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The Relationship between Pre-service Teachers' Cognitive Flexibility Levels and Techno-pedagogical Education Competencies*

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Abstract

The study aimed to examine the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies in terms of several variables and to determine whether there is a relationship between their cognitive flexibility levels and techno-pedagogical education competencies. Determining whether the relationship between the cognitive flexibility and techno-pedagogical content knowledge that was emphasized in theoretical studies exists would contribute to teacher education. Thus, it could be stated that the cognitive flexibility might be included among the factors to enable the development and use of the techno-pedagogical content knowledge. The study was conducted with a total of 616 pre-service teachers and designed by using the exploratory correlational research model. The sample was determined by using convenience sampling methods. "Cognitive Flexibility Scale" and "Techno-pedagogical Education Competency Scale" were used for data collection. The findings demonstrated that the pre-service teachers have a high level of cognitive flexibility and techno-pedagogical education competency. It was also found that the cognitive flexibility scores had a statistically significant difference in terms of all independent variables (gender, type of program, and having a computer and internet access), and the techno-pedagogical education competency scores did not indicate a statistically significant difference in terms of gender and type of program, while they demonstrated a significant difference in terms of having a computer and internet access. Pearson's correlation coefficient was calculated to determine the relationship between the pre-service teachers' cognitive flexibility and techno-pedagogical education competency scores, and a moderately significant relationship was found. It could be concluded that the relationship emphasized in theoretical studies between the cognitive flexibility and techno-pedagogical content knowledge is moderate. Accordingly, the cognitive flexibility could provide the development and use of techno-pedagogical content knowledge which has an important role in teacher education.

Key words: Cognitive Flexibility, Techno-pedagogical Education Competency, Pre-service Teachers

Introduction

As a result of developments in the field of science and technology, people's ways of accessing and producing information have changed (ISSU & Ulmer, 2006). This change has caused the age we live to be called the information age (Cox, 2000). In this process, the use of technology in the teaching environment has inevitably increased. This emphasizes that the teacher, the most important element of teaching environment (Orhaner & Tunç, 2003), should possess the characteristics of techno-pedagogical education competency to integrate technology into teaching and cognitive flexibility to adapt to change (Krueger, Hansen, & Smaldino, 2000).

The cognitive flexibility is defined as awareness that a person has choices for new situations in which there are options and alternatives available, being willing to be flexible and adaptable to new situations, and having self-determination to be flexible, namely self-efficacy or belief that one has the ability to be flexible (Gündüz, 2013; Martin & Anderson, 1998; Martin & Rubin, 1995). According to Altunkol (2011), the cognitive flexibility requires to be aware of choices to deal with a problem or to adapt to situations, to apply these choices willingly and to feel self-sufficient. The complexity of everyday life grasped by individuals requires the necessity of being cognitively flexible (Altunkol, 2011; Martin & Anderson, 1998). Accordingly, it could be said that the cognitive flexibility includes several skills such as having a different perspective for problems, finding different solutions

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to problems, transferring information to different situations, being versatile and open to change, thinking fluently, going beyond mediocrity, making the necessary arrangements for an activity and discovering new ways (Duman, 2018). The cognitive flexibility was discussed by Karadeniz (2004) in the form of hypertext and hypermedia of cognitive flexibility. In the study, she introduced the applications of the cognitive flexibility theory and hypertext and hypermedia based applications. In another study conducted by Karadeniz (2008) with 13 students studying in the second year of the department of computer education and instructional technology, the students were asked to find solutions to problems through research in case studies that were in the form of hypertexts and designed according to the cognitive flexibility theory. In the study, the students' level of knowledge in the hypertext environment and their opinions about learning in this environment were determined. It was found that the students who had different pre-knowledge about the hardware problems mentioned in the case study in the hypertext acquired expert-level knowledge. In addition, the students stated that they enjoyed learning in the hypertext environment; after learning the subjects under the teacher supervision, they expressed that the use of the hypertext environment as an activity in the courses would be beneficial (Karadeniz, 2008).

In the literature, measuring the cognitive flexibility was considered by Martin and Rubin (1995) and a cognitive flexibility scale consisting of three dimensions (awareness, willingness and self-efficacy) was developed. That the cognitive flexibility scale had internal reliability, structure validity and concurrent validity was revealed in the study. Martin and Anderson (1998) conducted a three-part study on the validity of the cognitive flexibility scale. In the first part, it was found that the cognitive flexibility was positively associated with self-confidence and sensitivity, which were two other communication competencies. In the second part, the participants' self-reported cognitive flexibility evaluations were positively correlated with their friends' scores. In the third part, a significantly positive relationship was found between the cognitive flexibility and confidence in performing communication behaviors. As a result of the study, it was concluded that the validity of the cognitive flexibility scale was supported and therefore, additional support was provided to the scale.

