağlam-Kaya (2019), in his study examining the TPACK competencies of teacher candidates in terms of various variables, reached the following conclusion: The TPACK competencies of teacher candidates

are a significant predictor of teacher self-efficacy. Similarly, in the study of Keser, Karaoğlan-Yılmaz, and Yılmaz (2015), it was revealed that there is a high level of positive correlation between pre-service teachers' self-efficacy regarding technology integration and their TPACK competencies. These results are in line with the data of the current study that the phenomenon of professional self-efficacy has the potential to affect TPACK competencies. In the study, it was concluded that the sociocultural environment significantly affects the TPACK competencies of preschool teachers. According to the preschool teachers, while the disadvantaged sociocultural environment decreases their TPACK competencies, the advantageous sociocultural environment increases their TPACK competencies. At the same time, the following conclusion was reached: there is a positive correlation between the profile of the parents, the knowledge of the students and the TPACK competencies of the teacher. Similarly, Blackwell et al. (2013) worked with 1329 preschool teachers and investigated the use of technological devices by teachers. According to the findings, it was determined that the technological devices used by the teachers differ according to the socio-economic levels of the children. In addition, it is among the results obtained that the fact that the institutions they work with have a positive policy towards the use of technology increases the use of computers.

According to the study conducted by Kulaksız and Karaca (2020), the contextual factors affecting the technological pedagogical content knowledge of science teachers were investigated, and it was revealed that the following factors had an effect on TPACK competencies: "teachers' beliefs and attitudes", "technical support", "technological infrastructure" and "student influence". The findings obtained as a result of the current study also show that the student profile affects teachers' TPACK competencies. In a study that contradicts these findings, Couse and Chen (2010) found that children who do not have a computer at home adapt to tablets as easily as children who have a computer at home and have no difficulty in getting used to it. While the findings of the current study reveal that the student profile increases TPACK competencies, the aforementioned study shows that the student profile is not a determining factor in the use of technology in the teaching environment. Based on these, a definite judgment could not be reached as a result of whether the student profile affects TPACK competencies or not.

In the study of Üredi and Ulum (2020), classroom teachers' perceptions of TPACK were revealed. According to the statements of the classroom teachers, the term "TPACK" means using technological tools in accordance with the level of the student in the teaching environment, integrating technology into the education environment, and using technology as a tool to make learning meaningful. Accordingly, classroom teachers' TPACK perceptions are associated with Technological Pedagogical Knowledge (TPK), Technological Pedagogical Content Knowledge (TPACK) and Technological Content Knowledge (TCK). One of the results revealed in the current study is that preschool teachers' TPACK perceptions are shaped around the following concepts: technological content knowledge (TCK), technological pedagogical knowledge (TPK), technological pedagogical content knowledge (TPACK), technology knowledge (TB), and pedagogical knowledge. (PK). Therefore, it can be said that teachers generally have Technological Content Knowledge (TCK) and Technological Pedagogy Knowledge (TPK) perceptions for TPACK. According to Koehler and Mishra (2008), it is emphasized that teachers and teacher candidates should use their technological knowledge in accordance with the classroom climate.

Finally, according to The National Association for the Education of Young Children (NAEYC), the conscious and purposeful use of technology and interactive media supports learning and the

development of children. In order for this to be fulfilled by the teachers who are the organizers of the teaching environment, they must have TPACK. From this point of view, the views of pre-school teachers regarding the effect of their TPACK competencies in the teaching process were examined under four headings. The most prominent benefits in the results obtained according to the research findings were determined as follows: providing permanent learning, increasing interest and attention, contributing to the personal and professional development of teachers and making learning fun by adding diversity to the learning environment. When the literature was examined, it was seen that many studies were conducted on the use of technology in the teaching process in the preschool period. Considering the results obtained from these studies, the use of technology in the learning environment by the teacher in the preschool period arouses the curiosity of children and contributes to permanent learning (İnci & Kandır, 2017); makes the learning environment fun (Ömrüzun, 2019); it embodies learning and saves time (Hacısalıhoğlu Karadeniz, 2014); it increases cooperation and interaction among children (Gedik, Çetin, & Koca, 2017). The results of the present study are largely similar to the results obtained from studies on this subject in the literature. As a result, the TPACK qualifications of pre-school teachers have many contributions to the teaching process, students and teachers. Therefore, it is necessary to focus on the use of technology in the preschool period and the importance of TPACK competencies of teachers should be understood and these competencies should be increased.

