



TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) CONFIDENCE OF TEACHERS WORKING IN THE TEXTBOOK WRITING COMMISSION

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Abstract: The aim of the study, which is designed based on survey model, is to measure whether the TPACK confidence makes a significant difference in terms of determined variables in the study. The research group consists of 201 teachers working as textbook authors in the textbook writing commissions in the 2022-2023 academic year. Data collected using "Personal Information Form" and "Technological Pedagogical Content Knowledge Confidence Survey" were analyzed by using t-test and one-way ANOVA tests. The results showed that the participants have a mid-level of confidence in TPACK. In addition, the results showed that while The TPACK confidence level didn't differ significantly by gender, age and experience (both in teaching profession and textbook writing commission); branches and the status of taking a course about using technology caused significant differences in some sub-dimensions of TPACK confidence level.

Key words: TPACK confidence, technology integration, textbooks, teachers

1. Introduction

Developing and using digital technologies for educational purposes is one of the main aims of the governments in the 21st century. The integration of technology is seen as the most essential component of effective learning in all fields of education. Despite the importance of technology integration in education, it is known that less than 50% of teachers use technology in their teaching (Fraillon, Ainley, Schulz, Duckworth & Friedman, 2019). The results of the 2018 Organisation for Economic Co-operation and Development (OECD) International Teaching and Learning Survey showed that teachers need training to enrich their technology-related skills, and only 43% of them feel ready for using technology in their professional life (OECD, 2019). Also, even if there was increasing usage of technology in distance education due to the pandemic, many teachers worldwide differed in their readiness to use technology in teaching (Scherer, Howard, Tondeur & Siddiq, 2021).

The fact that teachers need to use technology in their education should be considered independently of their content knowledge level. Regarding this type of knowledge, Schulman (1986) introduced the concept of pedagogical content knowledge (PCK), which indicates the unique integration of teachers' content knowledge with general pedagogical knowledge. Subject knowledge and general pedagogical strategies are used together in PCK. Both represent the structure of teacher knowledge because both are accessed simultaneously when teachers interpret and present the subject in an accessible way for students. In the covered PCK, the topics most taught in the 'subject area' are those that benefit most from representation of ideas, 'strong' analogies, illustrations, examples, explanations and demonstrations. In other words, it refers to the forms of finding and presenting the representation that makes the subject most understandable for students. PCK also requires a knowledge of what will make learning a particular concept easier and harder.

Mishra and Koehler (2006) developed Technology Pedagogy Content Knowledge (TPACK) in addition to PCK and defined it as a fundamental concept of effective teaching that brings together technology and pedagogical techniques to create a unique understandings among students from current knowledge. Archambault and Crippen (2009) also believe that TPACK includes relationships and understandings between students, teachers, content, technologies and practices. Nordin and Faekah

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(2016) expressed TPACK as the understanding of the relationship between technological knowledge, content knowledge and pedagogical knowledge in teaching practices. In summary, TPACK requires teachers to apply pedagogical content knowledge and technology effectively and efficiently, and to integrate technology with their teaching appropriately and effectively in order to teach effectively using technology. Figure 1 shows the general structure of technological pedagogical content knowledge.

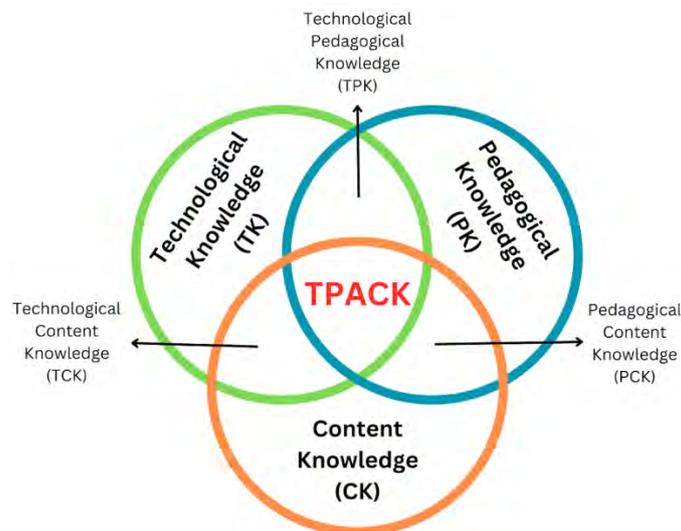


Figure 1. *The structure of TPACK (Koehler & Mishra, 2008)*

As seen in Figure 1, according to Koehler and Mishra (2008), three basic components are mentioned in order to integrate technology into an effective teaching: Content knowledge (CK), pedagogical knowledge (PK) and technological knowledge (TK). The relationship between these three main areas of knowledge was examined under the TPACK structure. According to TPACK model, which is the combination of these three knowledge areas, PCK is formed by the intersection of pedagogical knowledge and content knowledge, TCK is formed by the intersection of technological knowledge and content knowledge, and TPK is formed by the intersection of technological knowledge and pedagogical knowledge. Explanations on what each component of TPACK is given below (Koehler & Mishra, 2009):