In several studies, the cognitive flexibility was measured and examined its relationship with other variables (Altunkol, 2011; Asıcı & İkiz, 2015; Bilgin, 2009a, 2009b; Bilgin, 2017; Camcı Erdoğan, 2018; Chen, He, & Fan, 2019; Çikrıkci, 2018; Dennis & Vander Wal, 2010; Doğan Laçin & Yalçın, 2019; Esen Aygün, 2018; Gabrys, Tabri, Anisman, & Matheson, 2018; Günaydın & Öztürk, 2016; Gündüz, 2013; Kaptanbaş Gürbüz & Sezgin Nartgün, 2018; Kercood, Lineweaver, Frank, & Fromm, 2017; Lange & Dewitte, 2019; Önen & Koçak, 2015; Özgür & Çuhadar, 2015; Sapmaz & Doğan, 2013; Turan, Durgun, Kaya, Ertaş, & Kuvan, 2019; Üzümcü & Müezzin, 2018; Yaşar, 2019; Yaşar Ekici & Balcı, 2019; Yelpaze & Yakar, 2019). Bilgin (2009b) found that authoritarian parental attitudes, social competency expectancy and problem-solving skills affected the cognitive flexibility significantly. Altunkol (2011) adapted the cognitive flexibility scale developed by Martin and Rubin (1995) to Turkish by investigating its reliability and validity. In the study, conducted with 484 university students, Altunkol (2011) reported a significant negative relationship between the perceived stress and cognitive flexibility levels. In addition, it was concluded that the male students' cognitive flexibility levels were higher than that of the female students and there was a positive relationship between age and the cognitive flexibility levels. Gündüz (2013) examined the relationship between the emotional intelligence, cognitive flexibility, and psychological symptoms of 414 pre-service teachers. The emotional intelligence and cognitive flexibility were negatively correlated with the anxiety and depression. Önen and Koçak (2015), in their study conducted with 554 high school students, investigated the relationship between the cognitive flexibility levels and the attitudes of the students towards studying. It was found that the students demonstrated more positive attitudes, became more willing to study and developed a better studying practice as their cognitive flexibility levels increased. In their study with 105 pre-service teachers studying in the department of computer education and instructional technology, Günaydın and Öztürk (2016) stated that there was a positive correlation between the cognitive flexibility and self-efficacy scores, while there was no significant relationship between the pre-service teachers' demographic information and their cognitive flexibility and self-efficacy perceptions. In the study conducted with 441 adolescents to investigate the relationship between the cognitive flexibility and five factor personality traits, Bilgin (2017) reported that the adolescents became more extroverted, increased self-control skills and became more open to self-improvement as their cognitive flexibility levels increased, whereas the emotional inconsistency was found to increase in the adolescents with low cognitive flexibility. In terms of emotional inconsistency, it was seen that the rate of females was higher than that of males. Camcı Erdoğan (2018) examined the pre-service teachers' cognitive flexibility levels of gifted students in terms of different variables (gender, grade, parental occupation, living place) and found significant differences in terms of the occupations of parents and the place where they live. Esen Aygün (2018) conducted a study to determine the relationship between the pre-service teachers' cognitive flexibility levels and interpersonal problem-solving skills. While there was a significant difference in terms of gender and mothers' educational level, no significant difference was found in terms of grade, department, fathers' educational status, socio-economic, and socio-cultural status in the study. In addition, there was a moderate relationship between the pre-service teachers' cognitive

flexibility and interpersonal problem-solving skills. Kaptanbaş Gürbüz and Sezgin Nartgün (2018) demonstrated that the pre-service teachers attending pedagogical formation training certificate program had high levels of the cognitive flexibility and self-efficacy, and a positive, moderate statistically significant relationship was found between these variables. Yaşar Üzümcü and Müezzin (2018) found that there was a significant positive relationship between teachers' cognitive flexibility and professional satisfaction levels. Ekici and Balcı (2019) stated that as the pre-service preschool teachers' cognitive flexibility levels increased, their emotional responsiveness levels decreased significantly, and their cognitive flexibility and emotional responsiveness levels differed significantly in terms of income, the reason for choosing the department, participating in sports, and perceived parental attitude.

