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Investigation of Primary School Teachers' Professional Competencies and Technological Pedagogical Content Knowledge (TPACK) Competencies

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Abstract

This study aims to examine primary school teachers' Technological Pedagogical Content Knowledge (TPACK) levels and teaching self-efficacy according to their general demographic characteristics. Descriptive and correlational research methods were used in the study. The quantitative sample of the study consists of 217 teachers working in primary schools in Astana province in the 2022-2023 academic year. Personal information form, TPACK and Teaching Self-Efficacy scales were used as data collection tools. Information about the demographic variables of the participants was given with descriptive statistics including frequency and percentage. Independent sample T-Test, one-way ANOVA test, Tukey test, and Pearson correlation test were used for data analysis. As a result of the quantitative analyses, TPACK competencies of the teachers were found to be at a medium level, whereas their self-efficacy beliefs were found to be at a high level. Significant differences were observed in gender and professional seniority variables in terms of TPACK competencies. Especially the technology knowledge competencies of female teachers were found to be at low level. Again, the technology knowledge of teachers with high professional seniority was found to be significantly low. Finally, significant and positive relationships were found between self-efficacy beliefs and TPACK competencies of primary school teachers.

Introduction

As a result of studies on teacher evaluations from various perspectives, numerous approaches have been obtained to define a good teacher. Although there are different definitions of teacher competencies, it should not be ignored that these definitions are based on certain contents and are relative as good teachers are good for different reasons. Each teacher can create learning in different ways. It may not be right to use a phenomenon that makes one teacher good or competent for another. Many personal, unconventional, creative, cognitive and psychological factors may come into play. As a result, there are typologies of good teachers who adapt different teaching styles, preferences and practices to suit their students. The competencies that a good teacher should possess have been discussed and

defined from different perspectives by different researchers (Kaendler et al., 2015; Pantić & Wubbels, 2010). It is very important to determine the factors affecting teachers' personal and professional knowledge, skills, performances, orientations, motivation sources and attitudes in educational processes. In the studies conducted in this context, it is concluded that one of the important variables that shape teachers' attitudes and behaviors is the perception of efficacy (Bandura, 1997; Enochs & Riggs, 1990; Ross, 2004). Teacher self-efficacy is a teacher's judgment about whether he/she can arouse a desire to learn in students with his/her knowledge, skills and attitudes (Tschannen-Moran & Woolfolk-Hoy, 2001). If a teacher is successful, it is thought that his/her perceptions of self-efficacy will also be high. Teachers with low self-efficacy perceptions are less committed to their profession (Evans & Tribble, 1986), avoid teaching activities in the classroom (Woolfolk & Hoy, 1990), and spend less time on academic subjects (Gibson & Dembo, 1984). Teachers with high self-efficacy are thought to be open to innovations and technological developments (Kara, 2020). The qualities of a professional teacher identity can be summarized as follows (Garmston, 1998; Sünbül, 1996).

- To be sufficient in field knowledge.
- To be knowledgeable about various teaching methods and to choose the appropriate method for the subject.
- To have knowledge and understanding of child development and learning theories.
- To be aware of weak and strong points about oneself.
- To have a healthy communication and interaction with colleagues at school.

Perhaps the most prominent of these competencies mentioned above is that an effective teacher is aware of his/her inadequacies and competencies. This awareness is a very important step for teachers to develop and train themselves. Because teachers who are aware of their own competencies have the chance to continuously improve these competencies according to the changing and developing conditions of the day. In societies that are in the process of development and change, changes occur in many areas such as knowledge, technology, lifestyle, values and economy (Al-shummarani & Nasr, 2022; Bhargava & Pathy, 2011; Cakir, Ozturk, & Unal, 2019; Medley, 1977; Yılmaz İnce, 2022).

An important dimension of a teacher's professional competence is to be competent in his/her field. Being successful in the profession depends on having the knowledge and skills related to one's field. Teachers who receive information about their field during their education should not be contented with these. He/she should develop himself/herself by participating in continuous lifelong learning and should have the competence to effectively apply the knowledge foreseen by the education programs related to his/her field. In addition to content knowledge, another professional competence of a teacher is to have knowledge and skills especially for learning and teaching (Ben-Peretz, 2011). These competencies, which constitute mostly classroom teaching processes, include features such as using strategies, methods, techniques, teaching materials, measuring and evaluating achievement, effective communication skills and classroom management (Mandal, 2018; Zhu et al., 2013). Many quantitative studies emphasize the importance of understanding teacher efficacy and beliefs (Calderhead, 1996; Jones & Carter, 2007; Kaleli, 2020; Pajares, 1992). However, only a few have examined the relationship between teacher efficacy, teaching beliefs, teaching knowledge and how these translate into teacher practice, and even fewer have examined the potential influence of contextual factors on these links (Abell, 2007; Kara, 2020;

