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An investigation of the relationship between technological and pedagogical content knowledge levels and self-efficacy beliefs of special education teacher candidates

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Abstract

The aim of this study is to examine the relationship between special education teacher candidates' self-efficacy beliefs and their technological pedagogical content knowledge levels. In this study, in which descriptive and relational research design was used, the participant group consisted of 446 special education teacher candidates from three universities. The Teacher Self-Efficacy Belief Scale (SSPS) and the Technological Pedagogical Content Knowledge Scale (TPACKS) were used to collect the data. The collected data were analyzed with the SPSS package program and using parametric tests. It has been observed that the academic competence dimension, which is one of the sub-dimensions of special education teacher candidates, differs significantly according to the age and class variables, and the vocational competence dimension differs significantly according to the gender variable. It was understood that the TPACK scores differed in favor of the older age and class according to the age and class variables. It has been reported that there is a positive and significant relationship between SAS scores and TPACK scores, and that TPACK mean scores explain 18% of self-efficacy beliefs. It has been concluded that as the education level and life experience of the special education teacher candidates are above the average, both self-efficacy belief and technology knowledge increase.

Keywords: Self-Efficacy Beliefs, Special Education Teacher Candidates, The technological and Pedagogical Content Knowledge, Teacher Training

1. Introduction

Special education plays a vital role in teaching students the skills enabling them to integrate into the society and live independently. The higher the quantity and quality of education to be provided by special education, the easier it will be for students to

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integrate and participate in social environments. Considering the indispensable role of special education teachers in this process, the importance of the quality of undergraduate programs that prepare special education teacher candidates for the profession becomes evident (Ergül, Baydık & Demir, 2013). It is suggested that positive changes should be made in teacher training programs within the scope of the 2023 targets of the Ministry of National Education (MNE) so that teacher candidates can become teachers with high professional qualifications, knowledgeable in their field and a sense of belonging (Öztürk, Şahin & Vuran, 2022).

It is thought that teachers' ability to perform their jobs in a qualified and effective manner is directly related to their self-efficacy, abilities and beliefs about what they can achieve. It is claimed in the literature that special education teachers with high self-efficacy can meet the educational and other needs of their students in need of special education and are good at classroom management (Meijer & Foster, 1988; Cited by Bayrakdar, Batık & Barut, 2016). According to Bandura (1997), teachers' self-efficacy beliefs significantly affect their professional success. It can be thought that this effect is even stronger in an area such as special education teaching, where students who are affected by different disabilities are studied, various assistive technologies are used, and not only individualization but also adaptations are used intensively (Çay, Yıkmış & Özgüç, 2020).

Today, it is known that the professional standards regarding how a qualified special education teacher should be and the "high-impact interventions" that should be implemented by teachers are published by the Council for Exceptional Children (CEC). Among the 22-item high-impact interventions determined by the Council for Exceptional Children, it is emphasized that supportive and educational technologies should be used by teachers. Accordingly, teachers should choose, use and evaluate the effects of supportive and educational technologies that facilitate the realization of learning objectives, taking the universal design principles for learning into account (CEC, 2017b; cited by Kırcaali-İftar, 2019).

It is evident that it has become a necessity to use and benefit from the opportunities that technology provides in both in special education and in other teaching environments especially in pandemic conditions such as COVID-19. Therefore, the integration of education and technology is one of the most important issues that educators care about all over the world (Zehra & Yılayaz, 2013). The Technological and Pedagogical Content Knowledge (TPCK) model emerged as a result of such a need. This model, which includes three basic topics as technology knowledge, pedagogical knowledge and content knowledge, along with the intersection areas of these topics, has a total of seven areas, and can be thought to be an explanatory model in terms of new generation teacher competence (Mishra & Koehler, 2006). As seen in Figure 1, TPCK represents the

intersection point of these three basic competence areas. This fundamental transformation in teaching and the needs it creates also affect teacher competencies (Mazman & Usluel, 2011).

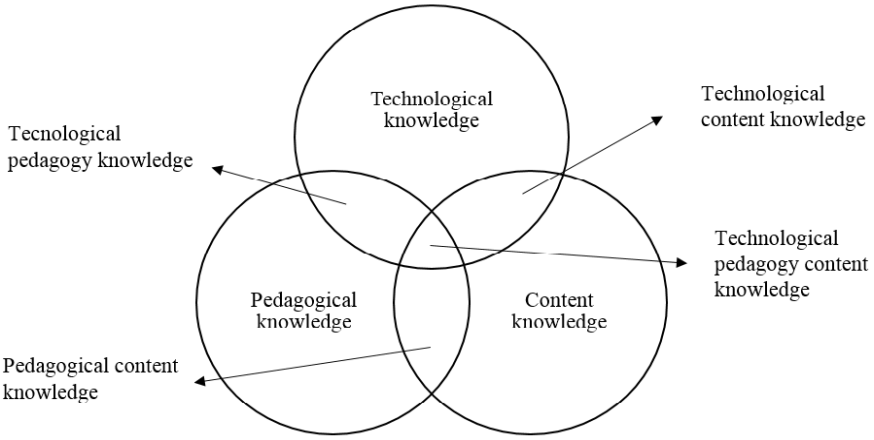

Figure 1. Schematic representation of TPCK (Misha ve Koehler, 2006).