According to Spiro, Feltovich, Jacobson, and Coulson (1992), areas in which complex and irregular situations are required to be applied and many different processes and concepts are employed at the same time are not well-structured areas. Areas such as mathematics and engineering might be considered as well-structured areas, while areas such as medicine, history, literature, law, and teaching might not. Working in well-structured areas requires the cognitive flexibility (Karadeniz, 2004, 2008; Spiro et al., 1992). In the teaching which includes elements such as teachers, students, aims, subjects, methods, tools and the environment, the teacher is the main element that ensures harmony and cooperation between all these elements (Orhaner & Tunç, 2003). Teachers need to decide wisely based on the situation in which she/he is fulfilled this task, to use her/his knowledge when necessary and to develop a self-efficacy, namely having a sufficient level of cognitive flexibility.

Teachers are the foremost practitioners to integrate technology into the teaching processes in schools. Therefore, pre- or in-service teachers should follow the technological developments as well as their knowledge, skills and perceptions related to the profession and have competencies to use technological tools at a certain level (Akgün, 2013). Because pre-service teachers are expected to have students intertwined with technology when they begin their career, they should accept the role of technology and could use this technology in education (Erdemir, Bakırcı, & Eyduran, 2009). With pre- or in-service teachers' use of technology in teaching, the concept of techno-pedagogical content knowledge has developed. The techno-pedagogical content knowledge model was created by adding the technology dimension to the pedagogical content knowledge of Shulman (1986). According to Shulman (1986), who suggested the concept of pedagogical content knowledge, pedagogical content knowledge includes the most useful representation of the most powerful analogies, illustrations, examples and explanations for subjects regularly taught in the subject area. This model mainly consists of content knowledge [CK], pedagogical knowledge [PK] and technological knowledge [TK] components. The pedagogical content knowledge [PCK]), the technological content knowledge [TCK] and the technological pedagogical knowledge [TPK] are the binary intersections of these basic components and the technological pedagogical content knowledge [TPCK or TPACK] is expressed as a combination of all components (Kereluik, Mishra, & Koehler, 2011; Koehler & Mishra, 2005, 2008, 2009; Mishra & Koehler, 2006). Figure 1 presents the components of TPACK (Kereluik et al., 2011; Koehler & Mishra, 2005). TPACK model is an approach emphasizing the interaction and cooperation among three different disciplines: pedagogy, technology and content knowledge (Kabakçı Yurdakul, 2011).

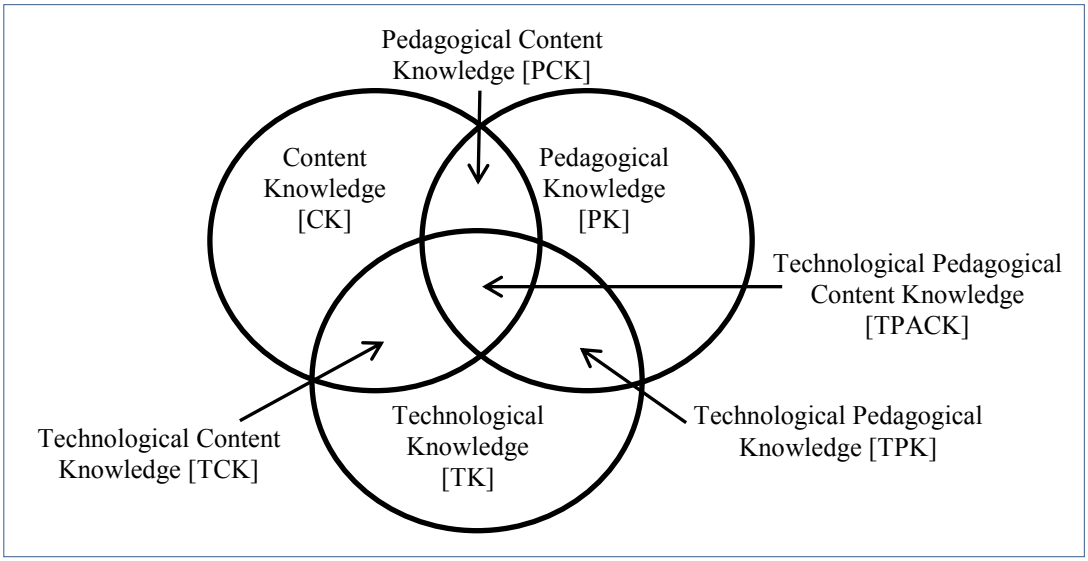

Figure 1. Components of Technological Pedagogical Content Knowledge [TPCK or TPACK] (Kereluik et al., 2011; Koehler & Mishra, 2005).