Nargund-Joshi & Liu, 2013). Roehring and Luft (2004) examined how teachers' efficacy and beliefs influence their pedagogical decisions. They categorized teachers as Inquiry Teachers, Process Oriented Teachers and Traditional Teachers. Accordingly, it was observed that teachers with inquiry orientation held student-centered beliefs and exhibited guided inquiry teaching strategy. It was noticed that teachers with process-oriented teaching orientation mainly used activities and laboratory activities.

On the other hand, teachers with a traditional orientation believed in the saying "There are only things that need to be said!" (Roehring & Luft, 2004) and emphasized that it would be sufficient to provide detailed information for the lesson format. Research emphasizes that the attention span of primary school children is only ten minutes. A teacher who only lectures will only be able to keep students in class for ten minutes (Alaagib, Musa & Saeed, 2019; van den Bogerd et al., 2020). By using a variety of activities and different materials (audio-visual and written), not only students' interest in the lesson can be increased by preventing them from "intellectual wandering", but also students with different learning skills can be helped to learn and remember the lesson better. Therefore, a contemporary teacher is expected to use a variety of teaching methods, techniques and different materials in their lessons (Lim, Chai & Churchill, 2011; Maba & Mantra, 2018; Mantra, 2017).

The most effective elements that can initiate change in schools are school administrators and teachers. Therefore, it is important that teachers gain competence in this field first. Especially in the last 30 years, the integration of computer technology into learning and teaching environments has become an inevitable component of many new educational reforms in terms of educational policy, pedagogy, curriculum and teaching resources (Chen, 2010). Nowadays, utilizing technology in the education process is a situation we encounter quite frequently. Technology is involved in the education process in a wide range from the process of teaching the lesson (information texts, audio recordings, animations, educational films, etc.) to the activity part of the lesson (online activity applications) to the evaluation process of the lesson (online exams, e-school, etc.). In this respect, it can be said that teachers who are responsible for education and training should have the competencies to use these technologies in a purposeful and effective manner. In this context, it is thought that developments should be monitored not for the use of technology in education, but for the correct use of technology in education. In this study, the relationship between primary school teachers' teaching competencies and their technological pedagogical content knowledge, which includes the area of integrating these competencies into technology in the right way, was examined, thus providing an opportunity to have a new idea about the correct use of technology in education. This issue increases the importance of the research (Aslan 2011, Bernato et al., 1988; Guzman & Nussbaum, 2012; Raob et al., 2012).

Different technology integration models have been proposed in the literature to ensure technology integration in educational environments. Among these models, the most frequently mentioned and prominent model is the Technological Pedagogical Content Knowledge (TPACK) model. The TPACK model serves as a framework for examining teachers' and pre-service teachers' knowledge about the use of technology in education based on three basic knowledge domains: technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK). Moreover, these domains are integrated with each other to form the following sub-dimensions: technological pedagogical knowledge (TPK), technological content knowledge (TCK) and pedagogical content knowledge (PCK) (Mishra & Koehler, 2006). Thus, TPACK is formed by the interaction of the development of

teachers' content knowledge, technology knowledge and teaching-learning knowledge, and the aim here is to provide a basic approach to teachers' technology-assisted subject matter teaching by combining these dimensions (Chaipidech et al., 2022; Niess, 2005).

TPACK is a theoretical framework that suggests that in order for the use of technology in education to provide the desired level of impact, the types of knowledge that constitute it and the dynamic relationship between these knowledge types should be handled together and defines how this can be done (Mishra & Koehler, 2006). This framework was created by adding the "Technology Knowledge" (TK) component to the "Pedagogical Content Knowledge" (PCK) theoretical framework created by Shulman (1986). As a result of this addition, new components such as "Technological Pedagogical Knowledge" (TPK) and "Technological Content Knowledge" (TCK) emerged. The concept of content knowledge includes teachers' basic knowledge about the subject to be learned or taught (Koehler & Mishra, 2008). It can be said that a teacher who has content knowledge should have a body of knowledge covering his/her field. In addition, teachers should be able to present this knowledge to their students in a complete and effective way and keep their field knowledge up to date. CK can be defined as the knowledge and usage skills about technological tools and computer programs to be used in teaching activities (Niess et al., 2020). On the other hand, TCK is the teacher's knowledge of how technology and subject area affect and limit each other (Wollmann & Lange-Schubert, 2022). Having pedagogical content knowledge (PCK) is one of the most important elements to be emphasized in teacher professional development. Pedagogical knowledge can be defined as “the relative status of a teacher that provides information about whether or not he/she is able to reflect the best teaching practices with the way he/she teaches” (Santos & Castro, 2021).

