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Analysis of Classroom Teachers' Knowledge on Technological Pedagogical Field

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SUMMARY

The object of this research is to determine the knowledge of the teachers about the technological pedagogical field. Mixed research method is used in the study. Quantitative data were collected with the "Technological Pedagogical Content Knowledge Scale" developed by Schmidt et al. (2009) and adapted to Turkish by Öztürk and Horzum (2011). Qualitative data, on the other hand, were collected using a semi-structured interview technique. The scale was applied to 581 participants using easily accessible situation sampling method. Semi-structured interview form was applied to 18 remaining participants. Considering the Technological Pedagogical Content Knowledge (TPACK) levels of classroom teachers, the results of the study show that teachers are observed to have the level of "I agree completely" in the Pedagogical Knowledge sub-scale, and the level of "I agree" on the other sub-scales. In the study, teachers stated that they used technology in their lessons. The teachers emphasized that they add technological media such as educational sites and Web 2.0 tools to their lessons for the purposes of attracting attention, learning by fun, evaluation and concretion. It was observed that teachers used technology in many lessons, especially in Turkish and mathematics.

Keywords: Classroom teacher, technological pedagogical content knowledge, mixed method

INTRODUCTION

Today, the rapid development of information and technology is reflected in education. The education system renews itself to keep up with the rapidly developing technology and increasing knowledge. According to the Ministry of National Education (MNE) (2019), "The rapid change in science and technology, the changing needs of the individual and society, innovations and developments in learning / teaching theories and approaches have directly affected the roles expected from individuals." Teachers have the most important role in this process. They are asked to educate and train individuals who can keep pace with the rapid changes in science and technology. One of the keys to the development of students is that teachers have professional competencies (MEB, 2017). Therefore, teachers should blend new technology and knowledge with pedagogical knowledge. Technology's contribution to educational environments is not limited to keep in step with the times. At the same time, it allows different subjects in various courses to be presented via technological infrastructure. In this context, while teachers are asked to have knowledge on technology, they are also expected to combine this technological knowledge with field knowledge and pedagogical knowledge.

Shulman (1986) defined pedagogical content knowledge (PCK), which consists of intersections of content knowledge and pedagogical knowledge areas. Koehler and Mishra (2008) created the TPACK structure by adding technology knowledge to Shulman's pedagogical content knowledge (PCK). They stated that the development of this structure is critical for effective teaching with technology. As seen in Figure 1, the knowledge of teachers is divided into three main components: content, pedagogy and technology. PCK, TCK, TPK and TPACK have emerged from the interactions between these knowledge structures (Mishra &Koehler, 2006; Koehler & Mishra, 2008; Koehler & Mishra, 2009).

Content knowledge (CB) is described as the knowledge of teachers about the subject to be learned or taught (Mishra & Koehler, 2006). Teachers should not just be capable of defining accepted facts in a certain field of expertise. At the same time, they must be able to explain why a particular proposition is deemed necessary and how it relates to other propositions in theory and practice, within and outside that particular discipline (Shulman, 1986). Content knowledge provides a broad perspective to the teacher by including information such as concepts, rules and ideas, as well as general cultural knowledge on the subject (Ekiz Kıran & Öztay, 2019).

Pedagogical knowledge (PK) is the knowledge of general pedagogical activities that a teacher can use regardless of a particular content and subject. PK includes strategies to increase students' motivation, communicate with students and parents, and ensure classroom management. In addition, it includes information transfer activities such as discovery learning, cooperative learning and problem-based learning that can be applied in all content areas (Cox and Graham, 2009). Pedagogical knowledge (PK) is the deep knowledge of teachers about teaching and learning processes, practices or methods. A teacher with deep pedagogical knowledge understands how students build knowledge and acquire skills, and how they develop habits of mind and positive dispositions related

to learning. Therefore, pedagogical knowledge requires an understanding of cognitive, social and developmental learning theories and how they are applied to students in the classroom (Koehler & Mishra, 2009). However, in their study, So and Kim (2009) revealed that although teacher candidates have theoretically pedagogical knowledge, there is an inconsistency between the technological tools, content presentations and educational strategies they stated in their lesson plans. In this context, it is important to know content and pedagogical knowledge as well as technological knowledge and their use together.

Technological knowledge (TK) is always in more flux compared to content and pedagogical knowledge. Technological knowledge (TK) includes standard tools such as books, chalk and chalkboard, and advanced tools such as internet and digital video (Koehler, Mishra, & Yahya, 2007).

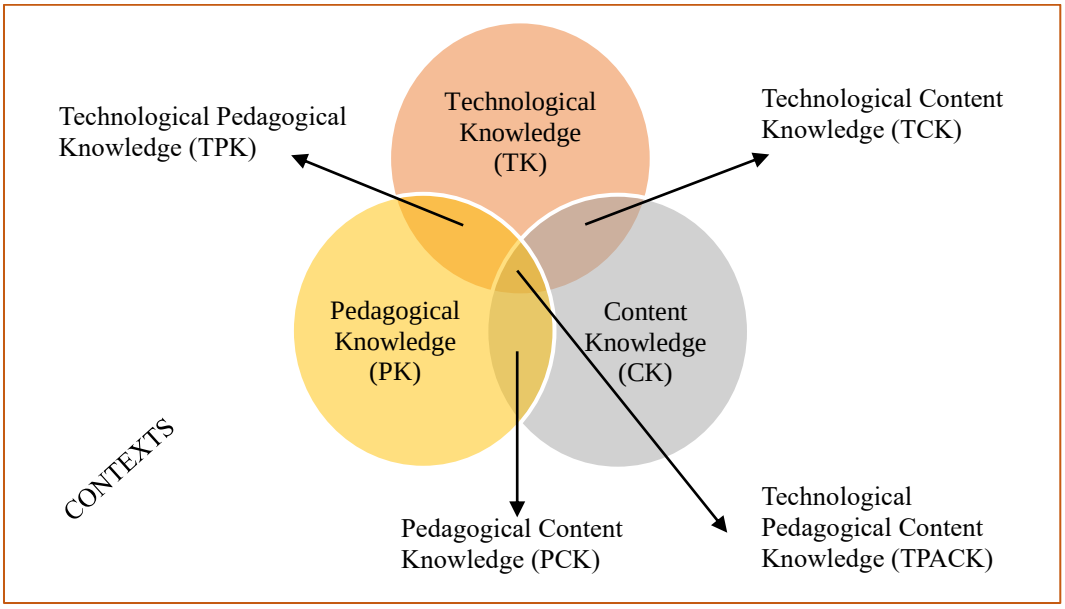

Figure 1. The TPACK framework and its knowledge components (Mishra & Koehler, 2006, p. 1025)

In the structure consisting of the combination of three main pieces of knowledge shown in Figure 1, the necessity of blending knowledge in the field of education is emphasized. Pedagogical content knowledge (PCK) covers the use of pictures, examples, explanations and illustrations to make the subject related to a certain field more understandable. In addition, this knowledge is used when determining what is easy and what is difficult for students of different ages and prior knowledge to learn a particular subject. (Shulman, 1986). Covering strategies for teaching a subject, pedagogical content knowledge includes the knowledge of how a teacher can explain certain topics, organize these topics, adapt them according to students' interests and abilities, and present them in the teaching process (Magnusson et al., 1999).

Technological content knowledge (TCK) is about how technology and content affect and limit each other. Teachers need to identify which technologies are best suited to address subject learning in their field. In addition, they must understand the compatibility or incompatibility of content and technology (Koehler & Mishra, 2009).

Mishra and Koehler (2005) state that the role of technology in pedagogy is more than the accumulation of technological skills and that the teacher's task is not only to find and apply the right tool. It is not enough for the resources to be made available to teachers to only cover information about technological tools. Pedagogical knowledge should also be taken into consideration while preparing these resources (Akkoç & Yeşildere İmre, 2015). In the rapidly developing technology environment, there are some reasons preventing the correct integration of technology in education. These can be listed as educating teachers according to certain technological infrastructures, using software that is not developed for use in education, not having programs for teachers to acquire technology skills, trying to use technological software that is not suitable for class level, subject, student, teacher and teaching style. Knowing how to use technology does not mean knowing how to use it in teaching. (Koehler & Mishra, 2006). Teachers should acquire the knowledge, attitude and skills required to effectively integrate information and communication technologies into their teaching processes (Şad et al., 2015).