Content Knowledge

It is defined as the knowledge a teacher has about the field to be taught. Although content knowledge changes according to different disciplines, being able to establish patterns among the sub-dimensions of the subject field, solving real-life problems with field knowledge, updating the knowledge about the subject field by following current developments are listed as indicators of content knowledge.

Pedagogical Knowledge

It covers applications in the teaching process, such as teaching methods/techniques/strategies and related information. In other words, according to which criteria the learning environment will be designed, how the teaching time will be managed more efficiently, knowing how the learning of student groups at different levels will take place can be listed as indicators of pedagogical knowledge.

Technological Knowledge

Since TPACK is a teacher knowledge model, when we define its components, it refers to the ability to use traditional technology tools (pencils, erasers, blackboards, books, etc.) and advanced technology tools (smart boards, internet, and digital video etc.). Using the needed technology appropriately, solving the problems encountered by using technology actively, using technology in line with ethical rules are listed as indicators of technological knowledge.

Technological Pedagogical Knowledge

It means knowing the pedagogical benefits and limitations of the technological tools that are thought to be used in the process of creating learning-teaching environments and being able to interact with technology and pedagogical methods. To be able to solve the problems related to the technology used in the learning environment and being able to benefit from technology in interacting with the student are listed as the indicators of technological pedagogical knowledge.

Technological Content Knowledge

It is defined as determining the technology that is most suitable for the subject area to be taught, and to determine the interaction and limitation of technology and the field. Using effective technology that will contribute to the content of the subject area, using technology to follow the current developments in the subject area, and using technology to establish a link between the subject area and real life are listed as the indicators of technological content knowledge.

Pedagogical Content Knowledge

According to the definition of Shulman (1986), who introduced the concept of pedagogical content knowledge to literature, it is the transformation of content knowledge into a form that can be best understood by students at different levels and levels. Being able to choose the teaching method that is suitable for the content of the subject to be taught, choosing the appropriate teaching material, and identifying appropriate analogies, presentations and examples are listed as the indicators of pedagogical content knowledge.

Considering the relationship between TPACK and textbooks, it is seen that electronic content (e-content) has a great importance. Just as textbooks are an integral part of traditional learning environments, e-contents have become an integral part of learning environments in the digital age. E-content can be a combination of text, audio, video, images, animations and visual effects delivered via the internet, satellite, broadcast or mobile technology (Peter, 2021). Structured e-content provides learners with positive learning experiences and improves learning outcomes. E-contents, which are an integrated part of textbooks, offer the opportunity to transform textbooks, which are seen as static sources of information, into dynamic tools that enrich the learning experience. E-contents should be considered as an integral part of textbooks. In this context, textbooks prepared within the framework of the curriculum should be supported with e-contents prepared in accordance with the purpose and structure of the relevant curriculum (Ministry of National Education, 2022).

In addition to the narrative content accompanied by colorful photographs and graphics, it is important to include sections and activities that are expanded by using worksheets and other materials (Woodward, Elliot & Nagel, 2013). Textbook research mostly consists of analyzing how concepts, non-textual elements in textbooks, visual representations, learning content or learning texts are integrated into the textbook (Vojř & Rusek, 2019). In this context, it is thought that it is important to know at what level the textbook authors use technology knowledge while integrating these elements into the textbook. In addition, it can be stated that it is important to use teachers' pedagogical and content knowledge appropriately in this technology integration process. E-contents used in textbooks will encourage teachers who use that textbook to use technology. Therefore, it is thought that it is important to investigate textbook authors' self-confidence about TPACK, which is thought to have an important effect on the reflection of e-contents in textbooks. In line with these explanations, the research questions were determined as follows:

1. What is the confidence level of textbook authors regarding technological pedagogical content knowledge?
2. Does the confidence level of textbook authors regarding technological pedagogical content knowledge change significantly according to the determined variables?

2. Method

2.1. Research Design

This research is designed based on survey model which is used for describing a past or current situation (Karasar, 2014). The aim of the study is to measure whether the TPACK confidence makes a significant difference in terms of gender, age, branch, years of service in teaching, years of service in the textbook writing commission, participation in training for technology use.