Knowledge of pedagogy influences a teacher's disposition about how to teach in the best way. However, a teacher should transform pedagogical content knowledge into practice. In this context, both pedagogical and instructional competencies of the teacher come to the fore. Therefore, pedagogical knowledge is a broader concept that includes teaching practices (Maeng et al., 2013). In this context, teachers' knowledge of which technologies are most appropriate for the subject matter they will convey in their field and how the subject area necessitates and perhaps even changes the technology or how the technology necessitates and perhaps even changes the subject area constitute the content of the content of the TCK component (Koehler & Mishra, 2009). TPK is the knowledge of how the teaching process will be affected when certain technological tools are used in certain ways (Koehler & Mishra, 2009). TPK also includes knowing the pedagogical approaches appropriate to the technological tools in question and the possibilities and limitations provided by the tools used.

Technological pedagogical content knowledge is a field of knowledge that emerges with the combination of technology, pedagogy and content knowledge dimensions and goes beyond them. TPACK, in essence, includes the knowledge of how to teach effectively with technology. For effective teaching, dimensions such as technological knowledge, pedagogical knowledge and content knowledge alone are not sufficient. For this reason, the teacher has to reach a synthesis of these dimensions in order to offer new learning experiences to his/her students, and this synthesis emerges as technological pedagogical content knowledge (Koehler et al., 2013; Wang, Schmidt-Crawford & Jin, 2018). In this context, TPACK, which is formed by the interaction of three basic components, can be briefly summarized as the teacher's knowledge of how to use the technological tool to be used

in a certain subject in order to facilitate student learning (Lachner et al., 2021; Schmid, Brianza & Petko, 2021). Integrating technology into teaching and learning in primary schools requires holistically changing both teachers' knowledge of educational technology and their beliefs, stances and pedagogical perceptions. Research has shown that teachers who undergo a training that includes TPACK tend to realize that this approach to applying technology in teaching promotes teaching and contributes to the learning process. Teachers who undergo such training understand that content, pedagogy and technology need to be integrated rather than perceived as separate components in their teaching. This will strengthen their self-efficacy on the one hand and develop their competence to integrate technology into their field on the other (Niess, 2005; Koehler, Mishra, & Yahya, 2007).

In this study involving primary school teachers, the question of whether there is a significant relationship between teachers' competencies in the teaching profession and their competencies in the professional field (technological pedagogical content knowledge) was sought to be answered. Thus, it was revealed to what extent there is a relationship between the general competencies and technological pedagogical content knowledge competencies of primary school teachers who are responsible for one of the most important levels of education.

In this context, answers to the following main question and sub-questions were sought in the study: What is the level of technological pedagogical content knowledge (TPACK) competencies of primary school teachers according to their own perceptions?

- According to the perceptions of primary school teachers, do their TPACK competencies differ according to gender?
- According to the perceptions of primary school teachers, do their TPACK competencies differ according to their seniority?
- What is the level of self-efficacy of primary school teachers?
- Do primary school teachers' self-efficacy differ according to gender?
- Do primary school teachers' self-efficacy differ according to their seniority?
- What is the relationship between primary school teachers' self-efficacy and TPACK competencies?

Method

This study is a quantitative study conducted according to descriptive survey and relational survey models. The descriptive survey model is a widely used model to reveal the current situation as it is. Quantitative methods were used in the research. The biggest advantage of the quantitative research method is that it offers the opportunity to reach a large number of participants. However, it can be said that this type of research has disadvantages in terms of providing in-depth information since it is based on the participants' responses to the measurement tools. The research population consists of primary school teachers working in Astana city in Kazakhstan in the academic year 2022-2023. For the quantitative sample, the central districts with the highest school density were determined. A total of 230 teachers were selected through cluster sampling among the schools in each district. 13 teachers were not included in the evaluation because they did not fill more than half of the questionnaire. In this context, research processes were carried out with 217 teachers. Depending on the purpose of the study, this sampling type enabled in-depth research by selecting information-rich situations. The research sample shows a balanced

distribution in terms of gender and professional seniority.