Technological pedagogical content knowledge (TPACK) is a form of knowledge that goes beyond the three basic components of technology, pedagogy and content. TPACK includes pedagogical techniques that use technologies to teach content, knowledge of how concepts are learned, technological solutions developed to solve problems faced by students, and how technologies can be used to develop new epistemologies or strengthen old

epistemologies (Koehler & Mishra, 2009). TPACK is a structure that integrates and transforms the technology, content and pedagogical knowledge needed by teachers to effectively use information and communication technologies in the classroom (Chai et al., 2013).

Hew and Brush (2007) stated that the biggest obstacles to technology integration are that teachers do not have technology-related knowledge and skills, technology-supported pedagogical knowledge and skills, and technology-related classroom management knowledge and skills. In a study conducted by Yalın et al. (2007), in primary schools in Turkey, the main obstacles encountered in the integration of science and communication technologies are determined. These are the lack of time, training, equipment and technical support to develop material through the computer. As seen in the studies, it is necessary to clarify how technology will be integrated into education in order to ensure the correct use of technology in education. According to Jang and Tsai (2012), teachers' pedagogical, technological and content knowledge should be sufficient for the successful integration of technology into education. In this context, it is important to develop technological pedagogical content knowledge, which is a type of knowledge that supports how teachers explain a subject in educational environments using technological infrastructure. The aim of this study is to examine classroom teachers in terms of technological pedagogical content knowledge. For this purpose, the following research questions were sought:

1) What is the level of technological pedagogical content knowledge of classroom teachers?
2) What are the opinions of classroom teachers on technological pedagogical content knowledge?
3) Does technological pedagogical content knowledge of classroom teachers:
    - Show a significant difference according to gender?
    - Show a significant difference according to the faculty of graduation?
    - Show a significant difference in terms of technology accessibility at the school where they work?
    - Show a significant difference in terms of technology accessibility at home?
    - Show a significant difference according to in-service training on technology use?

METHOD

Mixed method was used in this study. According to Creswell (2021, p. 2), the mixed method is “a research approach in which the researcher collects both quantitative data (closed-ended) and qualitative data (open-ended) to find answers to research questions, integrates these two data sets with each other and draws conclusions using the advantages of this integration”. In this context, both qualitative and quantitative data were collected in this study. Different patterns can be used in mixed research. Quantitative dominant mixed design was used in this study. “In this design, quantitative research methods have been applied first, and quantitative research is more emphasized in achieving the purpose of the researcher. Qualitative research methods help explain quantitative findings." (Creswell & Plano Clark, 2020, p.122). In this context, descriptive sequential design was used in the research.

Study Group

In this study, convenience sampling is used. 601 classroom teachers voluntarily participated in the quantitative data of the study. Data collected from 581 classroom teachers among them were included in the study. Qualitative data were collected by interview method from 18 classroom teachers. The demographic characteristics of the group from which quantitative data were collected are presented in Table 1.

Table 1: Demographic characteristics of the study group from which quantitative data were collected.

Demographic Variables	Groups	n	%
Gender	Woman	421	72.5
	Man	160	27.5
Graduation	Faculty of Education	509	87.6
	Other	72	12.4
Experience	1-5 years	229	39.4
	6-10 years	131	22.5
	11-15 years	94	16.2
	16-20 years	38	6.5
	21-25 years	36	6.2
	26 years ve over	53	9.1
Problems on access to technology at the school	Yes	192	33.0

	Partly	245	42.2
	No	144	24.8
Problems on access to technology at home	Yes	397	68.3
	Partly	168	28.9
	No	16	2.8
Level of Technology Use	Sufficient	358	61.6
	Partly sufficient	217	37.3
	Not Sufficient	6	1.0
Receiving in-service training on technology use	Yes	310	53.4
	No	271	46.6
TOTAL		**581**	**100**

As seen in Table 1, 421 of the classroom teachers participating in the study are women and 160 are men. 509 of them are graduates of education faculties, 72 of them are graduates from other faculties. 229 of them have 1-5 years of experience, 131 of them have 6-10 years of experience, 94 of them have 11-15 years of experience, 38 of them have 16-20 years of experience, 36 of them have 21-25 years of experience, and 53 of them have 26 years or more experience. 144 of them have problems in accessing technology at their school, 245 of them partially have problems and 192 of them do not. 16 of them have problems with access to technology at home, 168 of them have partial problems and 397 of them do not have any problems. 358 of them see themselves as sufficient in the use of technology, 217 of them consider themselves partially sufficient, and 6 of them see themselves inadequate. 310 of them received in-service training on technology use, 271 of them did not receive such training.

The characteristics of classroom teachers, from which qualitative data used in the study were collected, are shown in Table 2. According to Table 2, 6 of the interviewed teachers are male and 12 are female. Looking at their classroom teaching experiences, it is seen that six of them have 1 year, one of them has 3 years, three of them has 5 years, two of them have 6 years, two of them have 10 years, one of them has 11 years, one of them has 12 years, one of them has 14 years, and one of them has 30 years. As seen in Table 2, these teachers are serving in different regions of Turkey.

Table 2: Demographic characteristics of the study group from which qualitative data were collected

Teacher Code	Gender	Years of Experience	City of Institution
T1	Female	1	Sivas
T2	Female	3	Adıyaman
T3	Male	5	Ağrı
T4	Male	11	Malatya
T5	Female	1	Gaziantep
T6	Female	6	Çanakkale
T7	Female	1	Van
T8	Male	10	Hatay
T9	Male	1	Hatay
T10	Female	5	İstanbul
T11	Female	5	Kahramanmaraş
T12	Female	1	Malatya
T13	Female	1	Mardin
T14	Male	12	Amasya
T15	Female	10	Kayseri
T16	Male	6	Malatya
T17	Female	30	Denizli
T18	Female	14	Bingöl

Data Collection Tools

Quantitative data were collected with the "Technological Pedagogical Content Knowledge Scale" developed by Schmidt et al. (2009) and adapted to Turkish by Öztürk and Horzum (2011). Required permissions for the use of the scale have been obtained from the relevant authorities. It was observed that the total eigenvalue of the scale was 35.73, the total amount of variance explained was 76.12%, and the factor loading values of the items varied between .60 and .90. The Cronbach's alpha value for the whole scale, which consists of 7 factors and 47 items, was found to be .96. The reliability values of the factors of the scale are 0.95 for the first factor, "Technology Knowledge"; 0.95 for the second factor "Content information"; 0.97 for the third factor “Pedagogy Knowledge”;

0.97 for the fourth factor "Pedagogical Content Knowledge"; 0.93 for the fifth factor “Technological Content Knowledge”; 0.89 for the sixth factor "Technological Pedagogical Knowledge" and 0.94 for the seventh factor "Technological Pedagogical Content Knowledge". Reliability values were calculated using Cronbach Alpha internal consistency coefficients.

Qualitative data were collected using a semi-structured interview form consisting of in-depth questions to measure technological pedagogical content knowledge of the teachers. Firstly, a draft was created for this form. Then, the draft was finalized by taking the opinions of 2 field experts for content validity and 1 field expert for language validity.

Data Analysis

Descriptive statistics (arithmetic mean and standard deviation) were calculated in order to determine the TPACK levels of classroom teachers. The total scores of each scale were converted into 5-point rating scores by dividing them by the number of items. These scores were used to determine the levels of the teachers participating in the study regarding TPACK sub-factors. In the interpretation of these mean scores, these score ranges and the corresponding levels were used. The score ranges and corresponding levels used in the scale are as follows: 1.00-1.80 point range Totally disagree, 1.81-2.60 point range Disagree, 2.61-3.40 point range Undecided, 3.41-4.20 point range Agree, 4.21-5.00 point range Fully agree.

In order to understand whether there is a significant difference in terms of independent variables in the levels of classroom teachers regarding TPACK, independent variables were examined by t test and ANOVA test. First of all, it was examined whether the independent variables show a normal distribution for each level. In this context, it was checked whether each level of the independent variables showed normal distribution for all sub-scales. Skewness and kurtosis values took values between -2 +2 (George & Mallery, 2012). In addition to these, histogram and Q-Q plot charts were also examined. As a result, it was understood that the aforementioned independent variables showed normal distribution for each sub-scale. In addition, by examining the Levene test results, it was determined that the variances were homogeneous for all variables in all dimensions and throughout the scale ($p > .05$). Cohen d and Cohen f were calculated to be used in the interpretation of the research results. When interpreting the Cohen d value, regardless of its sign, .20 was considered as small, .50 medium and .80 large. Cohen f effect size was interpreted as .10 small, .25 medium and .40 large (Cohen, 1988).