CONCLUSION

In the conclusion part of the study, pre-school teachers' use of technology in the teaching process and their perceptions of TPACK competencies are revealed in the context of various factors. In the light of the findings obtained as a result of the research, the following conclusions were reached:

- It can be said that preschool teachers' level of using technology in teaching environments is at a moderate level.
- It can be said that the most used technological tool by preschool teachers in the teaching process is computers, and the technology they use most is Web 2.0 tools. These are followed by the following technologies: smart boards, projections, augmented reality technology and coding.
- It can be said that the technological tools that preschool teachers find most necessary to be used in teaching environments are computers, followed by smart boards, projectors and tablets. It has been revealed that tablets are not currently used in the classroom. According to pre-school teachers, "tablets" are among the technological tools that should definitely be in classroom environments in the future.
- According to preschool teachers, it can be said that Web 2.0 tools are the dominant ICTs that should be used in the teaching process. This is followed by augmented reality technology and metaverse technology, which is thought to guide education in the future.
- When we look at the trainings that preschool teachers consider necessary on the use of technology in education and the ICT competencies they consider necessary to be acquired, similar to the other results of the study, training in the use of Web 2.0 tools is the most necessary training. This is followed by basic computer usage skills, smart board usage skills, coding training, educational game design skills, professional film-video preparation skills, educational application/application/tool design skills, animation creation skills.
- Considering the current situation of preschool teachers regarding information and communication technologies (ICT), the following results emerged:

- It can be said that the majority of preschool teachers use ICT frequently and every day in the teaching process.
- It can be said that the majority of pre-school teachers' competencies about ICT are at a medium level.
- It can be said that the majority of preschool teachers can solve problems about ICT.
- Considering the pre-school teachers' preparation of audio-visual materials using their TPACK competencies, it can be said that the participating teachers mostly do collage, puzzle, and poster work. This is followed by the activities of preparing teaching materials, preparing and presenting slides, creating and vocalizing a children's book, adding voices to children's lyrics and creating a new song, making animations, cartoons, video and games, preparing and vocalizing cartoons, and creating a virtual exhibition.
- Considering the perceptions of preschool teachers about the effect of different variables on TPACK competencies, it can be said that teachers have the following perceptions:
 - It can be said that the majority of preschool teachers agree that there is no difference between the two genders in terms of TPACK competencies. This view is followed by the view that male teachers have higher TPACK competencies. In addition, no teacher came out with the opinion that female teachers' TPACK competencies are higher than male teachers'.
 - It can be said that the majority of preschool teachers have the opinion that having more years of experience will increase their TPACK competencies.
 - It can be said that the majority of pre-school teachers have the opinion that a high level of innovation will increase their TPACK competencies.
 - In terms of professional self-efficacy, according to most of the preschool teachers, the increase in professional self-efficacy also increases their TPACK competencies. In addition, some of the teachers have the opinion that the increase in TPACK competencies increases professional self-efficacy.
 - Most of the pre-school teachers have the view that the disadvantaged socio-cultural environment reduces their TPACK competencies and the advantageous socio-cultural environment increases their TPACK competencies.
 - It can be said that preschool teachers have the opinion that a positive parent profile increases their TPACK competencies.
 - It can be said that pre-school teachers have the opinion that the knowledge of the students increases their TPACK competencies.

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- The first author made significant contributions to the creation of the conceptual framework, planning, data acquisition and analysis and interpretation of the data.
- The second author contributed to the review of the findings related to the article's content, the preparation of the draft, and the final form of editing.