Data Collection Tools

The research data were collected using the "Scale for Assessing Teacher Technological Pedagogical Content Knowledge" developed by Schmidt, Baran, Thompson, Mishra, Koehler, and Shin (2010) and adapted into Kazakh by the researchers. The scale was applied to 256 primary school teachers and exploratory and confirmatory factor analysis was performed by the researchers and it was determined that all items in the original form of the scale could be included in the Kazakh form. The adapted scale consists of 47 items and is 5-point Likert-type. There are seven dimensions in the scale: Content Knowledge (CK), Technology Knowledge (TK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technology Content Knowledge (TCK), and Technology Supported Pedagogical Content Knowledge (TPACK). In addition, within the scope of the reliability study, the internal consistency coefficient of the whole scale was calculated as 0.91. The reliability of the subscales ranged between .76 and .93. The Cronbach Alpha coefficient calculated on the data collected within the scope of this research sample was calculated as 0.89. The high mean scores obtained from the TPACK scale indicate that the competence is high.

Teacher Self-Efficacy Scale

The Teacher Self-Efficacy Belief Scale developed by Dellinger, Bobbett, Olivier, and Ellet (2008) and adapted to Kazakh culture by the researchers was used as another measurement tool in the study. The Teacher Self-Efficacy Belief Scale consists of five factors and 29 items: Planning and Improving Learning (1,2,3,3,4,5,6,7,8,9), Creating a Positive Classroom Environment (10, 11, 12, 13, 14, 15, 16), Effective Learning Process (17, 18, 19, 20, 21, 22, 23), Individual Differences (24, 25, 26) and Academic Development (27, 28, 29). The Cronbach's alpha internal consistency coefficient of the Kazakh form of the scale was determined as .92. High mean scores obtained from the teaching self-efficacy scale indicate a high level of efficacy.

Data Analysis Techniques

Since the number of items in the factors in the scale is different, the raw factor scores were first converted into standard scores as the average score divided by the number of items in the factor in order to facilitate the comparison of factor scores. In order to determine whether parametric analyses could be used, the normal distribution status of the scale data collected from primary school teachers was examined first. In this framework, kurtosis and skewness coefficients of the data were calculated. It was determined that the kurtosis and skewness coefficients obtained were between -1.5 and +1.5. In this framework, it was decided that parametric analyses could be performed assuming that the data related to TPACK and teaching efficacy scales of primary school teachers were normally distributed. The collected data were analyzed using SPSS program and arithmetic mean, standard deviation, minimum, maximum values, t and ANOVA tests were used. A significance level of $p>0.05$ was considered sufficient.

Findings

Table 1 shows the descriptive statistics results regarding the scores of primary school teachers on the 7 subscales of the TPACK scale. According to the analysis, the participants obtained arithmetic mean values of 2.79±0.28 from TK subscale; 3.37±0.66 from PCK subscale; 3.80±0.85 from CK subscale; 2.54±0.37 from TPK subscale; 3.44±0.72 from TCK subscale, 3.14±4,10 from PCK subscale and finally 3.05±0.82 from TPACK subscale. According to the weighted mean values, technology knowledge (TK) and technology pedagogy (TPK) competencies of primary school teachers were found to be at low level; pedagogy knowledge (PK), technology content knowledge (TCK), pedagogy content knowledge (PCK) and technology pedagogy content knowledge (TPACK) competencies were found to be at medium level, whereas content knowledge (CK) competencies were found to be at high level.

Table 1. Descriptive Statistics of the Scores Obtained from TPACK Scale

	N	Minimum	Maximum	Mean	Std. Deviation
TK	217	1.50	4.80	2.79	0.28
PK	217	1.17	5.00	3.37	0.66
CK	217	2.00	5.00	3.80	0.85
TPK	217	2.00	4.90	2.54	0.37
TCK	217	2.00	5.00	3.44	0.72
PCK	217	1.86	4.14	3.14	0.63
TPACK	217	1.00	4.00	3.05	0.82

Table 2 shows the descriptive statistical results of primary school teachers' scores from the 6 sub-dimensions of the teaching self-efficacy scale.