Content analysis was used in the interpretation of qualitative data. The opinions of the classroom teachers were first transformed from the audio recording into text and the resulting texts were checked by an expert. Subsequently, themes and sub-themes were created based on these texts. The created themes and sub-themes were brought together by submitting to the opinion of a field expert. The themes with differences of opinion were reviewed and a common point was determined. For reliability, the reliability formula of Miles and Huberman (1994, p. 64) was used. [Reliability = Agreement / (Agreement + Disagreement)]. As a result, the reliability of the study was calculated as .87. According to Miles and Huberman, a reliability above .70 means that the research is reliable. Therefore, it can be said that this research is also reliable. The qualitative data obtained in the study were used both for the interpretation of quantitative data and to determine the use of teachers' TPACK skills in lessons.

FINDINGS

TPACK Levels of Teachers

Descriptive statistical data regarding the TPACK level of classroom teachers participating in the study are presented in Table 3.

Table 3: Distribution of teachers' TPACK levels by sub-dimensions

Sub-dimensions	Mean	SD	Knowledge Level
TK	3.79	.63	Agree
CK	3.98	.50	Agree
PK	4.38	.51	Totally Agree
PCK	4.15	.60	Agree
TCK	4.00	.65	Agree
TPK	4.02	.59	Agree
TPACK	4.09	.57	Agree

Considering the average of TPACK sub-scales presented in Table 3, it is seen that teachers have "totally agree" knowledge level in Pedagogical Knowledge sub-scale and "I agree" knowledge level in other sub-scales. As a result, it can be stated that teachers have above average knowledge levels in all sub-scales of TPACK, especially in the pedagogical knowledge area.

Teachers' Views on TPACK

Teachers' opinions about TPACK were examined in four dimensions. These can be listed as the purposes of using technology in their lessons, the ways they use technology, the technological tools they use, and the lessons they teach using technology. The teachers were asked about the purpose of using technology in their lessons. The collected opinions are grouped in 13 themes and presented in Table 4.

Table 4: Teachers' purposes to use technology in their lessons.

Theme	Teacher	f
Improving motivation	T1-T2-T5	3
Learning Retention	T2-T5-T6-T12-T15	5
Reinforcement	T2-T4-T8-T11-T12-T15	6
Completing the topic	T3-T9-T11-T13	4
Supporting the teacher	T5-T6-T8-T9	4
Addressing individual differences	T5	1
Learning with fun	T5-T6-T7-T9-T12-T15-T17-T18	8
Using in lecture	T1-T4-T9-T14-T16-T17	6
Activate the students	T6-T7-T14-T16	4
Evaluation	T4-T9-T11-T14-T16-T17	6
Concretion	T5-T6-T9-T12-T13-T15	6
Attract attention	T1-T2-T6-T10-T13-T14-T15-T16-T17	9

Among the purposes of using technology in lessons, the themes of attracting students' attention and learning while having fun are the most expressed by teachers. The themes of concretization, evaluation, use in lecture and reinforcement follow them, respectively. Teachers' views on the reasons for using technology are as follows:

> T1: Instead of lecturing, when a video opens, the subject draws their attention and the children are very happy.
> T9: It is extremely useful for us during the evaluation phase. Because in the games I use, there are points to measure whether the student knows the subject or not. For example, after teaching the child some letters, we play games to read the combinations of these letters. If the child has not learned the letters, he cannot be successful in the game. I can say that I use them during the evaluation phase.
>
> T15: Sometimes I use it to attract their attention, sometimes I use it for reinforcement purposes.

The opinion of a teacher who says that he uses technology to appeal to individual differences, to ensure learning by having fun, and to make education concrete and permanent is as follows:

> T5: I mean, not every student in the classroom can learn in the same way. I have to use technology to get every student at the same level or to keep them on average. Some of my students have auditory intelligence, some have visual intelligence and some have physical intelligence. But I have to do the same things for all of them at the same time. It is impossible for me to do this alone. That's why I'm getting help from technology. For example, a smart board is something that makes our lessons a lot easier. That smart board is both visual, auditory and even tactile… My main purpose (of using technological programs) is to ensure permanent learning in the child. More precisely, I wanted to make education more concrete and fun. The child could see a plain writing on the screen and learn. But using games to make teaching fun and colorful seemed more positive for me.

The themes of watching videos, making activities, showing examples, listening to music, playing games and reading e-books emerged as ways teachers use technology in their lessons. The ways teachers use technology in lessons are shown in Table 5.

Table 5: Teachers' ways of using technology in lessons

Theme	Teacher	f
Watching videos,	T1-T2-T4-T5-T6-T7-T8-T9-T11-T12-T13-T15-T16-17-T18	15
Making activities,	T1-T2-T4-T5-T6-T8-T9-T10-T11-T12-T15-T16-17-T18	14
Showing examples,	T3-T4-T5-T6-T8-T9-T15-T17	8
Listening to music,	T4-T5-T7- T8-T9	5
Playing games	T7-9T-T15-T18	4
Reading e-books	T4-T6-T10	3

The opinions of the teachers regarding the ways shown in the table above are as follows:

T7: I usually provide video support to children. I open the videos to make the lessons more fun. First I watch videos, then I play games. Often games like quizzes. I use technology in this way to make the lesson more enjoyable. It also attracts their attention.

T9: For example, as soon as I give a lesson, I open a video to the children on the computer so that the lesson is told again. I mean, I want the lesson to be taught to the child not only by me but also by someone else. There is a Wordwall site on the internet. There are many games out there. At the primary school level, there are addition exercises, multiplication exercises, exercises for Turkish word networks. I usually open these kinds of exercises from there and play games with the children using them.

Teachers also benefit from technological tools in their classrooms. These tools were examined under 4 themes: the technological tools used in the lesson process, the technological tools used in face-to-face education, the communication tools used in the distance education process, and the tools used in communication with parents. Data on these themes are presented in Table 6.

Table 6: Technological tools teachers use in lessons

Theme	Sub theme	Category	Teacher	f
Technological tools used in the lesson process	Education Sites	EBA	T1-T2-T3-T4-T5-T7-T9-T10-T11-T12-T13-T15-T16	13
		Okulistik	T1-T2-T3-T4-T5-T6-T8-T9-T10-T11-T13-T14-T15-T16-T17	15
		Morpa Kampüs	T4-T6-T8-T10-T11-T14-T15-T16-T17	9
		Eğitimhane	T7	1
	WEB 2 tools		T5-T9-T10-T17-T18	5
	Youtube		T1-T2-T4-T6-T7-T8-T9-T10-T11-T12-T13-T17	12
	Antropi teach		T15	1
Technological tools used in face-to-face education	Smart Board		T1-T3-T4-T5-T6-T7-T10-T11-T12-T13-T14-T15-T16-T17-T18	15
	Projector		T2-T6-T8-T9-T10-T11-T14-T16	8
	USB memory stick		T7-T9-T11-T16	4
	Telephone		T4-T11	2
	Computer		T5	1
Communication tools used in the distance education process	Zoom		T1-T2-T5-T7-T8-T10-T11-T12-T14-T15-T16-T17	12
	Whatsapp		T2-T5-T10-T13	4
	Google Classroom			
Tools used for communication with parents	Zoom meetings		T1-T6-T10-T11-T15-T16-T17-T18	8
	Whatsapp groups		T1-T2-T3-T4-T5-T9-T10-T11-T12-T13-T14- T15-T16-T17	14
	Telephone		T2-T3-T7-T11-T12-T13-T15	7

Training sites are at the top of the tools used in this process. As can be seen in Table 6, educational sites such as EBA, Okulistik, Morpakampüs and Eğitimhane are mentioned in the theme of technological tools used in the course of teaching. Along with these, WEB 2 tools, Youtube and Antropi teach programs were mentioned. Examples of teachers' views on educational sites are presented below:

T2: There are applications that I use especially while lecturing. EBA is one of them. I use the videos in EBA. Likewise, I also use Youtube. There are animations, lecture videos and activity videos specially prepared for children on YouTube. Similarly, I use the Okulistik program as well. I think it is also very useful, in terms of repetition. I think these are good programs in terms of repetition and effectiveness…

T15: We have smart boards in schools that we use in face-to-face education. There are certain programs such as Anthropi teach here. Here we can open the board and use it actively. We can draw the shapes we want. We can save them. I also use Morpa campus and Okulistik. EBA also has videos of Vitamin, I use them. I can do activities in these. We can watch videos and play games with the children. I think education becomes more fun this way.

As can be seen from the statements, teachers included both educational sites and programs such as Youtube in the contents of their lessons. The views of some of the teachers who developed their technological knowledge and used WEB 2 tools in their lessons are as follows:

T5: Considering the WEB 2 tools, I used Powtoon for animation and Canva for creating posters. Also, I used Google slides. I also used Google video editing tools.