2.2. Participants

The research group consists of 201 teachers working as a textbook author in the textbook writing commissions in the 2022-2023 academic year. The teachers participating in the study were selected through convenient sampling method from teachers working in the commissions. Table 1 shows the demographic characteristics of the participants:

Table 1. Demographic characteristics of the participants ($N=201$)

Groups		<i>f</i>	%
I like Mathematics.	Female	90	44.8
	Male	111	55.2
Mathematics is boring.	35 and younger	23	11.5
	from 36 to 45	104	51.7
	from 46 to 55	69	34.3
	56 and older	5	2.5
Branch	Hard sciences	93	46.3
	Soft sciences	108	53.7
Experience as a teacher (year)	5 and less	3	1.5
	from 6 to 10	26	12.9
	from 11 to 15	29	14.4
	from 16 to 20	34	16.9
	from 21 to 25	66	32.8
	26 and more	43	21.5
Experience as a textbook author (year)	5 and less	154	76.6
	from 6 to 11	41	20.4
	12 and more	6	3
Taking a course in technology use	Yes	150	74.6
	No	51	25.4

(Hard sciences are maths, biology, physics, chemistry, information technologies; soft sciences are geography, Turkish literature, philosophy, history, English, arts.)

As seen in Table 1, the numbers of female ($f: 90$) and male ($f: 111$) participants are close to each other. About half of the teachers are between the ages of 36-45 (51.7%). While the numbers of teachers who teach in hard science ($f: 93$) and soft science ($f: 108$) are close to each other; the majority of teachers has 21-25 years (32.8%) of experience in teaching profession. In addition, the majority of teachers has been working in the textbook writing commissions for 5 years or less (76.6%) and taken a course about using technology (74.6%).

2.3. Data Collection

The data for the study were collected by implementing the “Personal Information Form” and “Technological Pedagogical Content Knowledge Confidence Survey”.

Personal Information Form (PIF)

This form, prepared by the researchers, was used to collect the data about demographic characteristics of the teachers, including the questions about these characteristics such as gender, age, branch, experience as a teacher and a textbook author, and the status of taking a course about using of technology.

Technological Pedagogical Content Knowledge Confidence Survey (TPACK-CS)

This form, developed by Graham, Burgoyne, Cantrell, Smith, and Harris (2009) and adapted into Turkish by Timur and Taşar (2011), was used to investigate TPACK confidence level of teachers. The survey consists of 31 items and four dimensions: Technological Pedagogical Content Knowledge (TPACK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK) and Technological Knowledge (TK). Participants were asked to mark one of the options for the items of the survey "I'm not confident at all.", " I have little confidence.", "I am moderately confident.", "I have confidence a lot.", and "I'm totally confident.". Differently from other sub-dimensions, participants have other option "I don't know this kind of technology" for the questions in TK sub-dimension. Reliability analysis of the instrument showed that the Cronbach-Alpha coefficient was .92 for the whole of the survey. The reliability coefficients of the four sub-dimensions were also very high .89, .87, .89, .86 respectively for the TPCK, TPK, TCK, and TK sub-dimensions. In this study, the Cronbach's alpha coefficient was 0.96 for the whole survey. The Cronbach's alpha coefficient for the sub-dimensions was also high, .92 for TPACK, .95 for TPK, .95 for TCK, and .93 for TK. These results showed that the scale can be used in this study.

2. 4. Data Analysis

The resulting data were analyzed with SPSS program. Since the number of teachers participating in the research was more than 50, the results of the Kolmogorov-Smirnov test were examined for the whole scale and its sub-dimensions. Since $p > 0.05$ calculated for each dimension, it can be said that the sub-dimensions have a normal distribution (Güriş & Astar, 2014). Since the data sets showed normal distribution, t-test and one-way analysis of variance (One-Way-Anova) were applied.

3. Results

In this section, teachers' confidence in technological pedagogical content knowledge is presented under separate headings specific to the variables examined.

3. 1. TPACK Confidence Level of Teachers

Table 2 shows the findings of the teachers' scores on TPACK-CS obtained by using descriptive statistics results.

Table 2. *TPACK confidence level of teachers*

Sub-dimensions	N	\bar{X}	SD	Min.	Max.
TPACK	20	3.70	0.690	1.88	5.00
TPK		3.86	0.743	2.00	5.00
TCK		3.21	1.224	0.00	5.00
TK		3.67	0.831	1.27	5.00
Overall		3.65	0.719	1.68	5.00

According the Table 2, it's seen that while teachers have highest level of confidence in TPK sub-dimension (=3.86); their confidence level is lowest in TCK sub-dimension (=3.21). In addition, it is found that the level of TPACK confidence of teachers is 3.65 in overall.