Considering the literature, it is revealed that there are studies examining the TPCK levels of special education teachers in science teaching for students with special needs (Cahyani, Azizah & Evans, 2021), investigating the TPCK levels of teachers of the hearing impaired working in primary education (Peng & Daud, 2015), examining the TPCK levels of vocational special education teachers (Ramakrishnan, Salleh & Alias, 2019). Besides, there are also studies for not only improving TPCK levels of special education teachers and its intervention in the field (Kaplon-Schilis, 2018), but also for the examination of TPCK of special education teachers regarding various variables (Demirok, & Baglama, 2018).

On the other hand, it is seen that there are also research on the TPCK levels of teacher candidates in different branches such as science and technology teacher candidates (Meriç, 2014), classroom teacher candidates (Karalar & Aslan Altan, 2016), pre-school teacher candidates (Sancar-Tokmak, Yavuz Konokman & Yanpar Yelken, 2013) and music teacher candidates (Afacan & Cemil, 2017). Therefore, to the best of our research, there is no study on the TPCK of special education teacher candidates and there is a need for research on this issue. In addition, there is also no study examining the relationship between the self-efficacy beliefs of special education teacher candidates and their TPCK levels, to the best of our knowledge. Examining the relationship between self-efficacy perceptions and TPCK levels of teacher candidates who will work in special education, where teaching is customized according to individual needs and adaptations and assistive technologies are used intensively is thought to be crucial to see the possible deficiencies. In this way, it can be possible to make suggestions to overcome the deficiencies and to

contribute to the literature. In this study, which aims to examine the relationship between special education teacher candidates' self-efficacy beliefs and TPCK levels, answers to the following questions will be sought;

- What is the self-efficacy belief level of special education teacher candidates?
- Are the special education teacher candidates' self - efficacy beliefs affected by gender, age, grade and type of university variables?
- What are the TPCK levels of special education teacher candidates?
- Are TPCK levels of special education teacher candidates affected by the variables of gender, age, grade, type of university and owning a computer?
- What is the relationship between the special education teacher candidates' self-efficacy belief levels and their TPCK levels?

2. Method

2.1. Research Design

In this study, descriptive and relational research model was used. In this context, first of all, the self-efficacy beliefs and TPCK levels of special education teacher candidates were described. Then, the relationship between the self-efficacy beliefs of special education teacher candidates and their TPCK levels was examined. At this point, while trying to portray the current situation using descriptive research, the cause-effect relationship between two or more variables was attempted to reveal employing relational research (Büyüköztürk et al., 2019).

2.2. Study group

The study group of this research consists of 446 teacher candidates studying in the special education departments of three universities (2 state universities, 1 foundation university) in two different cities in Marmara Region. The selection of prospective teachers participating in the research was carried out within the framework of the "criterion sampling" method, which is one of the purposeful sampling types. Purposeful sampling is preferred when it is desired to work in one or more special cases that meet certain criteria or have certain characteristics (Büyüköztürk et al., 2019, p.92). The participants who make up the sample group of the research should meet the criteria of (1) being an undergraduate student and not working as a teacher at any private education institution, (2) being a special education teacher candidate, and (3) being a volunteer to participate in the research.

Table 1: Distribution of demographic data of special education teacher candidates

Variable	**Groups**	**F**	**%**
Gender	Female	259	58,1
	Male	187	41,9
Age	18-20	155	34,8
	21-23	195	43,7
	24 and over	96	21,5
Grade Level	1st grade	121	27,1
	2nd grade	156	35
	3rd grade	99	22,2
	4th grade	70	15,7
Total		446	100

As can be seen in Table 1, the majority of the participants, that is 58% (n=259) are women, while 41% (n=187) are men. In terms of age variable, the largest group consists of those aged between 21-23 with a percentage of 43% (n=195). This group is followed by 18-20 age group with a percentage of 34% (n=155) and the group aged 24 and over, which accounts for 21% (n=96). As for the grade level variable, while the majority of the participants, 35% (n=156), were second grade teacher candidates, 1st grade teacher candidates with a rate of 27% (n = 121) and 3rd grade teacher candidates with a rate of 22% (n = 99) follow them, respectively.

2.3. Data collection tools

In this study, the Teacher Self-Efficacy Belief Scale (TSBS), the Technological Pedagogical Content Knowledge Scale (TPCKS), and a 'Personal Information Form' were used. In addition, the necessary written permission was obtained from the researchers who conducted the validity-reliability study of two scales, which are TSBS and TPCK.

2.3.1. Teacher Self-Efficacy Belief Scale (TSBS): This scale, developed by Çolak, Yorulmaz, and Altınkurt (2017), consists of a four-factor structure. The scale, which is a 5-point Likert type, has 27 items. When Cronbach's Alpha internal consistency coefficients were examined, for the academic self-efficacy factor, one of the sub-factors, .75, for the occupational self-efficacy factor .86, for the social self-efficacy factor .88, for the intellectual self-efficacy factor .87 and .93 for the whole scale were calculated. Calculated internal consistency coefficients show that the reliability of the scale is high.

2.3.2. Technological Pedagogy Content Knowledge Scale (TPCK): The 5-point Likert-type scale developed by Horzum, Akgün, and Öztürk (2014) consists of 7 sub-factors. The scale, which consists of technology, pedagogy, content, technological content, pedagogical content, technological pedagogy and technological pedagogy content sub-actors has a total of 51 items. The Crombach Alpha coefficient was calculated as .97

2.3.3. Personal Information Form: In this form developed by the researchers, data on age, gender and grade variables of the participants were collected.