Considering that technological developments continue at a rapid pace and the technology is inevitable in the teaching environment, it could be stated that pre- or in-service teachers should have techno-pedagogical education competencies. The techno-pedagogical education competency, which means that the TPACK competency is given to pre- or in-service teachers, was discussed within the scope of a the Scientific and Technological Research Council of Turkey [TUBITAK] project and the Techno-pedagogical Education Competencies and Indicators were created for the teaching profession in a workshop attended by 24 instructors from nine different universities. As a result of this study, six competency areas, 20 competencies and 120 indicators were determined for the techno-pedagogical education competencies. The determined competency areas are as follows (Kabakçı Yurdakul, 2013; Kabakçı Yurdakul, Odabaşı, Kılıçer, Çoklar, Birinci & Kurt, 2014):

- designing the teaching process,
- conducting the teaching process,
- being innovative,
- considering ethical issues,
- problem-solving,
- expertise in the field.

The TPACK framework recognizes that teaching is a highly complex problem-solving form that requires the use of flexible and integrated knowledge. Teachers working in a complex and dynamic environment need to integrate their knowledge about how the student thinks and learns into their knowledge of the subject area and technology. The intersection of pedagogical knowledge, content knowledge and technological knowledge is an indication of the knowledge that should be in the teacher in addition to the technological pedagogical content knowledge (Mishra, Koehler, & Henriksen, 2010). Expert teachers use technological pedagogical content knowledge by integrating technological knowledge, pedagogical knowledge and content knowledge simultaneously. Each situation presented to teachers is a different combination of these three elements. There is not a single technological solution for each teacher, course or teaching approach. Solutions depend on the teacher's ability to manage the areas determined by content, pedagogical and technological knowledge in flexibility and the complex interactions between these elements. Not considering the unique complexity of each knowledge component or the complexity of the relationships between these components could cause simplified solutions or failure. Therefore, as well as developing fluency and the cognitive flexibility in these basic areas (TK, PK and CK), teachers need to develop fluency and the cognitive flexibility about how these contexts and contextual parameters are related (Koehler, Mishra, & Cain, 2013) . The TPACK framework emphasizes the role of teachers in designing their educational technology environments. In this approach, rather than taking specific tools into account, teachers focus on teaching approaches that continue with the change of technology, pedagogy or content. Teachers who have the flexibility to think, tolerance of ambiguity and are eager to experience could perfectly design and adapt their content, pedagogical and technological knowledge (Kereluik et al., 2011).

There are several studies in the related literature aiming at measuring the level of technological pedagogical content knowledge of pre- or in-service teachers and examining the relationship between those levels and various variables (Akgün, 2013; Çoklar & Özbek, 2017; Çuhadar, Bülbül, & Ilgaz, 2013; Erdemir et al., 2009; Ersoy, Kabakçı Yurdakul, & Ceylan, 2016; Hacıömeroğlu, Şahin, & Arcagök, 2014; Kabakci Yurdakul & Coklar, 2014; Kabakçı Yurdakul, 2011, 2018; Kabakci Yurdakul, Odabasi, Kilicer, Coklar, Birinci, & Kurt, 2012; Karakaya & Avgin, 2016; Karalar & Altan, 2016; Kiray, 2016; Kul, Aksu, & Birisci, 2019; Lau, 2019; Roussinos & Jimoyiannis, 2019; Şimşek, Demir, Bağçeci, & Kınay, 2013; Valtonen et al., 2019). In their study conducted with 325 pre-service teacher to determine their self confidence levels regarding technology use in education, Erdemir et al. (2009) reported that the pre-service teachers did not consider themselves adequate in computer and internet use for educational purposes and prepare complex multipurpose teaching materials but to search for information and prepare simple materials. In addition, it was concluded that the female pre-service teachers had a better level of self-confidence in using technology for educational purposes than that of males. In another study with 3105 pre-service teachers, Kabakçı Yurdakul (2011) aimed to determine the pre-service teachers' techno-pedagogical education competencies and differentiation in terms of using information and communication technologies [ICT] in these competencies. In the study, it was concluded that the pre-service teachers consider themselves as advanced in terms of their techno-pedagogical education competencies, the design, the implementation and the ethics sub-dimensions of the techno-pedagogical education, whereas they consider themselves to be sufficiently moderate in the expertise sub-dimension. In addition, it was concluded that the pre-service teachers' techno-pedagogical education competencies differ according to ICT use. In his study with 214 pre-service teachers, Akgün (2013) found that the pre-service teachers had a high level of web pedagogical content knowledge and teacher self-efficacy perception and there was a positive relationship