3. 2. Findings Obtained by Examining Teachers' TPACK Confidence Levels by Gender

In order to compare TPACK confidence level between female and male teachers, t-test was used. Table 3 shows the results of t-test.

Table 3. *TPACK confidence level of teachers by gender*

Sub-dimensions	Groups	N	\bar{X}	SD	p	t
TPACK	Female	90	3.70	0.71	.946	-0.068
	Male	111	3.70	0.67		

TPK	Female	90	3.79	0.74	.262	-1.125
	Male	111	3.91	0.74		
TCK	Female	90	3.14	1.22	.433	-0.786
	Male	111	3.28	1.22		
TK	Female	90	3.69	0.83	.788	0.269
	Male	111	3.66	0.83		
Overall	Female	90	3.62	0.72	.702	-0.384
	Male	111	3.66	0.71		

df=199

As seen in Table 3, there was not a significant difference in levels of TPACK confidence between female and male teachers both for all sub-dimensions and the overall results ($p_{\text{TPACK}} = .946$, $p_{\text{TPK}} = .262$, $p_{\text{TCK}} = .433$, $p_{\text{TK}} = .788$, $p_{\text{Overall}} = .702$).

3. 3. Findings Obtained by Examining Teachers' TPACK Confidence Levels by Age

Table 4 shows the results of ANOVA used to compare TPACK confidence level among teachers in different ages.

Table 4. TPACK confidence level of teachers by age

Sub-dimensions	Groups (Year)	N	\bar{X}	SD	Source of variance	df	Sum of squares	Mean squares	p
TPACK	35 and younger	23	3.70	0.59	Between groups	3	.939	.313	.582
	from 36 to 45	104	3.67	0.70	Within groups	197	94.306	.479	
	from 46 to 55	69	3.77	0.70	Total	200	95.244		
	56 and older	5	3.37	0.61					
TPK	35 and younger	23	3.96	0.74	Between groups	3	.322	.107	.902
	from 36 to 45	104	3.83	0.73	Within groups	197	110.104	.559	
	from 46 to 55	69	3.86	0.78	Total	200	110.426		
	56 and older	5	3.80	0.44					
TCK	35 and younger	23	3.34	1.56	Between groups	3	.522	.174	.951
	from 36 to 45	104	3.22	1.04	Within groups	197	299.238	1.519	
	from 46 to 55	69	3.18	1.37	Total	200	299.760		
	56 and older	5	3.12	1.10					
TK	35 and younger	23	3.61	0.84	Between groups	3	1.779	.593	.465
	from 36 to 45	104	3.70	0.86	Within groups	197	136.377	.692	
	from 46 to 55	69	3.69	0.78	Total	200	138.156		
	56 and older	5	3.10	0.49					
Overall	35 and younger	23	3.67	0.71	Between groups	3	.535	.178	.795
	from 36 to 45	104	3.64	0.70	Within groups	197	102.925	.522	
	from 46 to 55	69	3.67	0.76	Total	200	103.460		
	56 and older	5	3.33	0.44					

Table 4 shows that the TPACK confidence level of teachers does not differ significantly according to their age, including all dimensions of survey ($p_{\text{TPACK}} = .582$, $p_{\text{TPK}} = .902$, $p_{\text{TCK}} = .951$, $p_{\text{TK}} = .465$, $p_{\text{Overall}} = .795$).

3. 4. Findings Obtained by Examining Teachers' TPACK Confidence Levels by Branch

T-test was conducted in order to compare TPACK confidence level between those who teaches hard sciences and soft sciences. Table 5 shows the results of t-test:

Table 5. TPACK confidence level of teachers by branch

Sub-dimensions	Groups	N	\bar{X}	SD	p	t
TPACK	Hard sciences	93	3.61	0.66	.037*	-2.103
	Soft sciences	108	3.81	0.70		
TPK	Hard sciences	93	3.78	0.75	.105	-1.630
	Soft sciences	108	3.95	0.71		

TCK	Hard sciences	93	3.02	1.29	.015*	-2.451
	Soft sciences	108	3.44	1.10		
TK	Hard sciences	93	3.55	0.83	.024*	-2.269
	Soft sciences	108	3.81	0.81		
Overall	Hard sciences	93	3.53	0.72	.013*	-2.513
	Soft sciences	108	3.78	0.69		

df=199

As seen in Table 5, the confidence level in some dimensions differs significantly according to the branches. The results show that the teachers who teach soft sciences have more confidence in TPACK (Mean= 3.81, $p= .037$), TCK (Mean= 3.44, $p= .015$), TK (Mean= 3.81, $p= .024$) sub-dimensions, as well as in general score of TPACK-CS (Mean= 3.78, $p= .013$).