2.4. Data Collection Process and Analysis

Ethics committee approval was obtained with the decision of Trakya University Social and Human Sciences Research Ethics Committee dated 20.04.2022 and numbered as 4/22. After the approval of the ethics committee, the scales were duplicated and pre-service teachers from three universities were given the printed version of the scales and asked to complete. The data obtained from the scales completed by 446 pre-service teachers were analyzed using the SPSS 22.0 package program.

In the analysis of the data, the normality of the distribution was checked utilizing Kolmogorov-Smirnov test results, skewness-kurtosis values, normal distribution curves and histogram graphs, and the distribution was found to be normal. In the study, while the ¨Independent Groups t-Test¨ was used for the gender variable; ¨One-Way Analysis of Variance (ANOVA)¨ was employed for age and grade variables. The 'Pearson Correlation Analysis' was used to determine whether there is a relationship between the special education teacher candidates' self-efficacy perceptions and their mean TPCK scores. Moreover; 'Simple Linear Regression Analysis' was used to see whether pre-service teachers' self-efficacy perceptions predicted their mean TPCK scores.

3. Findings

The findings obtained as a result of the analysis of the data were summarized in a total of five titles in line with the general and sub-objectives of the research. For all scales and sub-dimensions used in the research ¨One-Way Analysis of Variance (ANOVA)¨ was preferred for age and grade level variables, and ¨Independent Groups t-test¨ was preferred for gender variable. In addition, ¨Pearson Correlation Analysis¨ was applied to determine whether there is a significant relationship between special education teacher candidates' self-efficacy beliefs and their technological pedagogy content knowledge levels. Finally; ¨Simple Linear Regression Analysis¨ was used to check whether the participants' self-efficacy beliefs predicted their technological pedagogy content knowledge levels. Each finding is described in detail below.

3. 1. Self-Efficacy Beliefs and Technological Pedagogy Content Knowledge Levels of Special Education Teacher Candidates

The finding regarding the self-efficacy belief and technological pedagogy content knowledge level of the special education teacher candidates was obtained as a result of the analysis of the data obtained using the TSBS and TPCK scales with the descriptive statistical method. Table 2 shows the mean and standard deviation of the total scores obtained from the TSBS and TPCK scales.

Table 2. Scores of Special Education Teacher Candidates' Self-Efficacy Beliefs and Technological Pedagogy Content Knowledge Levels Obtained from TSBS and TPCK Scales

Dimensions	N	$\overline{X}$	ss	$Sh_{\bar{x}}$
Academic competence	446	3,36	,75	,04
Professional competence	446	3,76	,78	,04
Social competence	446	3,82	,87	,04
Intellectual competence	446	3,67	,54	,03
Technological knowledge	446	3,74	,87	,04
Pedagogical knowledge	446	3,82	,66	,03
Content knowledge	446	3,84	,66	,03
Technological content knowledge	446	3,73	,84	,04
Pedagogical content knowledge	446	3,84	,66	,03
Technological pedagogy knowledge	446	3,80	,70	,03
Technological pedagogy content knowledge	446	3,79	,70	,03

In this study, the mean scores of the scale can take values between 1 and 5. Looking at Table 2, it is seen that the average scores obtained by the participants, which are Social competence ($\overline{X}$ = 3,82), professional competence ($\overline{X}$ = 3,76), intellectual competence ($\overline{X}$ = 3,67) and academic competence ($\overline{X}$ = 3,36), are slightly higher than the sub-dimensions of the TSBS. When the scores of the participants in the TPCK sub-dimension scores, which are content knowledge ($\overline{X}$ = 3,84), pedagogical content knowledge (X= 3,84), pedagogical knowledge ($\overline{X}$ = 3,82), technological pedagogy knowledge ($\overline{X}$ = 3,80), technological pedagogy content knowledge ($\overline{X}$ = 3,79), technological knowledge ($\overline{X}$ = 3,74) and technological content knowledge ($\overline{X}$ = 3,73) were examined, it was determined that the scores they got in the sub-dimensions were above the average.

3. 2. Finding Related to Whether Self-Efficacy Beliefs and Technological Pedagogy Content Knowledge Levels of Special Education Teacher Candidates Differ According to Gender Variable

The finding about whether the self-efficacy beliefs and technological pedagogy content knowledge levels of special education teacher candidates differ according to the gender variable was obtained as a result of analyzing the data obtained from the TSBS and TPCK scales by using the independent groups t-test. Table 3 shows the results of the independent group t-test, which was conducted to determine whether the total scores obtained from the TSBS and TPCK scales differ according to the gender variable.