Table 2. Descriptive Statistics of the Scores Obtained from the Teacher Self-Efficacy Scale

Teacher Self-Efficacy Scale	N	Minimum	Maximum	Mean	Std. Deviation
Planning and Improving Learning	217	2.00	5.00	4.21	0.79
Creating a Positive Classroom Environment	217	2.00	5.00	3.64	0.87
Effective Learning Process	217	1.00	5.00	3.10	0.93
Individual Differences	217	1.00	5.00	2.60	0.99
Academic Development	217	2.00	5.00	2.68	0.75
Teacher Competence Total	217	1.60	4.60	3.25	0.67

According to the analyses, the participants obtained arithmetic mean values of 4.21±0.79 from Planning and Improving Learning subscale; 3.64±0.87 from Creating a Positive Classroom Environment subscale; 3.10±0.93 from Effective Learning Process subscale; 2.60±0.99 from Individual Differences subscale; 2.68±0.75 from Academic Development subscale and finally 3.25±0.67 from the whole scale (teaching self-efficacy). According to the weighted mean values, the self-efficacy perceptions of primary school teachers about organizing learning environment according to individual differences and academic development were found to be below the low

middle level. Participant teachers' perceptions of self-efficacy in creating a positive classroom environment, providing effective learning process and general teaching self-efficacy were found to be at a medium level, while their perceptions of efficacy in planning and improving learning were found to be at a high level.

According to Table 3, the results of the comparison of primary school teachers' scores from the 7 sub-dimensions of the TPACK scale according to gender are shown. According to the t-test analysis, t values of 2.25 in TK subscale; 0.10 t value in PCK subscale; 0.99 t value in CK subscale; 0.09 t value in TPK subscale; 2.20 t value in TCK subscale, 1.29 t value in PCK subscale and finally 1.26 t value in TPACK subscale were calculated. According to the t values, no difference was found in primary school teachers' content knowledge (CK), technology pedagogy knowledge (TPK), pedagogy knowledge (PK), pedagogy content knowledge (PCK) and technology pedagogy content knowledge (TPACK) competencies according to gender variable ($p>0.05$). On the other hand, technology knowledge (TK) and technology content knowledge (TCK) competencies of the participants show significant difference according to gender variable ($p<0.05$). In these two dimensions, it was observed that male primary school teachers obtained higher averages compared to their female colleagues.

Table 3.t-Test Analysis Results of TPACK Scale Scores by Gender

TPACK Scale	Gender	N	Mean	Std. Deviation	t	p
TK	Female	122	2.76	0.29	-2.25	0.025
	Male	95	2.84	0.25		
PK	Female	122	3.36	0.71	-0.10	0.922
	Male	95	3.37	0.60		
CK	Female	122	3.75	0.82	-0.99	0.324
	Male	95	3.86	0.88		
TPK	Female	122	2.54	0.37	-0.09	0.931
	Male	95	2.55	0.37		
TCK	Female	122	3.34	0.64	-2.20	0.029
	Male	95	3.56	0.79		
PCK	Female	122	3.09	0.61	-1.294	0.197
	Male	95	3.20	0.65		
TPACK	Female	122	2.99	0.81	-1.261	0.209
	Male	95	3.13	0.83		

Table 4 shows the comparison results of primary school teachers' teaching self-efficacy according to gender variable. According to the analyses, a t value of 0.05 was calculated between the mean scores of male and female participants in the 'Planning and Developing Learning' subscale; a t value of 0.54 in the 'Creating a Positive Classroom Environment' subscale; a t value of 1.01 in the 'Effective Learning Process' subscale; a t value of 0.37 in the 'Individual Differences' subscale; a t value of 0.94 in the academic development subscale and finally a t value of 0.47 in the whole teaching self-efficacy scale. According to these findings, self-efficacy perceptions of primary school teachers did not reveal a significant difference according to gender variable.

Table 4. t-Test Analysis Results of the Scores Obtained from the Teacher Self-Efficacy Scale according to Gender

Teacher Self-Efficacy Scale	Gender	N	Mean	Std. Deviation	t	p
Planning and Improving Learning	Female	122	4.20	0.76	-0.05	0.959
	Male	95	4.21	0.82		
Creating a Positive Classroom Environment	Female	122	3.66	0.84	0.54	0.591
	Male	95	3.60	0.90		
Effective Learning Process	Female	122	3.04	0.95	-1.01	0.318
	Male	95	3.17	0.91		
Individual Differences	Female	122	2.58	0.96	-0.37	0.714
	Male	95	2.63	1.02		
Academic Development	Female	122	2.64	0.72	-0.94	0.346
	Male	95	2.74	0.80		
Teacher Competence Total	Female	122	3.23	0.67	-0.47	0.638
	Male	95	3.27	0.67		

Table 5 shows the results of the comparison of primary school teachers' scores from the 7 sub-dimensions of the TPACK scale according to their working time in the profession. According to the F test analysis, 10.88 F values were calculated for TK subscale, 1.42 F values for PCK subscale, 2.28 F values for CK subscale, 5.44 F values for TPK subscale, 2.73 F values for TCK subscale, 3.08 F values for PCK subscale and finally 2.35 F values for TPACK subscale. According to the t values, there was no difference in primary school teachers' content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technology content knowledge (TCK) and technology pedagogical content knowledge (TPACK) competencies according to the working time in the profession variable ($p>0.05$). On the other hand, participants' technology knowledge (TK) and technology pedagogy knowledge (TPK) competencies show a significant difference according to their seniority in the profession ($p<0.05$). According to Tukey test analysis, it was observed that in these two dimensions, teachers with a professional seniority of 0-9 years obtained higher averages compared to their colleagues with a professional seniority of 20 years and above.