T17: There is an application called Wordwall. I prepared the wheel of fortune game using it. For example, I was typing 20 words of the letter P. The children were spinning the wheel of fortune. They were reading whatever word came up, so they were reading them in turn. They were also having fun. They were also playing at home. So I used it a lot in my lessons in 1st grade. For example, I'm doing puzzles on the Jigsaw Planet site. While introducing Denizli in the lesson, I make puzzles using Denizli pictures. By combining the pieces of the puzzle, they get to know Denizli, our city. There are video making tools called ToolWiz. There are Scoompa and Vivavideo where I can combine children's activities. I use a program called YouCut to edit videos. I think I use technology to the fullest.

T18: I am a first grade teacher. I use more game-oriented tools. For example, Wordwall and Educandy are very useful for me. In this way, we made the reading and writing learning process very enjoyable. We managed to teach all students to read and write, even by distance education.

As can be seen, teachers also used Web 2 tools in their lectures. They have adapted their lessons according to these programs. Besides, the teachers also mentioned the technological devices used in face-to-face education. Especially smart boards and projectors are the most used tools. There are teachers who also use their personal computers and phones. Teachers' views on this theme are as follows:

T3: In terms of technology, we have a smart board in the classroom. We can use the smart board frequently in lessons. Our school also has internet infrastructure.

T4: While I am lecturing, I always have the phone in my hand. I definitely have a phone in my hand ... I'm giving an example. We attend English lessons. In English lessons, we sometimes pronounce a word and check the spelling to make sure it is not wrong. We check on the phone at the same time.

T8: Smart boards are probably more enjoyable. I don't know right now, because I haven't used it on the smart board. But I use the projector and the computer effectively.

When the opinions of the teachers are examined, it is seen that they also benefit from the technological equipment in their classrooms. In addition, teachers also expressed the technological tools they use while communicating with students in distance education. The teachers stated that they used the Zoom program while lecturing, the Whatsapp application to communicate with the students who could not attend the live class, and the Google Classroom to communicate with the whole class.

T1: In terms of technology, I use EBA and Zoom the most. Since we are in the distance education process, I use these two too much.

T2: We have families who experience some anxiety due to the pandemic. That's why they don't want to send their kids to school. I'm trying to send their homework and lectures on WhatsApp.

T10: There is Google Classroom. I created a class there. I keep in touch from there.

Teachers try to communicate with parents as well as students. In this context, they stated that they use the Zoom program for remote meetings, phones for verbal communication, and Whatsapp for written communication. The opinion of a teacher on this subject is as follows:

T11: We are now communicating with parents via WhatsApp groups. Again, we communicate by phone very often. Especially, I say again, we do not hold meetings in schools as we are in the pandemic process. When we also teach children online (at Zoom), I can hold meetings with them.

Table 7: Lessons where teachers use technology

Theme	Teachers	f
Maths	T1-T4-T7-T8-T10-T13-T15-T16	8
Science	T2-T8-T11-T12-T15	5
Turkish	T3-T4-T5-T6-T7-T9-T12-T13-T14-T16	10
Life science and Social studies	T4-T6-T8-T11-T14-T17	6
Music	T4-T8-T9	3
Game and physical activities	T4-T10	2
Visual arts	T10	1

Table 7 shows the lessons in which teachers used technology. It is understood that teachers mostly use technology in Turkish language and then in mathematics lesson. However, it is seen that they use technological tools in almost all lessons. Teachers' views on the use of technology in lessons are as follows:

T13: It attracts the attention of children as it is explained in a fun way by using colored syllables or punctuation marks in Turkish. There is more fluency.

T1: I use it mostly in mathematics. In the lesson, I first open a video from Okulistik, and after I listen to that video, I teach myself3. After explaining it myself, I do activities such as pushing the button and finding the right thing.

T7: I use it in mathematics. I use it to make topics more fun and concrete for third grade students. I teach rhythmic counting, for example, by singing rhythmic songs. I think I get more efficiency.

T2: I use it a lot in science class. Unfortunately, it is not possible to do every subject in the classroom with test tubes or by providing all the necessary materials. It is not very possible both economically and in terms of transportation. In terms of science and mathematics, I think it has a lot of influence on children's thinking in three dimensions. We cannot always practice showing and having it done in our classes. But in Science .... Let it be an experiment, let it be the activities. It shows students that they can do more than I did in the classroom. That's why I try to use it specifically in Science. I think they understand that the limits are actually in their imagination, not just in the textbooks or in what I am talking about.

T4: I use them in all lessons. For example, we use it in a text study, vocabulary study and semantic study in Turkish lesson. We use it again in mathematics lesson, in activities, in different lectures. We watch documentaries and educational videos in our life studies lesson. In music class, for example, I make my students play the flute in the classroom. But I can't play the flute very well. We listen to lectures with the children. I say, "Guys, I will learn at the same time with you." We learn with the children at that moment. In the physical education lesson, we try to do the physical movements there.

The teachers emphasized that they used the technology in different lessons by giving various examples regarding the use of technology in lessons. These opinions show that teachers can reflect technology to their lessons and apply them to the course contents.

TPACK Knowledge Level of Teachers by Gender Variable

In the study, firstly, it was examined whether there is a difference between the gender of the teachers and their TPACK levels. The data obtained as a result of the test are presented in Table 8.

Table 8: Results of t-test analysis of TPACK scores of teachers according to their gender

Dimensions	Gender	N	$\bar{X}$	Ss	*t*	*df*	*p*	Cohen d
TK	Female	421	3.71	.62	-4.702	579	.000*	.43
	Male	160	3.99	.61				
CK	Female	421	3.96	.50	-1.755	579	.080	
	Male	160	4.04	.50				
PK	Female	421	4.38	.51	0.93	579	.926	
	Male	160	4.38	.51				
PCK	Female	421	4.14	.61	-.801	579	.424	
	Male	160	4.18	.58				
TCK	Female	421	3.96	.67	-1.956	579	.051	
	Male	160	4.08	.58				
TPK	Female	421	3.98	.61	-2.273	579	.023*	.21
	Male	160	4.11	.55				
TPACK	Female	421	4.05	.58	-2.813	579	.005*	.26
	Male	160	4.20	.53				

*p<.05

When the data in Table 8 are examined, it is seen that the scores of teachers from TPACK sub-scales (CK, PK, PCK and TCK) do not differ statistically significantly according to the gender variable (p> .05). However, in other TPACK subscales, (TK[t (579) = - 4.702. p <.05], TPK [t (579) = - 2.273. p <.05] and from TPACK [t (579) = - 2.813. p <.05]) there is a significant difference between the scores and their gender. When the averages ($\bar{X}$) are examined, it is seen that male teachers have higher levels of knowledge in these subscales than female teachers. In order to determine to what extent the gender variable has an effect on TPACK, Cohen's d value was calculated. Cohen d for TP, TPK and TPACK subscales are calculated as (.43), (.21) and (.26) respectively. These values show that gender variable has a “small” effect size on TPACK.

In the group where qualitative data are collected, the number of female teachers is higher than that of male teachers. It is seen that the female teachers interviewed try to improve themselves in terms of technology and to use technology in their lessons. Male teachers told similar technological tools and contents with female teachers in their interviews. In quantitative data, male teachers' higher TPK and TPACK subscales compared to female teachers may be due to the fact that men are more interested in technology. In order to understand this difference in quantitative data, technological pedagogical content information can be examined in more detail in terms of gender variable by interviewing more teachers.

TPACK Knowledge Level of Teachers According to the Faculty of Graduation Variable

It was examined whether there is a difference between the faculty that teachers graduated from and their TPACK levels. The data obtained as a result of the test are included in Table 9.

Table 9: Results of t-test analysis of TPACK scores of teachers according to their gender

Dimensions	Faculty	N	X̄	Ss	*t*	*df*	*p*	Cohen d
TK	Education	509	3.79	.62	-.392	579	.695	
	Other	72	3.82	.71				
CK	Education	509	3.97	.51	-1.050	579	.294	
	Other	72	4.04	.47				
PK	Education	509	4.37	.51	-.903	579	.367	
	Other	72	4.43	.46				
PCK	Education	509	4.14	.61	-.926	579	.355	
	Other	72	4.21	.58				
TCK	Education	509	3.98	.66	-1.181	579	.238	
	Other	72	4.08	.61				
TPK	Education	509	4.00	.59	-2.020	579	.044*	.24
	Other	72	4.15	.64				
TPACK	Education	509	4.08	.57	-1.504	579	.131	
	Other	72	4.19	.56				

*p<.05

According to the data in Table 9, it is seen that teachers differ in a statistically significant level according to the variable of the faculty they graduated with TPACK subscales except TPK (p> 0.05). On the TPN subscale [t (579) = - 2.020. p <.05] there is a significant difference between the score obtained and the faculty graduated from. When the averages are compared, it is seen that teachers who graduated from other faculties ($\bar{X}$ = 4.15) have a higher level of technological pedagogical knowledge than teachers who are graduates of education faculties ($\bar{X}$ = 4.00). Cohen d value was calculated in order to determine the effect of graduated faculty variable on TPK scores. Cohen's d (.24) value shows that the graduated faculty variable has a "small" effect size on TPK.