Table 3. Results of the Independent Group t-Test Performed to Determine Whether TSBS and TPCK Scale Scores Differ According to Gender Variable

Score	Groups	*N*	$\bar{x}$	*ss*	$Sh_{\bar{x}}$	t_{Test}		
						t	*Sd*	*p*
TSBS mean	Female	259	3,70	,59	,036	-,868	357	,022*
	Male	187	3,65	,70	,051			
Academic Competence	Female	259	3,36	,70	,043	,260	444	,141
	Male	187	3,34	,81	,059			
Professional Competence	Female	259	3,82	,74	,046	1,796	372	,021*
	Male	187	3,68	,83	,060			
Social Competence	Female	259	3,86	,83	,052	1,515	444	,101
	Male	187	3,74	,92	,067			
Intellectual competence	Female	259	3,65	,53	,033	-1,166	444	,586
	Male	187	3,71	,56	,041			
TPCK mean	Female	259	3,80	,57	,036	-,017	444	,349
	Male	187	3,80	,62	,045			
Technological knowledge	Female	259	3,61	,93	,058	-3,605	444	,188
	Male	187	3,92	,76	,056			
Pedagogical knowledge	Female	259	3,86	,65	,040	1,605	444	,318
	Male	187	3,76	,67	,049			
Content knowledge	Female	259	3,89	,61	,038	1,800	444	,080
	Male	187	3,78	,71	,052			
Technological content knowledge	Female	259	3,71	,75	,047	-,697	444	,221
	Male	187	3,77	,95	,069			
Pedagogical content knowledge	Female	259	3,89	,63	,039	1,761	444	,093
	Male	187	3,78	,69	,051			
Technological pedagogy knowledge	Female	259	3,79	,70	,044	-393	444	,752
	Male	187	3,82	,71	,058			
Technological pedagogy content knowledge	Female	259	3,78	,68	,042	-,462	444	,637
	Male	187	3,81	,73	,053			

As can be seen in Table 3, as a result of the independent groups t-tests conducted to determine whether the pre-service teachers' TSBS and TPCK and sub-dimensions of the sample group show a significant difference according to the gender variable, the mean TSBS was found to be (t=-,868; p<.05). Moreover, a significant difference was found between the professional competence sub-dimension of the same scale (t=-,868; p<.05) and the gender variable in favor of female teacher candidates. It was found that the gender variable did not make a significant difference in other dimensions of TSBS (p>.05). Besides, there was no significant difference between the TPCK and sub-dimension averages and the gender variable (p>.05).

3. 3. Finding Related to Whether Self-Efficacy Beliefs and Technological Pedagogy Content Knowledge Levels of Special Education Teacher Candidates Differ in Terms of Age and Grade Level Variables

The finding about whether the self-efficacy belief and technological pedagogy content knowledge levels of the special education teacher candidates differ according to the variables of age and grade level were obtained by analyzing the data obtained from the TSBS and TPCK scales with ANOVA. Table 4 shows the results of ANOVA to determine whether the total scores obtained from the TSBS scale and Table 5 from the TPCK scale differ according to the variables of age and grade level.

Table 4. Results of ANOVA Analysis Conducted to Determine Whether TSBS Scores Differ According to Age and Grade Variables

Score	Group	N	$\overline{X}$	SD	F	*p*	Post-Hoc
TSBS mean	a. 18-20	155	3,62	,46	1,195	,304	
	b. 21-23	195	3,73	,65			
	c. 24 and over	96	3,68	,82			
	Total	446	3,67	,64			
Academic Competence	a. 18-20	155	3,20	,66	5,244	,006*	a>b; a>c
	b. 21-23	195	3,41	,76			
	c. 24 and over	96	3,48	,81			
	Total	446	3,36	,75			
Professional Competence	a. 18-20	155	3,74	,62	,442	,643	
	b. 21-23	195	3,80	,78			
	c. 24 and over	96	3,71	,97			
	Total	446	3,76	,78			
Social Competence	a. 18-20	155	3,77	,71	,637	,529	
	b. 21-23	195	3,86	,86			
	c. 24 and over	96	3,76	1,10			
	Total	446	3,81	,87			
Intellectual competence	a. 18-20	155	3,65	,46	1,957	,142	
	b. 21-23	195	3,73	,57			
	c. 24 and over	96	3,61	,60			
	Total	446	3,68	,54			
TSBS mean	a. 1st grade	121	3,67	,53	1,080	,354	
	b. 2nd grade	156	3,66	,58			
	c. 3rd grade	99	3,77	,56			
	d. 4th grade	70	3,60	,96			
	Total	446	3,68	,64			

Table 4 continued.

Score	Group	N	X	SD	F	*p*	Post-Hoc
Academic Competence	a. 1st grade	121	3,32	,71	3,557	,014*	c>b
	b. 2nd grade	156	3,23	,69			
	c. 3rd grade	99	3,47	,69			
	d. 4th grade	70	3,53	,94			
	Total	446	3,36	,75			
Professional Competence	a. 1st grade	121	3,78	,72	,302	824	
	b. 2nd grade	156	3,75	,67			
	c. 3rd grade	99	3,80	,63			
	d. 4th grade	70	3,70	1,19			
	Total	446	3,76	,78			
Social Competence	a. 1st grade	121	3,78	,74	2,352	,072	
	b. 2nd grade	156	3,86	,80			
	c. 3rd grade	99	3,92	,80			
	d. 4th grade	70	3,58	1,24			
	Total	446	3,81	,87			
Intellectual competence	a. 1st grade	121	3,66	,47	1,868	,134	
	b. 2nd grade	156	3,65	,52			
	c. 3rd grade	99	3,79	,49			
	d. 4th grade	70	3,61	,72			
	Total	446	3,68	,54			