Table 5. F-Test Analysis Results of the Scores Obtained from TPACK Scale According to Professional Seniority

TPACK Scale	Professional Seniority	N	Mean	Std. Deviation	F	p
TK	0-9 years	44	2.89	0.10	10.88	0.000
	10-19 years	93	2.84	0.22		
	20 years and above	80	2.69	0.36		
	Total	217	2.79	0.28		
PK	0-9 years	44	3.41	0.59	1.42	0.244
	10-19 years	93	3.28	0.66		
	20 years and above	80	3.45	0.70		

TPACK Scale	Professional Seniority	N	Mean	Std. Deviation	F	p
	Total	217	3.37	0.66		
CK	0-9 years	44	3.86	0.65	2.28	0.105
	10-19 years	93	3.66	0.96		
	20 years and above	80	3.93	0.78		
	Total	217	3.80	0.85		
TPK	0-9 years	44	2.70	0.30	5.44	0.005
	10-19 years	93	2.50	0.38		
	20 years and above	80	2.51	0.37		
	Total	217	2.54	0.37		
TCK	0-9 years	44	3.63	0.93	2.73	0.068
	10-19 years	93	3.45	0.65		
	20 years and above	80	3.32	0.64		
	Total	217	3.44	0.72		
PCK	0-9 years	44	3.06	0.64	3.10	0.058
	10-19 years	93	3.26	0.62		
	20 years and above	80	3.04	0.61		
	Total	217	3.14	0.63		
TPACK	0-9 years	44	3.26	0.72	2.35	0.098
	10-19 years	93	3.05	0.74		
	20 years and above	80	2.93	0.94		
	Total	217	3.05	0.82		

Table 6 shows the results of the comparison of primary school teachers' teaching self-efficacy according to the professional seniority variable. According to the F test analysis, 1.09 F value was calculated between the mean scores of the participants with different professional seniority in the 'Planning and Developing Learning' subscale; 0.03 F value in the 'Creating a Positive Classroom Environment' subscale; 0.13 t value in the 'Effective Learning Process' subscale; 1.93 F value in the 'Individual Differences' subscale; 1.24 F value in the academic development subscale and finally 1.73 F values in the whole teaching self-efficacy scale. According to these findings, self-efficacy perceptions of primary school teachers did not show a significant difference according to professional seniority variable.

Table 6. F Test Analysis Results of the Scores Obtained from the Teacher Self-Efficacy Scale According to Professional Seniority

Teacher Self-Efficacy Scale	Professional Seniority	N	Mean	Std. Deviation	F	P
Planning and Improving Learning	0-9 years	44	4.36	0.97	1.09	0.337
	10-19 years	93	4.17	0.69		
	20 years and above	80	4.16	0.79		
	Total	217	4.21	0.79		

Teacher Self-Efficacy Scale	Professional Seniority	N	Mean	Std. Deviation	F	P
Creating a Positive Classroom Environment	0-9 years	44	3.61	0.92	0.03	0.975
	10-19 years	93	3.63	0.78		
	20 years and above	80	3.65	0.94		
	Total	217	3.64	0.87		
Effective Learning Process	0-9 years	44	3.16	1.24	0.13	0.882
	10-19 years	93	3.09	0.75		
	20 years and above	80	3.08	0.94		
	Total	217	3.10	0.93		
Individual Differences	0-9 years	44	2.71	1.22	1.93	0.245
	10-19 years	93	2.63	0.59		
	20 years and above	80	2.73	1.07		
	Total	217	2.60	0.99		
Academic Development	0-9 years	44	2.61	0.65	1.24	0.291
	10-19 years	93	2.62	0.76		
	20 years and above	80	2.79	0.79		
	Total	217	2.68	0.75		
Teacher Competence Total	0-9 years	44	3.33	0.86	1.73	0.181
	10-19 years	93	3.15	0.45		
	20 years and above	80	3.31	0.75		
	Total	217	3.25	0.67		

Table 7 shows the Pearson Product Moment Correlation Coefficient values between the TPACK competencies of primary school teachers and their scores obtained from the teaching self-efficacy scale.