3. 5. Findings Obtained by Examining Teachers' TPACK Confidence Levels by Experience in Teaching Profession

The results of ANOVA used to compare TPACK confidence level among teachers with different length of experience in working as teachers can be seen in Table 6:

Table 6. TPACK confidence level of teachers by experience in teaching profession

Sub-dimensions	Groups (Year)	N	\bar{X}	SD	Source of variance	df	Sum of squares	Mean squares	p
TPACK	5 and less	3	3.41	0.07	Between groups	5	1.808	.362	.584
	from 6 to 10	26	3.85	0.62	Within groups	195	93.436	.479	
	from 11 to 15	29	3.69	0.64	Total	200	95.244		
	from 16 to 20	34	3.83	0.53					
	from 21 to 25	66	3.62	0.76					
	26 and more	43	3.67	0.76					
TPK	5 and less	3	3.47	0.43	Between groups	5	3.182	.636	.332
	from 6 to 10	26	4.03	0.74	Within groups	195	107.244	.550	
	from 11 to 15	29	3.84	0.64	Total	200	110.426		
	from 16 to 20	34	4.04	0.61					
	from 21 to 25	66	3.76	0.80					
	26 and more	43	3.78	0.79					
TCK	5 and less	3	3.06	0.11	Between groups	5	5.176	1.035	.635
	from 6 to 10	26	3.42	1.46	Within groups	195	294.584	1.511	
	from 11 to 15	29	3.36	1.01	Total	200	299.760		
	from 16 to 20	34	3.40	0.93					
	from 21 to 25	66	3.10	1.27					
	26 and more	43	3.04	1.35					
TK	5 and less	3	3.45	0.50	Between groups	5	4.516	.903	.258
	from 6 to 10	26	3.73	0.84	Within groups	195	133.640	.685	
	from 11 to 15	29	3.90	0.67	Total	200	138.156		
	from 16 to 20	34	3.84	0.84					
	from 21 to 25	66	3.56	0.92					
	26 and more	43	3.53	0.73					
Overall	5 and less	3	3.38	0.28	Between groups	5	2.992	.598	.330
	from 6 to 10	26	3.78	0.71	Within groups	195	100.468	.515	
	from 11 to 15	29	3.75	0.60	Total	200	103.460		
	from 16 to 20	34	3.81	0.54					
	from 21 to 25	66	3.54	0.82					
	26 and more	43	3.54	0.74					

Table 6 shows that the TPACK confidence level of teachers does not differ significantly according to their experience in teaching profession, including all dimensions of survey ($p_{TPACK}= .584$, $p_{TPK}= .332$, $p_{TCK}= .635$, $p_{TK}= .258$, $p_{Overall}= .330$).

3. 6. Findings Obtained by Examining Teachers' TPACK Confidence Levels by Experience in Textbook Writing Commissions

Table 7 shows the results of ANOVA used to compare TPACK confidence level among teachers with different years of experiences in textbook writing commissions:

Table 7. TPACK confidence level of teachers by experience in textbook writing commissions

Sub-dimensions	Groups (Year)	N	\bar{X}	SD	Source of variance	df	Sum of squares	Mean squares	p
TPACK	5 and less	154	3.69	0.05	Between groups	2	.218	.109	.797
	from 6 to 11	41	3.75	0.10	Within groups	198	95.026	.480	
	12 and more	6	3.58	0.32	Total	200	95.244		
TPK	5 and less	154	3.83	0.06	Between groups	2	.810	.405	.482
	from 6 to 11	41	3.97	0.09	Within groups	198	109.616	.554	
	12 and more	6	3.66	0.27	Total	200	110.426		
TCK	5 and less	154	3.21	0.10	Between groups	2	.047	.023	.985
	from 6 to 11	41	3.22	0.17	Within groups	198	299.713	1.514	
	12 and more	6	3.30	0.36	Total	200	299.760		
TK	5 and less	154	3.66	0.06	Between groups	2	.782	.391	.570
	from 6 to 11	41	3.75	0.11	Within groups	198	137.374	.694	
	12 and more	6	3.37	0.37	Total	200	138.156		
Overall	5 and less	154	3.63	0.74	Between groups	2	.377	.188	.697
	from 6 to 11	41	3.71	0.59	Within groups	198	103.084	.521	
	12 and more	6	3.48	0.76	Total	200	103.460		

As seen in Table 7, the TPACK confidence level of teachers does not differ significantly according to their experience in textbook writing commissions, including all dimensions of survey ($p_{TPACK} = .797$, $p_{TPK} = .482$, $p_{TCK} = .985$, $p_{TK} = .570$, $p_{Overall} = .697$).