As can be seen from the ANOVA results in Table 4, the difference between the arithmetic mean of the academic competence dimension, which is one of the TSBS sub-dimensions, and the variables of age (F=5.244; p<.05) and grade (F=3.557; p<.05) was found to be significant. There was no significant difference between TSBS mean, professional competence, social competence and intellectual competence scores, and age and grade variables (p,>.05). Complementary posthoc analyzes were used to determine from which groups the significant differences detected in the academic competence sub-dimension originated. Games-Howell multiple comparison analysis was used because there was no homogeneous distribution among the variances (L=12.015; L=16.781 p<.05). As a result of the analyzes, based on the results of the Games-Howell test, which was conducted to determine which groups differ in terms of academic competence scores and age and grade variables, a difference between the 18-20 age group and the 21-23 age group in favor of the 21-23 age group was found (p<.05). Likewise, a difference (p<.05) was found between the 18-20 age group and the 24 and older age group in favor of the 24 and older age group. The difference between 21-23 and 24 and over age groups was not significant (p>.05). In the examination made between academic competence scores and grade variables, a significant difference (p<.05) was detected between pre-service teachers in the 2nd grade and those in the 3rd grade in favor of the 3rd grade students. There was no significant difference between the other groups (p>.05).

Table 5. Results of ANOVA Analysis Conducted to Determine Whether TPCK Scores Differ According to Age and Grade Variables

Score	Group	N	$\bar{X}$	SD	F	*p*	Post-Hoc
TPCK mean	a. 18-20	155	3,60	,58	14,475	,000*	b>a; c>a
	b. 21-23	195	3,89	,56			
	c. 24 and over	96	3,93	,58			
	Total	446	3,80	,59			
Technological knowledge	a. 18-20	155	3,64	1,02	1,825	,162	
	b. 21-23	195	3,81	,80			
	c. 24 and over	96	3,78	,77			
	Total	446	3,75	,87			
Pedagogical knowledge	a. 18-20	155	3,61	,68	12,666	,000*	b>a; c>a
	b. 21-23	195	3,91	,62			
	c. 24 and over	96	3,97	,64			
	Total	446	3,82	,66			
Content knowledge	a. 18-20	155	3,66	,65	9,745	,000*	b>a; c>a
	b. 21-23	195	3,91	,65			
	c. 24 and over	96	3,99	,63			
	Total	446	3,84	,66			
Technological content knowledge	a. 18-20	155	3,54	,78	6,897	,001*	b>a; c>a
	b. 21-23	195	3,86	,88			
	c. 24 and over	96	3,80	,78			
	Total	446	3,74	,84			
Pedagogical content knowledge	a. 18-20	155	3,62	,65	15,348	,000*	b>a; c>a
	b. 21-23	195	3,92	,61			
	c. 24 and over	96	4,04	,66			
	Total	446	3,84	,65			
Technological pedagogy knowledge	a. 18-20	155	3,59	,74	11,239	,000*	b>a; c>a
	b. 21-23	195	3,91	,65			
	c. 24 and over	96	3,92	,68			
	Total	446	3,80	,70			
Technological pedagogy content knowledge	a. 18-20	155	3,55	,70	15,762	,000*	b>a; c>a
	b. 21-23	195	3,90	,66			
	c. 24 and over	96	3,96	,67			
	Total	446	3,79	,70			

Table 5 continued

Score	Group	N	$\overline{X}$	SD	F	*p*	Post-Hoc
TPCK mean	a. 1st grade	121	3,62	,59	13,202	,000*	c>b
	b. 2nd grade	156	3,72	,56			
	c. 3rd grade	99	3,96	,56			
	d. 4th grade	70	4,08	,56			
	Total	446	3,80	,59			
Technological knowledge	a. 1st grade	121	3,55	,86	7,737	,000*	c>a; d>a; c>b; d>b
	b. 2nd grade	156	3,63	,81			
	c. 3rd grade	99	3,99	1,02			
	d. 4th grade	70	3,99	,64			
	Total	446	3,74	,87			
Pedagogical knowledge	a. 1st grade	121	3,66	,65	7,800	,000*	c>a; d>a; c>b; d>b
	b. 2nd grade	156	3,75	,66			
	c. 3rd grade	99	3,92	,58			
	d. 4th grade	70	4,09	,73			
	Total	446	3,82	,66			
Content knowledge	a. 1st grade	121	3,66	,69	9,324	,000*	c>a; d>a; d>b
	b. 2nd grade	156	3,77	,65			
	c. 3rd grade	99	4,00	,59			
	d. 4th grade	70	4,09	,61			
	Total	446	3,84	,66			
Technological content knowledge	a. 1st grade	121	3,51	,78	9,498	,000*	c>a; d>a; d>b
	b. 2nd grade	156	3,63	,76			
	c. 3rd grade	99	3,97	,99			
	d. 4th grade	70	4,02	,70			
	Total	446	3,73	,84			
Pedagogical content knowledge	a. 1st grade	121	3,69	,65	10,558	,000*	c>a; d>a; c>b; d>b
	b. 2nd grade	156	3,75	,61			
	c. 3rd grade	99	3,97	,61			
	d. 4th grade	70	4,16	,69			
	Total	446	3,84	,65			
Technological pedagogy knowledge	a. 1st grade	121	3,59	,78	9,855	,000*	c>a; d>a; d>b
	b. 2nd grade	156	3,76	,63			
	c. 3rd grade	99	3,93	,64			
	d. 4th grade	70	4,10	,67			
	Total	446	3,80	,70			
Technological pedagogy content knowledge	a. 1st grade	121	3,63	,74	7,475	,000*	c>a; d>a; d>b
	b. 2nd grade	156	3,73	,66			
	c. 3rd grade	99	3,89	,70			
	d. 4th grade	70	4,08	,62			
	Total	446	3,79	,70			