TPACK Level of Teachers by Professional Seniority

Descriptive statistics of teachers' perceived TPACK levels according to professional seniority variable are presented in Table 10. ANOVA results regarding whether there is a significant difference between the scores are also included in Table 11.

Table 10: Distribution of TPACK Levels by Professional Seniority Levels of Teachers

Dimensions	Seniority	N	X̄	Ss
TK	(1)1-5 years	229	3.81	.60
	(2)6-10 years	131	3.85	.63
	(3)11-15 years	94	3.75	.60
	(4)16-20 years	38	3.80	.64
	(5)21-25 years	36	3.63	.72
	(6)26 + years	53	3.70	.72
CK	(1)1-5 years	229	3.92	.53
	(2)6-10 years	131	4.01	.47
	(3)11-15 years	94	4.00	.47
	(4)16-20 years	38	4.07	.48
	(5)21-25 years	36	3.99	.39
	(6)26 + years	53	4.10	.57
PK	(1)1-5 years	229	4.24	.53
	(2)6-10 years	131	4.44	.49
	(3)11-15 years	94	4.51	.47
	(4)16-20 years	38	4.46	.52
	(5)21-25 years	36	4.52	.45
	(6)26 + years	53	4.45	.45
PCK	(1)1-5 years	229	3.93	.61
	(2)6-10 years	131	4.25	.62
	(3)11-15 years	94	4.28	.52
	(4)16-20 years	38	4.33	.55

	(5)21-25 years	36	4.29	.42
	(6)26 + years	53	4.36	.53
TCK	(1)1-5 years	229	3.80	.65
	(2)6-10 years	131	4.11	.67
	(3)11-15 years	94	4.08	.58
	(4)16-20 years	38	4.17	.62
	(5)21-25 years	36	4.13	.52
	(6)26 + years	53	4.17	.63
TPK	(1)1-5 years	229	3.94	.58
	(2)6-10 years	131	4.07	.59
	(3)11-15 years	94	4.01	.56
	(4)16-20 years	38	4.13	.67
	(5)21-25 years	36	4.07	.60
	(6)26 + years	53	4.12	.66
TPACK	(1)1-5 years	229	3.96	.57
	(2)6-10 years	131	4.18	.56
	(3)11-15 years	94	4.13	.49
	(4)16-20 years	38	4.24	.61
	(5)21-25 years	36	4.17	.53
	(6)26 + years	53	4.22	.63

Table 11: ANOVA Results of Teachers' TPACK Levels by Professional Seniority

		Sum of Squares	df	Mean Square	F	p	Fark	Cohen f
TK	Between Groups	2.077	5	.415	1.033	.397	-	
	Within Groups	231.216	575	.402				
	Total	233.292	580					
CK	Between Groups	2.044	5	.409	1.586	.162	-	
	Within Groups	148.196	575	.258				
	Total	150.241	580					
PK	Between Groups	7.389	5	1.478	5.883	.000*	2, 3>1	.22
	Within Groups	144.435	575	.251				
	Total	151.824	580					
PCK	Between Groups	18.036	5	3.607	10.578	.000*	2, 3, 4, 5, 6 >1	.30
	Within Groups	196.081	575	.341				
	Total	214.117	580					
TCK	Between Groups	14.357	5	2.871	7.008	.000*	2, 3, 6>1	.24
	Within Groups	235.580	575	.410				
	Total	249.937	580					
TPK	Between Groups	2.707	5	.541	1.514	.184	-	
	Within Groups	205.682	575	.358				
	Total	208.389	580					
TPACK	Between Groups	7.017	5	1.403	4.355	.001*	2>1	.19
	Within Groups	185.306	575	.322				
	Total	192.323	580					

*p<.05

As seen in Table 11, there is a significant difference between class teachers' perceived PK, PCK, TCK and TPACK scores and their professional seniority. It is seen that there is a statistically significant difference between the PD scores of teachers according to professional seniority [F (5; 575) = 5.883, p <.05]. It is understood that the effect

size calculated for this difference (.22) is small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It is seen that teachers with professional seniority of 6-10 ($\bar{X}$ = 4.44) and 11-15 ($\bar{X}$ = 4.51) years have higher PK scores than teachers with professional seniority of 1-5 ($\bar{X}$ = 4.24) years.

It is seen that the PCK scores perceived by the classroom teachers differ significantly according to professional seniority [F (5; 575) = 10.578, p <.05]. The effect size calculated for this difference (.30) is moderate. Scheffe post hoc test was conducted in order to find out which groups caused the difference. The teachers who have seniority of 6-10 ($\bar{X}$ = 4.25) years, 11-15 ($\bar{X}$ = 4.28) years, 16-20 ($\bar{X}$ = 4.33) years, 21-25 ($\bar{X}$ = 4.29) years and 26 and more ($\bar{X}$ = 4.36) years are observed to have higher PACK scores than the teachers who have a professional seniority of 1-5 ($\bar{X}$ = 3.93) years.

It is seen that the scores of TCK perceived by classroom teachers differ statistically significantly according to professional seniority [F (5; 575) = 7.008, p <.05]. It was observed that the effect size calculated for this difference (.060) was large. Scheffe post hoc test was conducted in order to find out which groups caused the difference. Teachers with 6-10 ($\bar{X}$ = 4.11) years, 11-15 ($\bar{X}$ = 4.08) years, and 26 and more ($\bar{X}$ = 4.17) years of professional seniority have higher TCK scores than teachers with 1-5 ($\bar{X}$ = 3.80) years of professional seniority.

It is seen that the TPACK scores perceived by classroom teachers differ statistically significantly according to professional seniority [F (5; 575) = 4.355, p <.05]. It has been observed that the effect size calculated for this difference (.19) is small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It is seen that teachers with professional seniority of 6-10 ($\bar{X}$ = 4.18) years have higher TPACK scores than teachers with professional seniority of 1-5 ($\bar{X}$ = 3.96) years.

It is seen that the participants with 1-5 years of professional seniority are at a low level in many sub-scales compared to teachers at other seniority levels. Even 1-year teachers' use of technology in their lessons does not differ much from teachers of other seniority levels. However, the lack of pedagogical knowledge may have caused the low level of knowledge of teachers. It is seen that teachers with 10, 14 and 30 years of seniority apply for training to improve themselves technologically. This may be an indication that senior teachers are trying to improve themselves.

TPACK Knowledge Level of Teachers According to Technology Access at School

Descriptive statistics of teachers' perceived TPACK levels according to the variable of access to technology at school are presented in Table 12. ANOVA results on whether there is a difference between teachers' access to technology at school and their TPACK levels are shown in Table 13.

Table 12: Distribution of TPACK Levels of Teachers by Technology Access at School

Dimensions	Access to Technology at School	N	$\bar{X}$	Ss
TK	(1)No	144	3.74	.60
	(2)Partially	245	3.76	.62
	(3)Yes	192	3.86	.66
CK	(1)No	144	3.93	.52
	(2)Partially	245	3.95	.50
	(3)Yes	192	4.06	.49
PK	(1)No	144	4.32	.54
	(2)Partially	245	4.39	.51
	(3)Yes	192	4.41	.48
PCK	(1)No	144	4.02	.63
	(2)Partially	245	4.14	.62
	(3)Yes	192	4.26	.53
TCK	(1)No	144	3.83	.63
	(2)Partially	245	3.98	.67
	(3)Yes	192	4.14	.61
TPK	(1)No	144	3.92	.60
	(2)Partially	245	3.99	.60
	(3)Yes	192	4.13	.57
TPACK	(1)No	144	4.00	.55
	(2)Partially	245	4.03	.59
	(3)Yes	192	4.24	.53

Table 13: ANOVA Results of Teachers' TPAK Levels According to Access to Technology at School