3. 7. Findings Obtained by Examining Teachers' TPACK Confidence Levels by Status of Taking a Course About Technology

An independent samples t-test was conducted to compare TPACK confidence level between those who took a course about using of technology and who didn't. Table 8 shows the results of t-test:

Table 8. TPACK confidence level of teachers by status of taking a course

Sub-dimensions	Groups	N	\bar{X}	SD	p	t
TPACK	Yes	150	3.73	0.70	.392	0.858
	No	51	3.63	0.63		
TPK	Yes	150	3.88	0.77	.397	0.849
	No	51	3.78	0.63		
TCK	Yes	150	3.27	1.28	.278	1.088
	No	51	3.05	1.00		
TK	Yes	150	3.75	0.80	.020*	2.336
	No	51	3.44	0.87		
Overall	Yes	150	3.70	0.74	.098	1.664
	No	51	3.50	0.63		

df=199

As seen in Table 8, the confidence level in TK sub-dimension differs significantly according to the status of taking a course about technology use. The results show that the teachers who took a course have more confidence in TK (Mean= 3.75) than teachers who didn't (Mean= 3.44, $p = .020$).

4. Conclusion, Discussion, and Recommendations

In this study, firstly, it was aimed to examine the level of TPACK confidence of teachers working in textbook writing commissions. The results showed that teachers had medium level of confidence

regarding technological pedagogical content knowledge. In a similar way, it was found that a high percentage of participants had a very low level of perceived competences while using digital technologies for teaching and learning in the study conducted by Al-Abdullatif (2019). Additionally, in the same study, participants expressed a very low level for most TPACK integration practices. Considering the other similar studies showing that teachers have problem with using/integrating the technology in their teaching process (Özdemir & Erduran, 2019; Başaran, Ülger, Demirtaş, Kara, Geyik & Vural, 2021; Winter, Costello, O'Brien & Hickey, 2021; Basilotta-Gómez-Pablos, Matarranz, Casado-Aranda & Otto, 2022), it can be said that the result of this study supports the other findings in the field.

Another finding obtained in the study is that gender did not significantly change teachers' TPACK confidence level. When TPACK is considered as a component of the teaching profession, it can be stated that this component is not expected to change according to gender. Because there are many studies stating that beliefs, perceptions and competencies related to the teaching profession do not change according to gender (Burmabıyık, 2014; Sánchez Prieto, Trujillo Torres, Gómez García & Gómez García, 2020; Özcan & Saraç, 2020; Al-Momani, 2022). In this respect, it can be stated that the TPACK did not change according to gender, which is consistent with other findings. Similarly, it was found that teachers' TPACK confidence levels did not differ significantly according to age. When the demographic characteristics of the teachers participating in the research are examined, it is seen that the majority of the teachers are above the age of 36. The fact that age does not make a significant difference in the results of the research may be due to the average age of the teachers. In general, it can be mentioned that teachers, who are likely to have a traditional and technology-free student background, maintain these habits. This possibility may explain the lack of significant difference in teachers' TPACK confidence.

It was determined that just as the age of the teachers did not significantly change the TPACK confidence level, the experience they had in the teaching profession did not significantly change the TPACK confidence level as well. It can be said that this finding supports the finding related to the age variable. However, it is thought that the fact that the experience gained in the textbook writing commission did not significantly change TPACK self-confidence is unexpected. Although it is thought that authors/teachers who are responsible for including electronic content in textbooks can create a significant increase in TPACK confidence levels, a finding that does not support this situation was obtained in this study.

According to the research, teachers' teaching in hard and soft sciences significantly changed their TPACK confidence levels in almost all sub-dimensions. The results showed that the teachers who teach soft sciences have more confidence in TPACK. It can be thought that instructional methods that change according to the discipline (soft sciences or hard sciences) taught affect teachers' TPACK confidence. In the study of Vo, Zhu and Diep (2020), it was examined how the teaching methods used by teachers teaching in soft sciences and hard sciences changed. According to the findings of the study, it was found that teachers teaching in soft sciences use online assignments more, give more space to online activities, and use online student-teacher communication more often than those in hard sciences. According to these findings, it can be stated that soft science teachers use technology more in their teaching and this situation significantly increases their TPACK confidence level.