As can be seen from the ANOVA results in Table 5, TPCK mean is (F=14,475; p<,05), and a significant relationship was found between the age variable and pedagogical knowledge (F=12,666; p<,05), content knowledge (F=9,745; p<,05), technological content knowledge (F=6,897; p<,05), pedagogical content knowledge (F=15,348; p<,05), technological pedagogy knowledge (F=11,239; p<,05), technological pedagogy content knowledge (F=11,239; p<,05) ,05). However, the relationship between technology knowledge (F=1,825; p>,005) and age was not found to be significant. Besides, the relationship between the TPCK mean and grade variable (F=13,202; p<,05), technology knowledge (F=7,737; p<,05), pedagogical knowledge (F=7,800; p<,05), content knowledge (F=9.324; p <,05), technological content knowledge (9,498; p<,05), pedagogical content knowledge (F=10,558; p<,05), technological pedagogy knowledge (F=9,855; p<,05), and technological pedagogy content knowledge (F=7,475, p<,05) scores were found to be significant. Complementary posthoc analyzes were used to determine from which groups the differences between the groups with significant differences originated. In order to decide which posthoc technique to use, the homogeneity of the variances was checked first and it was determined that the variances were homogeneous (L=,25; L=,24; p>,05). For this reason, the Scheffe test was preferred.

As a result of the Scheffe test, which was conducted to determine between which groups the TPCK scores differ according to age and graed variables, a significant difference at the p<,05 level between age variable and TPCK mean, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogy knowledge and technological pedagogy content knowledge sub-dimension scores was found. The difference between 18-20 age group and 21-23 age group was in favor of 21-23 age group. It was also revealed that there was a significant difference at the p<,05 level between in favor of 24 and above as a result of the analysis between the 18-20 age group and the 24 and older age group. However, there was not a significant difference between the age groups of 21-23 and 24 and above (p>,05). This significance covers the TPCK mean and all of the sub-dimensions listed. On the other hand, between the mean scores of TPCK and the grade variable, a significant difference was found at the p<,05 level between the 2nd grade and 3rd grade teacher candidates in favor of the 3rd grade. Similarly, there is a significant difference at the p<,05 level between the 1st and 3rd grades in the technology knowledge, pedagogy knowledge, and pedagogical content knowledge sub-dimensions in favor of the 3rd grade teacher candidates. As a result of the analysis done for the same sub-dimensions, a significant difference at the p<,05 level was detected between the 1st and 4th grades in favor of the 4th grade, between the 2nd and 3rd grade in favor of the 3rd grade, and finally between the 2nd and 4th grades in favor of the 4th grade teacher candidates. A significant difference could not be found between the other groups (p>,05).

3. 4. Finding Related to Whether There is a Relationship Between Self-Efficacy Belief and Technological Pedagogy Content Knowledge Levels of Special Education Teacher Candidates

The finding about whether there is a significant relationship between the self-efficacy belief and technological pedagogy content knowledge levels of the special education teacher candidates was obtained by analyzing the data obtained from the TSBS and TPCK scales using Pearson Moments. The obtained result was presented in Table 6.

Table 6. Results of Pearson Moments Analysis performed to determine the relationship between the mean scores of TSBS and TPCK

Dimension/ Scale	N	Academic Competence		Professional Competence		Social Competence		Intellectual competence		TSBS	
		R	p	R	p	r	p	r	p	r	P
Technological knowledge	446	,308**	,000	,228**	,000	,195**	,000	,183**	,000	,285**	,000
Pedagogical knowledge	446	,360**	,000	,378**	,000	,228**	,000	,276**	,000	,393**	,000
Content knowledge	446	,443**	,000	,332**	,000	,224**	,000	,202**	,000	,390**	,000
Technological content knowledge	446	,374**	,000	,238**	,000	,191**	,000	,218**	,000	,319**	,000
Pedagogical content knowledge	446	,391**	,000	,314**	,000	,240**	,000	,228**	,000	,373**	,000
Technological Pedagogy knowledge	446	,356**	,000	,292**	,000	,212**	,000	,168**	,000	,330**	,000
Technological pedagogy content knowledge	446	,346**	,000	,276**	,000	,203**	,000	,210**	,000	,328**	,000
TPCK mean	446	,447**	,000	,356**	,000	,262**	,000	,256**	,000	,419**	000

* Relation (correlation) is significant at 0.05 level.