		Sum of Squares	df	Mean Square	F	p	Fark	Cohen f
TK	Between Groups	1.487	2	.744	1.854	.158	-	-
	Within Groups	231.805	578	.401				
	Total	233.292	580					
CK	Between Groups	1.841	2	.921	3.585	.028*	3>1	.11
	Within Groups	148.400	578	.257				
	Total	150.241	580					
PK	Between Groups	.666	2	.333	1.273	.281	-	-
	Within Groups	151.158	578	.262				
	Total	151.824	580					
PCK	Between Groups	4.675	2	2.337	6.450	.002*	3>1	.14
	Within Groups	209.442	578	.362				
	Total	214.117	580					
TCK	Between Groups	8.124	2	4.062	9.710	.000*	3>1, 2	.18
	Within Groups	241.812	578	.418				
	Total	249.937	580					
TPK	Between Groups	3.863	2	1.931	5.458	.004*	3>1	.13
	Within Groups	204.526	578	.354				
	Total	208.389	580					
TPACK	Between Groups	6.179	2	3.090	9.594	.000*	3>1, 2	.18
	Within Groups	186.144	578	.322				
	Total	192.323	580					

*p<.05

As seen in Table 13, there is a significant difference between the perceived CK, PCK, TCK, TPK and TPACK scores of classroom teachers and their access to technology at school. It has been observed that the CK scores of the teachers differed statistically significantly according to the technology access status at school [F (2; 578) = 3.585, p <.05]. It was observed that the effect size calculated for this difference (.11) was small. As a result of the Scheffe post hoc test conducted to understand from which groups the observed difference stems, it is seen that teachers who have access to technology at school ($\bar{X}$ = 4.06) have higher CK scores than teachers who do not ($\bar{X}$ = 3.93).

It is seen that the PCK scores of the teachers differ statistically significantly according to their access to technology at school [F (2; 578) = 6.450, p <.05]. It has been observed that the effect size calculated for this difference (.14) is small. Scheffe post hoc test was conducted to find out the groups which caused the difference. It is seen that teachers who have access to technology ($\bar{X}$ = 4.26) have higher PCK scores than teachers who do not ($\bar{X}$ = 4.02).

It is seen that the TCK scores perceived by the classroom teachers differ statistically significantly according to the access to technology at school [F (2; 578) = 9.710, p <.05]. It was observed that the effect size calculated for this difference (.18) was small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It was observed that teachers with access to technology ($\bar{X}$ = 4.14) have higher TIP scores than teachers with partial access ($\bar{X}$ = 3.98) and without access ($\bar{X}$ = 3.83).

It is seen that the TPK scores perceived by classroom teachers differ statistically significantly according to the access to technology at school [F (5; 575) = 5.458, p <.05]. It has been observed that the effect size calculated for this difference (.13) is small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It is seen that the TPK scores of the teachers who have access to technology at school ($\bar{X}$ = 4.13) are higher than the teachers who do not (X 3. = 3.92).

It is seen that the TPACK scores perceived by the classroom teachers differ statistically significantly according to the technology access status at school [F (5; 575) = 9.594, p <0.05]. It was observed that the effect size calculated for this difference (.18) was small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It is seen that teachers who have access to technology ($\bar{X}$ = 4.24) at school have higher TPACK scores than teachers who have partial access ($\bar{X}$ = 4.03) and have no access ($\bar{X}$ = 4.00).

When qualitative findings are examined, it is seen that teachers have access to technology in schools. Teachers complement the deficiencies in schools regarding this issue by their own means. For example, if the school does not have a smart board but has a projector, the teacher takes the computer himself. If there is no technological equipment at the school, the teacher provides it himself. The opinion of a teacher regarding this is as follows: S6: In previous years, I really worked in troubled places with no technological opportunities. I worked in villages

where children did not even have a room of their own. Sometimes they didn't even have a bed of their own. Technology did not exist in the schools there, either. I tried to do it with my own means. I took my own computer. Eight kids in my consolidated classroom tried to do something using my computer. I had a photocopy machine, but there was no electricity in the village. We tried to solve the problem by taking photocopies from the stationery in the district center. It was really hard. But in schools located in central locations, technological infrastructure is stronger.

The lack of technological infrastructure also puts an additional workload on the teacher. The imposition of restrictions on smart boards by the management has also caused teachers to be unable to open some educational sites on the Internet. They also produced solutions to solve this problem.

> T7: It is also limited in our smart board. So we can only enter EBA. I make the preparations at home and upload them to a flash drive. When I go to school, I connect the flash memory to the smart board and explain the subject from there… It is a huge problem for me. It increases my workload.

Teachers' use of technology in their classrooms varies according to the possibilities in their classrooms and schools. A teacher who has the opportunity in his class gave the following opinion:

> T4: For example, while I teach face to face in the classroom, I also do live lessons (distance education) at the same time. We use smart boards and computers in the classroom. The internet is always at our fingertips. Now we have to support the information we will transfer to students with the internet. In other words, we feel inadequate when there is no internet and other technological media. These are absolutely necessary.

As the teacher stated in his opinion, technology is a great support for the teacher in the classroom. Therefore, in schools where access to technology is limited, teachers' lower technological pedagogical content knowledge is in line with qualitative data.

TPACK Level of Teachers According to Their Access to Technology at Home

It was examined whether there is a difference between the teachers' access to technology at home and their TPACK levels. Descriptive statistics of TPACK levels according to the variable of access to technology at home are presented in Table 14. ANOVA results on whether there is a difference between teachers' access to technology at home and their TPAK levels are included in Table 15.

Table 14: Distribution of TPACK Levels of Teachers by Home Technology Access Status

Dimensions	Access to Technology at Home	N	$\bar{X}$	Ss
TK	No	16	3.48	.35
	Partially	168	3.69	.65
	Yes	397	3.84	.62
CK	No	16	3.81	.59
	Partially	168	3.95	.53
	Yes	397	4.00	.49
PK	No	16	4.23	.64
	Partially	168	4.37	.53
	Yes	397	4.39	.49
PCK	No	16	3.98	.77
	Partially	168	4.08	.65
	Yes	397	4.18	.57
TCK	No	16	3.73	.86
	Partially	168	3.87	.67
	Yes	397	4.06	.63
TPK	No	16	3.76	.67
	Partially	168	3.90	.60
	Yes	397	4.08	.58
TPACK	No	16	3.84	.73
	Partially	168	4.00	.59
	Yes	397	4.14	.55

Table 15: ANOVA Results of Teachers' TPACK Levels According to Their Access to Technology at Home

		Sum of Squares	df	Mean Square	F	p	Difference	Cohen f
TK	Between Groups	4.347	2	2.174	5.488	.004*	3>2	.13
	Within Groups	228.945	578	.396				
	Total	233.292	580					
CK	Between Groups	.843	2	.422	1.631	.197	-	-
	Within Groups	149.398	578	.258				
	Total	150.241	580					
PK	Between Groups	.417	2	.208	.796	.452	-	-
	Within Groups	151.407	578	.262				
	Total	151.824	580					
PCK	Between Groups	1.597	2	.798	2.171	.115	-	-
	Within Groups	212.520	578	.368				
	Total	214.117	580					
TCK	Between Groups	5.551	2	2.776	6.565	.002*	3>2	.14
	Within Groups	244.385	578	.423				
	Total	249.937	580					
TPK	Between Groups	5.135	2	2.568	7.302	.001*	3>2	.16
	Within Groups	203.254	578	.352				
	Total	208.389	580					
TPACK	Between Groups	3.211	2	1.605	4.906	.008*	3>2	.13
	Within Groups	189.113	578	.327				
	Total	192.323	580					

*p<.05

As seen in Table 15, there is a significant difference between the perceived TK, TCK, TPK and TPACK scores of classroom teachers and their access to technology at home. It is seen that teachers' TK scores differ statistically significantly according to their access to technology at home [F (2; 578) = 5.488, p <.05]. It has been observed that the effect size calculated for this difference (.13) is small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It is seen that teachers who have access to technology at home ($\bar{X}$ = 3.84) have higher TK scores than teachers who have access to partially ($\bar{X}$ = 3.69).

It is seen that the TCK scores perceived by classroom teachers differ statistically significantly according to professional seniority [F (2; 578) = 6.565, p <0.05]. It has been observed that the effect size calculated for this difference (.14) is small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It is understood that teachers who have access to technology at home ($\bar{X}$ = 4.06) have higher TCK scores than teachers who have partial access ($\bar{X}$ = 3.87).

It is seen that TPK scores perceived by classroom teachers differ statistically significantly according to professional seniority [F (5; 575) = 7.302, p <.05]. It has been observed that the effect size calculated for this difference (.16) is small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It is seen that teachers who have access to technology at home ($\bar{X}$ = 4.08) have higher TPK scores than teachers who have partial access ($\bar{X}$ = 3.90).