According to another finding obtained in the study, it is seen that the training of teachers for technology use makes a significant difference in the Technology Knowledge sub-dimension of TPACK confidence. As Osamwonyi (2016) mentioned, we cannot underestimate the need for in-service education of teachers. It is essential for supporting their work performance and motivation. Lack of in-service training of teachers will be an obstacle for professional growth as well as avoiding gaps between current and ideal situation. In addition, there are many studies showing that in-service training provides the development of teachers in various professional subjects (Gaudreau, Royer, Frenette, Beaumont & Flanagan, 2013; Vu, Han & Buell, 2015; Alfaidi & Elhassan, 2020; Bayrak & Bayrak, 2021).

Considering all the findings and interpretations, it can be stated that the TPACK confidence of the teachers who work as textbook writers will increase the TPACK competencies of other teachers.

Because teachers working as textbook authors are responsible for enriching the contents specified in the curriculum with electronic content. Teachers who use textbooks enriched with e-content will also be encouraged to use technology in their teaching. Therefore, it should be ensured that the teachers who will take part in the writing of the textbooks are primarily competent in the field of technology. When necessary, their needs regarding this issue should be supported with in-service trainings and their knowledge should be updated. Moreover, in-service training should be provided to teachers on how to use the e-contents in the textbooks.

References

- Alfaidi, S. D. A., & Elhassan, F. A. M. (2020). The role of in-service training programs in teachers' development. *International Journal of Learning and Teaching*, 6(3), 191-95.
- Al-Abdullatif, A. M. (2019). Auditing the TPACK confidence of pre-service teachers: The case of Saudi Arabia. *Education and Information Technologies*, 24(6), 3393-3413.
- Al-Momani, M. O. (2022). Cognitive competencies of secondary school teachers in Jordan from their point of view. *IJIET (International Journal of Indonesian Education and Teaching)*, 6(1), 180-192. <https://doi.org/10.24071/ijiet.v6i1.4305>
- Archambault, L., & Crippen, K. (2009). Examining TPACK among K-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education*, 9(1), 71-88.
- Basilotta-Gómez-Pablos, V., Matarranz, M., Casado-Aranda, L.A., & Otto, A. (2022). Teachers' digital competencies in higher education: a systematic literature review. *International Journal of Educational Technology in Higher Education*, 19(1), 1-16. <https://doi.org/10.1186/s41239-021-00312-8>
- Başaran, M., Ülger, I. G., Demirtaş, M. Kara, E., Geyik, C. & Vural, Ö. F. (2021). Uzaktan eğitim sürecinde öğretmenlerin teknoloji kullanım durumlarının incelenmesi [Investigation of teachers' use of technology in the distance education process]. *OPUS International Journal of Society Researches*, 17 (37), 4619-4645. <https://doi.org/10.26466/opus.903870>
- Bayrak, N. & Bayrak, G. (2021). Eğitimde teknoloji kullanımını içerikli hizmet içi eğitim kurslarının öğretmenlerin teknolojik pedagojik alan bilgisi özgüvenine etkileri [The effects of in-service training courses about the use of technology on teachers' technological pedagogical content knowledge self-confidence]. *Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, 18(1), 1009-1041. <https://doi.org/10.33711/yyuefd.957385>
- Burmabıyık, Ö. (2014). Öğretmenlerin teknolojik pedagojik içerik bilgilerine yönelik öz-yeterlilik algılarının çeşitli değişkenler açısından incelenmesi (Yalova İli Örneği) [Investigation of perceptions of self-sufficiency towards teachers' technological pedagogical content knowledge in terms of different variables (Case of Yalova)]. Master's thesis, Sakarya Üniversitesi.
- Fraillon, J., Ainley, J., Schulz, W., Duckworth, D., & Friedman, T. (2019). IEA international computer and information literacy study 2018 assessment framework. Springer Nature. <https://doi.org/10.1007/978-3-030-19389-8>
- Gaudreau, N., Royer, É., Frenette, É., Beaumont, C., & Flanagan, T. (2013). Classroom behaviour management: The effects of in-service training on elementary teachers' self-efficacy beliefs. *McGill Journal of Education*, 48(2), 359-382.
- Graham, C. R., Burgoyne, N., Cantrell, P., Smith, L., St. Clair, L., & Harris, R. (2009). TPACK development in science teaching: Measuring the TPACK confidence of inservice science teachers, *TechTrends, Special Issue on TPACK*, 53(5), 70-79.
- Güriş, S., & Astar, M. (2014). Bilimsel araştırmalarda SPSS ile istatistik [Statistics with SPSS in scientific research]. İstanbul: Der Kitabevi
- Karasar, N. (2014). Bilimsel araştırma yöntemi [Scientific research method]. Ankara: Nobel.