** Relation (correlation) is significant at 0.01 level.

As can be understood from Table 6, there is a significant positive relationship (p<,01) between the technology knowledge, one of the TPCK sub-dimensions, and sub-dimensions of TSBS, which are academic competence (r=,308), professional competence (r=228), social competence (r=195), intellectual competence (r=183), and TSBS mean (r=.285) scores. There is also a positive relationship (p<,01) between pedagogical knowledge and sub-dimensions of TSBS, which are academic competence (r=,360), professional competence (r=378), social competence (r=228), intellectual competence (r=276) and TSBS mean (r=,393) scores. there is a significant relationship (p<.01). Moreover, a positive relationship (p<,01) between content knowledge and sub-dimensions of TSBS, which are academic competence (r=,443), professional competence (r=332), social competence (r=224), intellectual competence (r=202) and TSBS mean (r=,39) scores. There is also a significant relationship (p<,01) between pedagogical content knowledge and sub-dimensions of TSBS, which are academic competence (r=,391), professional competence (r=314), social competence (r=240), intellectual competence (r=228) and TSBS mean (r=,373). A significant positive relationship (p<,01) was detected between the technological pedagogy knowledge and sub-dimensions of TSBS, which are academic competence (r=,356), professional competence (r=292), social competence (r=212), intellectual competence (r=168) and TSBS mean (r=.330). There is a positive significant relationship (p<.01) between technological pedagogy content knowledge and sub-dimensions of TSBS, which are academic competence (r=,346), professional competence (r=276), social competence (r=203), intellectual competence (r=210) and TSBS mean (r=,328) scores. A significant positive relationship (p<,01) was also found between the mean scores of TPCK and sub-dimensions of TSBS, which are academic competence (r=,447), professional competence (r=356), social competence (r=262), intellectual competence (r=256) and TSBS mean scores (r=,419).

3. 5. Finding Related to Whether Self-Efficacy Belief Level of Special Education Teacher Candidates Predicts Technological Pedagogy Content Knowledge Level

In order to determine whether the self-efficacy belief level (predicted) of special education teacher candidates was predicted by the technological pedagogy content knowledge level (predictor) 'Simple Linear Regression' was conducted. The obtained result was presented in Table 7.

Table. 7. Simple linear regression analysis on the effect of TPCK mean scores on TSBS mean scores

Independent variable (TPCK)	B	SH	Beta	t	P
TSBS	,387	,040	-,419	9,72	,000
R=,419 R2 = ,175 F(1,032)= 94,40 p = ,000					

When Table 7 is examined, it is seen that the model is statistically significant (p>,01). In addition, it was determined that there was a positive and significant (β=,387; p>,01) relationship between the mean TPCK scores and the mean scores of TSBS. Accordingly, it was understood that TPCK explained 18% (R2 = ,175) of self-efficacy perception.

4. Discussion

Considering the first finding of the research, it was detected that the self-efficacy belief levels and technological content knowledge levels of the special education teacher candidates are above the average based on the obtained data regarding both TSB scale and its sub-dimensions (social competence, professional competence, intellectual competence and academic competence) and TPCK scale and its sub-dimensions (content knowledge, pedagogical content knowledge, pedagogical knowledge, technological pedagogical knowledge, technological pedagogical content knowledge). To the best of our research, no research has been found in the literature that studies the self-efficacy belief level of special education teacher candidates along with the level of technological content knowledge. On the other hand, when the studies conducted on the self-efficacy belief levels of special education teacher candidates (Bayrakdar, Batık & Barut, 2016) were examined, it was found that the self-efficacy levels of special education teacher candidates are high.

The second finding of the study is about whether the self-efficacy beliefs and technological pedagogical content knowledge levels of special education teacher candidates differ according to the gender variable. When the scores obtained by the special education teacher candidates from both TSBS and its sub-dimensions and TPCKS and its sub-dimensions were examined, no difference was found regarding the scores obtained by the special education teacher candidates in the TPCKS and its sub-dimensions in terms of gender. On the other hand, a difference was found in favor of female teacher candidates only in the professional competence sub-dimension of the TSBS scale. In other words, the level of self-efficacy of teacher candidates differed in favor of female teacher candidates in terms of gender variable in the sub-dimension of

professional competence. In the literature, it has been revealed by research findings that the self-efficacy levels of special education teacher candidates do not make a difference in terms of gender (Bayrakdar, Batık & Barut, 2016; Gönüldaş & Gümüşkaya, 2017). However, in the study conducted by Karabulut, Yandı & Kaya (2019), male students' self-efficacy belief levels were found to be higher than female students.

As for the results of this research, no significant difference was observed in the TPCK levels of teacher candidates in terms of gender variable. When the literature is considered, no research has been found with special education teacher candidates to the best of our knowledge. On the other hand, when we investigated the studies conducted with prospective teachers from different branches, we came across research results in parallel with our research findings (Chai, Ling Koh, Tsai, & Lee Wee Tan, 2011; Zehra & Yılayaz, 2013). In addition, Erdoğan & Şahin (2010) and Öztürk (2013) revealed in their research that the TPCK levels of female teacher candidates are higher than male teacher candidates. Lin, Tsai, Chai, & Lee (2013) found that female teachers/pre-service teachers had higher TPCK levels in their study conducted with both in-service and pre-service teachers. Similarly, Cahyani Azizah & Evans (2021) and Peng & Daud (2015) detected higher TPCK levels of female teachers in their study on special education teachers.