Table 7. Pearson Correlation Coefficients for the Scores Obtained from TPACK and Teacher Self-Efficacy Scales

TPACK Scale		Planning and Improving Learning	Creating a Positive Classroom Environment	Effective Learning Process	Individual Differences	Academic Development	Teacher Competence Total
TK	r	0.097	0.028	.185**	.220**	0.046	0.122
	p	0.155	0.683	0.006	0.001	0.502	0.074
PK	r	.215**	.234**	.183**	.233**	0.060	.244**
	p	0.001	0.001	0.007	0.001	0.382	0.000
CK	r	.332**	.356**	.156*	0.059	0.091	.252**
	p	0.000	0.000	0.021	0.384	0.180	0.000
TPK	r	.324**	.277**	.302**	.232**	0.018	.304**
	p	0.000	0.000	0.000	0.001	0.788	0.000

TPACK Scale		Planning and Improving Learning	Creating a Positive Classroom Environment	Effective Learning Process	Individual Differences	Academic Development	Teacher Competence Total
TCK	r	0.061	0.062	.150*	.179**	0.124	0.065
	p	0.372	0.361	0.027	0.008	0.068	0.344
PCK	r	0.084	0.090	0.122	0.065	0.026	0.102
	p	0.218	0.186	0.073	0.341	0.706	0.135
TPACK	r	.388**	.358**	.321**	.335**	0.019	.376**
	p	0.000	0.000	0.000	0.000	0.779	0.000

According to the results of the analysis, teacher self-efficacy scores and TK (r=0.122; p>0.05), PC (r=0.244; p<0.05), CK (r=0.252; p<0. 05), TPK (r=0.304; p<0.05), TCK (r=0.065; p>0.05), PCK (r=0.102; p>0.05), and TPACK (r=0.376; p<0.05) correlation values were calculated. According to these values, it is understood that there are significant and positive moderate relationships between teacher self-efficacy level and PCK, CK, TPK and TPACK competencies. In general, as teachers' TPACK competencies increase, an increase is observed in teacher self-efficacy perceptions.

Discussion

In this study, it was aimed to determine the Technological Pedagogical Content Knowledge and teaching self-efficacy of primary school teachers and to examine the relationship between these two variables. The data collected to answer the research questions asked in line with this purpose were analyzed and the results of the analysis were shown in tables in the findings section. In the first dimension of the study, according to the results obtained regarding the research problem "What is the level of Technological Pedagogical Content Knowledge competencies of primary school teachers?", it was concluded that the participants' Technological Pedagogical Content Knowledge competencies were at a medium level. According to this result obtained regarding the research question, it was seen that primary school teachers' technology knowledge and technological content knowledge were at a low level, while their pedagogical knowledge, content knowledge, the relationship between technology and content knowledge, pedagogical elements contained in the field knowledge, pedagogical competencies in the use of technology, and technological pedagogical content knowledge competencies, which are the synthesis of technology, pedagogy and content knowledge, were at a medium level. These findings were also found in other studies (Archambault & Crippen, 2009; Koh & Chai, 2011; Koyuncuoğlu, 2022). The reasons for this can be inadequate in-service trainings, technical problems and teacher's lack of technological knowledge, as well as the readiness problems of teachers and prospective teachers in technology integration.

In another finding of the study, partial relationships were observed between teachers' TPACK competencies and their gender. In general, no significant difference was found in TPACK competence according to gender. Similarly, the fact that the general TPACK competencies of teachers did not differ according to gender in some studies is similar to the results of other studies (Jang & Tsai, 2012; Kara, 2021; Koh & Chai, 2011; Koyuncuoğlu,

2022). However, significant differences were found in TK and TCK dimensions according to gender. A significant difference was observed in favor of men in the dimensions involving research technology knowledge. These findings are in line with the findings of Doğru (2020), Kara (2021) and Koyuncuoğlu (2022). The fact that male participants are more prone to technology and female teachers are more prone to classroom teaching management and techniques can be shown as one of these factors. However, such hypotheses need to be examined in more depth.