It is seen that the TPACK scores perceived by classroom teachers differ statistically significantly according to professional seniority [F (5; 575) = 4.906, p <.05]. It has been observed that the effect size calculated for this difference (.13) is small. Scheffe post hoc test was conducted in order to find out which groups caused the difference. It is seen that teachers who have access to technology at home ($\bar{X}$ = 4.14) have higher TPACK scores than teachers who have partial access ($\bar{X}$ = 4.00).

According to the result obtained from the interviews with the teachers, all teachers have access to technology in their homes. However, due to some difficulties in internet infrastructure and technological equipment, there are problems in students' access to technology. There are also teachers who have access to technology but cannot reflect it in the content of their lessons. Regarding this, one teacher's opinion is as follows:

> T16: Some of my friends, who could not use technology fully, bought items such as blackboards and markers at their homes and told the online lesson as if they were in the classroom. They were experiencing the difficulty of this. But the platforms I used also had a board. So I could project it on the screen and the kids were watching from there. In that sense, we were very comfortable in distance education.

As stated in the teacher's opinion, beyond access to technology, it is necessary to use it properly and reflect it to the content of the lessons. In this context, when evaluating access to technology at home, the inclusion of

technological information in the content of education should be taken into account, apart from tools such as internet and computers.

Teachers' TPACK Knowledge Level According to Technology Usage Levels

Descriptive statistics of teachers' perceived TPACK levels according to technology usage level variable are presented in Table 16. ANOVA results regarding whether there is a difference between the technology usage level of teachers and their TPACK levels are given in Table 17.

Table 16: Distribution of TPACK Levels by Teachers' Technology Usage Level

Dimensions	Technology Usage Level	N	$\bar{X}$	Ss
TK	Not enouh	6	3.00	.97
	Partially enough	217	3.36	.50
	Enough	358	4.06	.54
CK	Not enouh	6	3.87	.70
	Partially enough	217	3.80	.49
	Enough	358	4.09	.48
PK	Not enouh	6	4.52	.34
	Partially enough	217	4.30	.56
	Enough	358	4.42	.47
PCK	Not enouh	6	4.79	.40
	Partially enough	217	4.04	.62
	Enough	358	4.20	.58
TCK	Not enouh	6	4.62	.37
	Partially enough	217	3.80	.65
	Enough	358	4.10	.62
TPK	Not enouh	6	4.03	.55
	Partially enough	217	3.82	.61
	Enough	358	4.14	.56
TPACK	Not enouh	6	4.18	.66
	Partially enough	217	3.87	.56
	Enough	358	4.22	.54

Table 17: ANOVA Results of Teachers' TPAK Levels According to Technology Usage Level

		Sum of Squares	df	Mean Square	F	P	Difference	Cohen f
TK	Between Groups	69.739	2	34.870	123.230	.000*	3>2,1	.65
	Within Groups	163.553	578	.283				
	Total	233.292	580					
CK	Between Groups	11.247	2	5.624	23.386	.000*	3>2	.28
	Within Groups	138.993	578	.240				
	Total	150.241	580					
PK	Between Groups	2.167	2	1.083	4.184	.016*	3>2	.11
	Within Groups	149.657	578	.259				
	Total	151.824	580					
PCK	Between Groups	5.750	2	2.875	7.975	.000*	1>2	.16
	Within Groups	208.367	578	.360			3>2	
	Total	214.117	580					
TCK	Between Groups	14.271	2	7.135	17.501	.000*	1>2	.24
	Within Groups	235.666	578	.408			3>2	
	Total	249.937	580					
TPK	Between Groups	13.962	2	6.981	20.753	.000*	3>2	.26
	Within Groups	194.427	578	.336				
	Total	208.389	580					
TPACK	Between Groups	16.242	2	8.121	26.658	.000*	3>2	.30
	Within Groups	176.081	578	.305				
	Total	192.323	580					

*p<.05

As seen in Table 17, there is a significant difference between the subscale scores perceived by classroom teachers and the level of technology usage. It is seen that teachers' TK scores differ in a statistically significant level according to their level of technology use [F (2; 578) = 123.230, p <.05]. It has been observed that the effect size calculated for this difference (.65) is large. Scheffe post hoc test was conducted to find out from which groups this difference originated. It is seen that teachers with sufficient level of technology use ($\bar{X}$ = 4.06) have higher TK scores than teachers who are partially sufficient ($\bar{X}$ = 3.36) and insufficient ($\bar{X}$ = 3.00).

It is seen that the perceived CK scores of classroom teachers differ statistically significantly according to the level of technology use [F (2; 578) = 23.386, p <.05]. It has been observed that the effect size calculated for this difference (.28) is medium. Scheffe post hoc test was conducted to find out which groups caused the difference. Accordingly, teachers with sufficient technology usage level ($\bar{X}$ = 4.09) have higher CK scores than teachers who are partially sufficient ($\bar{X}$ = 3.80).

It is seen that the PK scores perceived by the classroom teachers differ in a statistically significant level according to the level of technology use [F (2; 578) = 4.184, p <.05]. It was observed that the effect size calculated for this difference (.11) was small. Scheffe post hoc test was conducted to find out which groups caused the difference. It is understood that teachers with sufficient level of technology use ($\bar{X}$ = 4.42) have higher PK scores than teachers who are partially sufficient ($\bar{X}$ = 4.30).

It is seen that PCK scores perceived by classroom teachers differ statistically significantly according to the level of technology use [F (2; 578) = 7.975, p <.05]. It has been observed that the effect size calculated for this difference (.16) is small. Scheffe post hoc test was conducted to find out which groups caused the difference. It is seen that teachers with insufficient technology usage level ($\bar{X}$ = 4.79) have higher PCK scores compared to teachers who are partially sufficient ($\bar{X}$ = 4.04). Likewise, it is seen that teachers with sufficient technology usage level ($\bar{X}$ = 4.20) have higher PCK scores than teachers who are partially sufficient ($\bar{X}$ = 4.04).

It is seen that the TCK scores perceived by the classroom teachers differ in a statistically significant level according to the level of technology use [F (2; 578) = 17.501, p <.05]. It was observed that the effect size calculated for this difference (.24) was small. Scheffe post hoc test was conducted to find out which groups caused the difference. It is seen that teachers with insufficient level of technology use ($\bar{X}$ = 4.62) have higher TCK scores than teachers who are partially sufficient ($\bar{X}$ = 3.8099). Similarly, it is seen that teachers with sufficient technology usage level ($\bar{X}$ = 4.10) have higher TCK scores than teachers who are partially sufficient ($\bar{X}$ = 3.80).

It is seen that the TPK scores perceived by classroom teachers differ in a statistically significant level according to the level of technology use [F (2; 578) = 20.753, p <.05]. It has been observed that the effect size calculated for this difference (.26) is medium. Scheffe post hoc test was conducted to find out which groups caused the difference. It is seen that teachers with sufficient level of technology use ($\bar{X}$ = 4.14) have higher TPK scores than teachers who are partially sufficient ($\bar{X}$ = 3.82).

It is seen that the TPACK scores perceived by the classroom teachers differ in a statistically significant level according to the level of technology use [F (2; 578) = 26.658, p <.05]. It was observed that the effect size calculated for this difference (.30) was medium. Scheffe post hoc test was conducted to find out which groups caused the difference. It is observed that teachers with sufficient level of technology use ($\bar{X}$ = 4.22) have higher TPACK scores than teachers who are partially sufficient ($\bar{X}$ = 3.87).

In the interviews, 11 teachers stated that they see themselves partially competent in using technology, while 7 teachers stated that they see themselves competent. The teachers who said that they were partially sufficient also stated that they adapted to technology, but emphasized that they had a lot to learn. Teachers' views on this subject are as follows:

> T2: I definitely do not see myself competent in using technology or other issues. One must always be a researcher. Because every day a new application or software comes into our lives… I make an effort to learn as much as I can. I am doing research on this subject. I am doing research on how I can teach more efficiently or use technology more efficiently in my social life.
>
> T5: Actually, I was not a very adequate person. But I attended some courses and received some training. After those trainings, I am still not at a very adequate level but I am at an average level. I did not know how to use some educational sites or some web 2 tools. I didn't know how to use them. I learned as a result of these trainings. I mean, I'm not very good, but I'm an average individual.

Teachers who consider themselves competent stated that they learn technology easily and are very interested in technology. Teachers' views on this are as follows:

> T3: Since I have been interested in these technological devices since childhood, I think I can use them at a very good level. So, I have an accumulation of knowledge from the past. We have been using the computer for many years. So I see the benefit of this in our lessons, too.

T15: We are currently using technology more actively. I received various training on this. I think I am proficient.