Koehler, M., & Mishra, P. (2008). Introducing TPCK. In AACTE Committee on Innovation and Technology (Eds.), *The handbook of technological pedagogical content knowledge for teaching and teacher educators* (pp. 3-29). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

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

Ministry of National Education. (2022). Elektronik eğitim içerikleri: genel bakış [Electronic education contents: an overview]. Talim ve Terbiye Kurulu Başkanlığı, Elektronik Eğitim İçerikleri Daire Başkanlığı. Ankara.
https://ttkb.meb.gov.tr/meb_iys_dosyalar/2022_12/07160301_elektronikegitimicerikleri_genelbakis.pdf (21.03.2023)

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A New Framework for Teacher Knowledge. *Teachers College Record*, 108(6), 1017-1054.
<https://doi.org/10.1111/j.1467-9620.2006.00684.x>

Nordin, H., & Faekah, T. A. T. (2016). Validation of a technological pedagogical content knowledge instrument in a Malaysian secondary school context. *Malaysian Journal of Learning and Instruction*, 13(1), 1-24. <https://doi.org/10.32890/mjli2016.13.1.1>

Organisation for Economic Co-operation and Development (OECD). (2019). TALIS 2018 results (volume I): Teachers and school leaders as Lifelong learners. OECD Publishing.
<https://doi.org/10.1787/1d0bc92a-en>

Osamwonyi, E. F. (2016). In-Service education of teachers: overview, problems and the way forward. *Journal of Education and Practice*, 7(26), 83-87.

Özcan, B., & Saraç, L. (2020). COVID-19 pandemisi sürecinde öğretmen çevrimiçi uzaktan eğitim rol ve yeterlikleri: Beden eğitimi öğretmenleri örneği [Teachers' roles and competencies in online distance learning during the covid-19 pandemic crisis: a case of physical education teachers]. *Milli Eğitim Dergisi*, 49(1), 459-475.

Özdemir, N. & Erduran, Y. A. (2019). Matematik öğretmenlerinin teknolojik pedagojik alan bilgisine ilişkin yeterliliklerinin değerlendirilmesi [An evaluation of mathematics teachers' efficiency about technological pedagogical content knowledge]. *Manisa Celal Bayar Üniversitesi Eğitim Fakültesi Dergisi*, 7(1), 29-47.

Peter, R. M. (2021). Necessity of e-content and digital education in ELT during covid-19 pandemic situation. *Journal of Linguistics and English Language Teaching*, 1(1), 56-61.

Sánchez Prieto, J., Trujillo Torres, J. M., Gómez García, M., & Gómez García, G. (2020). Gender and digital teaching competence in dual vocational education and training. *Education Sciences*, 10(3), 84.

Scherer, R., Howard, S. K., Tondeur, J., & Siddiq, F. (2021). Profiling teachers' readiness for online teaching and learning in higher education: Who's ready? *Computers in Human Behavior*, 118, 106675.
<https://doi.org/10.1016/j.chb.2020.106675>

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

Timur, B., & Taşar, M. F. (2011). Teknolojik pedagojik alan bilgisi öz güven ölçeğinin (TPABÖGÖ) Türkçe'ye uyarlanması [The adaptation of the technological pedagogical content knowledge confidence survey into Turkish]. *Gaziantep University Journal of Social Sciences*, 10(2), 839-856.

Vo, M. H., Zhu, C., & Diep, A. N. (2020). Examining blended learning implementation in hard and soft sciences: A qualitative analysis. *International Journal of Research in Education and Science*, 6(2), 250-272.

Vojir, K., & Rusek, M. (2019). Science education textbook research trends: a systematic literature review. *International Journal of Science Education*, 41(11), 1496-1516.
<https://doi.org/10.1080/09500693.2019.1613584>

Vu, J. A., Han, M., & Buell, M. J. (2015). The effects of in-service training on teachers' beliefs and practices in children's play. *European Early Childhood Education Research Journal*, 23(4), 444-460.

Winter, E., Costello, A., O'Brien, M., & Hickey, G. (2021). Teachers' use of technology and the impact of Covid-19. *Irish Educational Studies*, 40(2), 235-246.
<https://doi.org/10.1080/03323315.2021.1916559>

Woodward, A., Elliot, D. L., & Nagel, K. C. (2013). Textbooks in school and society: An annotated bibliography and guide to research. Routledge. New York.

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