The results of Burmabıyık (2014), Sabo and Archambault (2012) show that there is no significant difference in TPACK scale due to professional seniority. In some studies, TPACK levels were found to be in favor of participants with lower professional seniority (Kara, 2021; Lee & Tsai, 2010; Lin et al., 2012). In the study conducted by Lee and Tsai (2010), it was observed that the TPACK-Web self-efficacy levels of older and more experienced teachers were lower than younger teachers. On the other hand, Chuang and Ho (2011) conducted a study with preschool teachers and found that participants with more than 10 years of teaching experience had low technology efficacy, while they had higher scores in terms of pedagogical knowledge, content knowledge and pedagogical content knowledge. The researchers found a significant negative correlation between technology knowledge and age. As a matter of fact, in this study, teachers with low professional seniority obtained high averages in TK, TCK and TPK dimensions. In this respect, we can say that new primary school teachers are more competent in technology knowledge and integration of technology into the field. Inan and Lowther (2010), who found that there is a positive relationship between technological readiness, access to resources and teachers' computer use competencies, stated that computer use habits together with other demographic variables are one of the effective factors in the process of technology integration into education for teachers. In fact, young primary school teachers' intensive computer use and technological activities positively affect their TK, TCK and TPK competencies.

In the second dimension of the research, what is the level of teaching self-efficacy of primary school teachers? Answers to this question were sought. The teachers' perceptions of creating a positive classroom environment, providing effective learning process and general teaching self-efficacy were found to be at a medium level, whereas their perceptions of efficacy in planning and developing learning were found to be at a high level. Similarly, in many studies in which the self-efficacy levels of classroom teachers were measured, it was revealed that their self-efficacy levels were above average (Friedman & Kass, 2002; Skaalvik & Skaalvik, 2007). Considering the effectiveness of self-efficacy belief in increasing academic motivation (Schunk, 1991), its contribution to the quality and level of the individual's action and the quality and level that makes the individual active (Bandura, 1993, 1997), the high level of teacher self-efficacy can be seen as a positive result. However, it was found that teachers' self-efficacy beliefs did not differ significantly in the whole scale and its sub-dimensions according to their gender and professional seniority variables. Self-efficacy beliefs are more flexible in the initial stages of learning and it is thought that the development of teacher efficacy is based on pre-service education and experiences in the first years of teaching (Mulholland & Wallance, 2001; Woolfolk-Hoy & Burke-Spero, 2005). However, teachers' self-efficacy beliefs become stronger over the years.

The last finding of the study is the relationship between self-efficacy and TPACK competencies of primary school

teachers. In general, a significant and positive relationship was found between self-efficacy perception and TPACK competencies. These findings are similar to the findings of Abbit (2011), Blonder, Feldman-Maggor ,and Rap (2022), Dong et al. (2020), Joo, Park and Lim (2018), López-Vargas, Duarte-Suárez and Ibáñez-Ibáñez, (2017), Saudelli and Ciampa (2016), and Zeng, Wang, and Li (2022). According to Fullan (2015) and Kahveci, Gilmer, and Southerland (2008), integrating technology into teaching and learning requires changing both teachers' knowledge of educational technology and their beliefs, attitudes, and pedagogical perceptions. A strong sense of self-efficacy in using a technological tool is a vital prerequisite for teachers to apply this tool in teaching (Albion, 1999; Blonder, Feldman-Maggor, & Rap, 2022). Teachers with a high sense of self-efficacy are more open to new ideas and are more willing to experience new methods and provide students with new and unique learning opportunities and experiences (Tschannen-Moran & Hoy, 2001). In this respect, there is a strong relationship between TPACK competencies and teaching self-efficacy beliefs, especially in primary school teachers.

Based on these results, it was concluded that the self-efficacy of primary school teachers is at a good level, while their Technological Pedagogical Content Knowledge is at a medium level. This research was conducted with the data obtained from primary schools operating in Astana province in Kazakhstan. It may be recommended to repeat the study in different provinces and districts with different sample groups. In this study, TPACK and teacher self-efficacy were examined according to gender and seniority variables. However, TPACK and self-efficacy, which are extremely important in the emergence of effective schools, can be re-examined by using variables such as marital status, education level, socioeconomic level, teacher's postgraduate education, number of students, weekly class hours. In future studies, experimental or survey studies including observation findings on the extent to which these primary school teachers can reflect these knowledge and competence levels to their classroom environments can be conducted.

Increasing technological opportunities for teachers will affect their use of technology in their lessons. However, teachers should receive in-service trainings in their schools in order to use the constantly changing, renewed and developing technological hardware and software appropriately in teaching and to solve the technical problems they encounter. In addition, the technological infrastructure in teacher training institutions and the extent to which instructors use these technologies in their courses within the framework of TPACK can be an important step. In addition, whether TPACK and self-efficacy levels of teachers differ according to their course loads, and how this situation is from the perspective of students, both quantitative and qualitative researches will provide important contributions to the field.

Notes

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