T17: I think I use technology well. I think I use Web 2 tools well. The most important reason for this was that I took part in e-Twinning projects. I started e-Twinning projects with zero knowledge. I learned it myself by watching it on YouTube, tampering with Web 2 tools, and uploading and deleting it on the phone. It is not something that cannot be learned.

It is observed that teachers generally try to keep up with technology and make use of technological tools and programs. In order to adapt, they are constantly trying to improve themselves. In this context, it is also an indication that teachers who see themselves as sufficient in their technological pedagogical content knowledge level have higher technological awareness than teachers who consider themselves partially competent. This awareness also helps teachers to improve themselves.

TPACK Level of Teachers According to In-Service Training in Technology Field

It was investigated whether there is a difference between teachers' in-service training in the field of technology and their TPACK levels. The data obtained as a result of the test are included in Table 18.

Table 18: T-test analysis results of teachers' TPACK scores according to their in-service training status

Dimensions	In-service Training	N	$\bar{X}$	Ss	t	df	p	Cohen d
TK	No	271	3.66	.62	-	579	.000*	.37
	Yes	310	3.90	.61	.4.535			
CK	No	271	3.88	.48	-4.555	579	.000*	.37
	Yes	310	4.07	.51				
PK	No	271	4.33	.49	-1.970	579	.049*	.16
	Yes	310	4.42	.52				
PCK	No	271	4.05	.58	-3.820	579	.000*	.31
	Yes	310	4.24	.61				
TCK	No	271	3.87	.64	-.633	579	.000*	.36
	Yes	310	4.11	.64				
TPK	No	271	3.92	.61	-3.856	579	.000*	.32
	Yes	310	4.11	.57				
TPACK	No	271	3.98	.57	-4.246	579	.000*	.36
	Yes	310	4.19	.56				

*p<.05

When the data in Table 18 are examined, it is seen that the scores of the classroom teachers from the TPACK subscales differ statistically significantly according to the in-service education variable (p <.05). Teachers' scores from the scales of TK [t (579) = - 4.535, p <.05], CK [t (579) = - 4.555, p <.05], PK [t (579) = - 1.970, p <.05], PCK [t (579) = - 3.820, p <.05], TCK [t (579) = -. 633, p <.05], TPK [t (579) = - 3.856, p <.05] and TPACK [t (579) = - 4.246, p <0.05] differ statistically significantly from the in-service education they received in the field of technology.

When the averages ($\bar{x}$) are compared, it is seen that teachers who receive in-service training have higher levels of knowledge than those who do not receive in-service training. In order to determine the effect of the in-service training variable on TPACK, Cohen's d value was calculated. These values are (.37) for the TK subscale,(.37) for the CK subscale, (.31) for the PCK subscale, (.36) for the TCK subscale, (.32) for TPK subscale, and (.36) for the TPACK subscale. Accordingly, it can be said that the variable of receiving in-service training in technology field has a "small" effect size on TPACK. It is also observed that Cohen's d (.16) value has a smaller effect size only for the PK subscale.

As a result of the interviews with the teachers, it was understood that they had not previously received in-service training for technology. However, especially with the pandemic, teachers realized the importance of technology more and received technology-oriented training to be more active in their lessons. In addition, there are teachers who develop themselves in web 2 tools by participating in educational projects. Teachers' views on these issues are as follows:

T15: I received the distance education prepared by the National Education…. I participated actively. Here I received 15-16 trainings. I received in-service training to improve myself and use technology more actively.

T5: But I attended some courses and received some trainings. After those e-trainings, again I'm not at a very competent level, but at an average level right now. I didn't know how to use some educational sites or some web 2 tools. I didn't know how to use them. I learned as a result of these trainings.

T18: Frankly, I did not know much about Web 2 tools in the previous years. For the last two years, I started to learn, especially thanks to eTwinning projects. In the previous years, I was using classical tools such as presentation. I have been trying to improve myself for the last two years.

It is observed that teachers receive training in order to improve themselves, even if there is no in-service training. These trainings contribute to teachers' use of different technological tools. In this context, the change in technological pedagogical content knowledge resulting from the evaluation of quantitative data depending on in-service training is confirmed by qualitative data.

CONCLUSION AND DISCUSSION

In this study, the technological pedagogical content knowledge of classroom teachers was examined. It is seen that teachers' TPACK levels are at the level of "totally agree" in pedagogical knowledge dimension and "agree" level in other dimensions. In studies conducted with teachers and teacher candidates to examine TPACK levels (Açıkgül & Aslaner, 2015; Bal & Karademir, 2013; Kabakçı Yurdakul, 2011; Sancar Tokmak et al., 2013; Sezer, 2015; Şad et al.2015; Yavuz Konokman et al., 2013), the result was found to be high levels of TPACK. This coincides with the result of our research. In the study of Sağlam Kaya (2019), it was concluded that the TPACK scores of prospective teachers were at medium and high levels, varying according to the department they studied. In the research of Bal and Karademir (2013), it was stated that teachers see themselves as less competent at the technological knowledge level, and high enough in other subscales.

Looking at the gender variable, it is seen that the levels of male teachers are higher than female teachers in TPK and TPACK subscales. Akkoyunlu and Orhan (2003) found that men have higher skills than women in terms of high level computer skills. Çoklar (2014) stated that in the TPACK specialization factor, the competencies of male teacher candidates are higher than that of women. Öztürk (2013), in his research examining the TPACK level of pre-service teachers, concluded that male teacher candidates are at a higher level than female teacher candidates in pedagogical knowledge levels. Similar to this study, in the study conducted by Erdoğan and Şahin (2010), it was observed that the TPACK levels of male teacher candidates were higher than that of women. As seen in the studies, in some sub-dimensions of the TPACK scale, men have higher levels of knowledge than women. There are also studies that reach the opposite results of this research. Altun (2018) emphasized that in certain dimensions of TPACK, female classroom teachers got higher scores than male classroom teachers. It is stated that female teachers are at a higher level in content and pedagogical knowledge dimensions. In the study conducted by Akyıldız and Altun (2018) with prospective classroom teachers, it was determined that female teacher candidates obtained better scores than male pre-service teachers in the pedagogy knowledge, pedagogical content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge dimensions of the TPACK scale. There are also studies in which the researchers found no significant differences between genders (Gömleksiz & Fidan, 2011; Sancak Tokmak et. al., 2013; Şad et al., 2015; Ünal, 2013; Yavuz Konokman et al., 2013).

According to the results of the study, there was no significant difference in TPACK levels, except for the TPN subscale, in their graduation status. In addition, it was concluded that the TPACK levels of teachers who received in-service training were higher than those who did not receive in-service training. Teachers with sufficient technological infrastructure at home and at school have a higher level in some sub-scales than teachers with partially sufficient infrastructure. Likewise, teachers who consider themselves competent in using technology have higher TPACK levels than teachers who see themselves as partially competent.

Teachers use technology in their lessons for the purposes such as drawing attention, learning with fun, evaluating and concretizing the subjects. These technologies are brought into their classes by means of watching videos, making events and playing games. Classroom teachers use technology in their lessons and in student-parent communication through educational sites, web 2 tools and different technological tools. Teachers use technology in many lessons such as science, life science and music, especially in Turkish and mathematics. In the study conducted by Doğru and Aydın (2018) with geography teachers, it was understood that most of the teachers used technology-based teaching using smart boards, projectors and computers in their lessons. Teachers use technology in their lessons in order to make the subjects more concrete. Thus, they think that the lessons become more interesting and students understand the subjects better. In Şahin's (2019) study, similar to the results of the study, it was observed that teachers mostly used computers, printing devices, portable memory and internet technologies. It was emphasized that they mostly use information technologies for the purpose of increasing the learning level and retention, using rich content in lessons, attracting students' attention, motivation and making lessons fun.

Within the scope of the results obtained in line with the data obtained from the teachers' TPACK scale and semi-structured interviews, the following suggestions can be made:

• The fact that teachers with a seniority of 1-5 years have a lower level in some sub-scales compared to the more senior ones has revealed the necessity to attach importance to pre-service trainings. In this context, classroom teaching undergraduate programs can be reviewed and courses for reflecting technological information to educational environments can be added.

• The higher level of knowledge of teachers who receive in-service training compared to those who do not indicate the importance of teachers' in-service training. In this context, in-service training can be given to teachers to increase both their technological knowledge and their technological pedagogical knowledge.

• Teachers' access to technology in home and school environments can be made more effective. Switching to distance education during the epidemic increases teachers' need for technology in their homes. Equipment and infrastructure deficiencies in schools should also be eliminated. Necessary arrangements can be made for teachers to use technology more effectively in their lessons.

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