The third finding of the study is about whether the self-efficacy beliefs and technological pedagogical content knowledge levels of special education teacher candidates differ in terms of age and grade level variables. According to the results obtained, it was determined that both the average of TSBS general score and the professional competence, social competence and intellectual competence scores did not differ according to the age and grade variables. However, there was a difference in the academic competence scores which is one of the TSBS sub-dimensions in terms of age variable. Therefore, as the age increases, the scores obtained also increase. In the results obtained regarding which groups the TPCK scores differ according to age and grade variables, a difference was detected both in the general average scores of TPCK and the scores obtained from sub-dimensions of TPCK that are technology knowledge, pedagogical knowledge, and pedagogical content knowledge in favor of teacher candidates attending upper grades and teachers in the older age group. Likewise, considering the age variable of pre-service teachers' self-efficacy levels, a difference was also determined in favor of the older teachers in terms of academic competence, which is one of the sub-dimensions of the scale. Examining the relevant literature, there are research results stating that the self-efficacy levels of special education teacher candidates do not make a significant difference in terms of the age variable (Gönüldaş & Gümüşkaya, 2017).

In the literature, there are studies reporting that there is no significant difference between special education teacher candidates in terms of grade variable (Kaymakamoğlu, 2017; Karabulut, Yandı & Kaya, 2019). On the other hand, it was determined that the

self-efficacy belief levels of the teacher candidates studying in other branches other than the special education department differ concerning grade level. For example; Bingöl (2018) revealed that psychological counseling and guidance teacher candidates' self-efficacy beliefs about special education increase as their grade level increases. According to the current research findings, the increase in self-efficacy as the grade level increases can be attributed to the increase in the knowledge of pre-service teachers with the education they receive. Therefore, it is claimed that the education received positively affects self-efficacy (Al-Darmaki, 2004; Sharpley, & Ridgway, 1993; Soresi, Nota & Lent, 2004). According to Bandura (1977), the education received positively affects self-efficacy in that field.

As far as the results of this research is concerned, a significant difference in the mean TPCKS of teacher candidates regarding pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge sub-dimensions was determined in favor of 21-23 age group between 18-20 age group and 21-23 age group. The same result was also obtained for the same variables in favor of 24 and above age group between the 18-20 and the of 24 and above age group. When the literature is examined, it was found that Peng & Daud (2015) conducted a study with special education teachers and experienced teachers got higher scores in content knowledge, pedagogical knowledge, technological knowledge and pedagogical content knowledge sub-dimensions as far as age variable is concerned. On the contrary, there are research results in the literature stating that the technological knowledge of elderly special education teachers is insufficient (Cahyani, Azizah & Evans, 2021). Similarly, there are research results reporting that older preschool teachers have insufficient technological knowledge (Liang, Koh, Yang & Tsai, 2013). There are studies in the literature that do not observe a significant difference between teacher candidates in terms of age variable (Koh, Chai, & Tsai, 2010; Öztürk, 2013). Concerning the results of this research, the higher mean scores of the TPCK of the older teacher candidates in pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge sub-dimensions can be linked to the fact that they are involved in technology more as their education and life experiences increase.

As regards to another result of this research, it was revealed that the TPCKS levels of the special education teacher candidates were high. It is seen that there is not enough data about TPCKS levels of special education teacher candidates in the literature. On the other hand, there are research results reporting that prospective teachers from different branches have high TPCKS levels (Çuhadar, Bülbül and Ilgaz, 2013; Karalar & Altan, 2016; Sezer, 2015). Today, with the development of technology and the use of technology in every field, the work of teachers and students in the process of not only accessing and

creating information but also learning and teaching becomes easier. For this reason, the correct and effective use of information and communication technologies by pre-service teachers will contribute positively to their professional careers (Öztürk, 2013).

Considering another result of this research, the mean TPCK scores of the teacher candidates showed a significant difference in favor of the teacher candidates attending senior grades. In parallel with the findings of our research, Karalar & Altan (2016) detected in their research with prospective classroom teachers that teacher candidates attending senior grades got high TPCK scores. In the studies conducted by Birhanlı & Gündüz (2021) and Meriç (2014) with science and technology teacher candidates, and by Sancar, Tokmak, Yavuz and Yelken (2013) with preschool teachers, they did not find a significant difference in terms of grade variable. As for another result of our research, the reason why the mean TPCK scores of the teacher candidates differ significantly from the teacher candidates studying in senior grades can be related to the fact that the prospective teachers take more classes towards the end of their education and the content of these courses includes information about the use of technology.

In the fourth finding of this study, the data obtained from the TSBS and TPCK scales in order to reveal whether there is a relationship between the self-efficacy belief and technological pedagogical content knowledge levels of the special education teacher candidates, it was found that there is a positive significant relationship between the teacher candidates' self-efficacy belief and technological pedagogical content knowledge levels. Regarding the fifth finding of our research, it was determined whether the level of self-efficacy belief of the special education teacher candidates predicted the level of technological pedagogical content knowledge. The results obtained showed that there is a positive and significant relationship between TPCK mean scores and TSBS mean scores. Accordingly, it was understood that TPCK explained 18% of self-efficacy perception. As far as the literature is concerned, there are research findings parallel to our research findings (Çam, 2017; Karalar & Altan, 2016; Sakin & Yıldırım, 2019). In addition, in the study conducted with teacher candidates, Akgün (2013) revealed that there is a positive and significant relationship between the teacher candidates' web pedagogical content knowledge and self-efficacy levels. Considering the results of our research, the fact that there is a positive relationship between TPCK and self-efficacy levels shows that individuals with high self-efficacy levels can learn and use technology more competently. If the self-efficacy level of teacher candidates or in service teachers is high, it can be thought that these individuals may combine their field knowledge and technology knowledge and use this knowledge positively in the education of their students.

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