between the web pedagogical content knowledge and the teacher self-efficacy perception. There was also a significant relationship between the department and internet usage frequency. However, no significant relationship was found between web pedagogical content knowledge and gender variable. Çuhadar et al. (2013) determined that the pre-service teachers were questioning in terms of their individual innovation characteristics, but their techno-pedagogical education competencies were at an advanced level. A positive and moderate relationship was found between the individual innovativeness traits and the techno-pedagogical education competencies. In the study conducted by Şimşek et al. (2013), the techno-pedagogical education competencies of the teacher trainers were found to be advanced. While there was no significant difference in terms of gender, department and title, there was a significant difference in favor of the 31-40 age group.

Kabakci Yurdakul and Coklar (2014) determined that the usage stages and levels of ICT directly affect the TPACK competencies. In an experimental study, it was observed that the pre-service teachers' TPACK competencies increased from intermediate to advanced level and the TPACK competencies increased as the ICT usage increased. However, no significant relationship between gender and the TPACK competencies was found (Ersoy et al., 2016). In the studies of Karakaya and Avgin (2016), it was found that physics, chemistry, biology and science teachers (N=87) had a high level of TPACK self-efficacy, but they did not demonstrate a significant difference according to gender, the institution they worked in and technology course participation. However, there was a significant difference according to branch, duration of work and education status. In the study of Karalar and Altan (2016), there was no significant difference between the pre-service teachers' TPACK competency perception scores, the design, the application and the ethics sub-dimensions scores according to gender, while significant difference was observed in favor of males in the expertise sub-dimension. In addition, while the pre-service teachers' TPACK competencies indicated a significant difference according to their computer usage levels and having an internet access, there was no significant difference in terms of having a smartphone. Çoklar and Özbek (2017) applied the TPACK self-efficacy and individual entrepreneurship scales to 421 teachers and found a positive relationship between teachers' individual entrepreneurship and TPACK self-efficacy levels. In a longitudinal study, Valtonen et al (2019) followed TPACKs of 148 pre-service teachers from three Finnish universities for three years. The measurements done at three different times demonstrated that there was an improvement in all TPACK areas.

Although there have been several studies investigating the relationship between the cognitive flexibility and various variables, and the relationship between technological pedagogical content knowledge and various variables, no study investigating the relationship between the cognitive flexibility and technological pedagogical content knowledge based on data has been found. However, in the theoretical studies, it was stressed that the pre- or in-service teachers who have the cognitive flexibility could use the pedagogical content knowledge appropriately (Kereluik et al., 2011; Koehler et al., 2013; Mishra et al., 2010). Therefore, it is thought that determining whether the relationship between the cognitive flexibility and techno-pedagogical content knowledge emphasized in theoretical studies exists would contribute to teacher education. Thus, it could be stated that the cognitive flexibility might increase the pre-service teachers' techno-pedagogical content knowledge which has an important role in teacher education. Additionally, it is possible to develop the pre-service teachers' cognitive flexibility as well as the development of techno-pedagogical content knowledge by utilizing environments designed according to the cognitive flexibility theory (Karadeniz, 2008). The study aims to investigate the relationship between the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies. The study also includes the examination of the relationship between the pre-service teachers' cognitive flexibility levels and technopedagogical education competencies in terms of various variables (gender, type of program, and having a computer and internet access).

The problem of the study is "what is the relationship between the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies and does this relationship differ in terms of various variables?" The sub-problems of the research are as follows:

1. What are the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies?
2. Do the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies differ in terms of various variables (gender, type of program, and having a computer and internet access)?
3. What is the relationship between the pre-service teachers' cognitive flexibility levels and in techno-pedagogical education competencies?
4. Does the relationship between the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies differ in terms of various variables (gender, type of program, and having a computer and internet access)?

Method

Research model

The study, which was conducted to examine the relationship between the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies, used the exploratory correlational research model. This model is used to identify and analyze the relationships between the variables (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2014; Fraenkel & Wallen, 2006). The exploratory correlational research is executed either to explain important human behaviors or to predict likely outcomes. If a relationship of sufficient magnitude exists between two variables, it becomes possible to predict a score on one variable if a score on the other variable is known. Basic steps in correlational research are selecting a problem, choosing a sample, selecting or developing instruments, determining procedures, collecting and analyzing data, and interpreting results (Fraenkel & Wallen, 2006).

Sample

The sample of the study was determined by using convenience sampling method. In the convenience sampling method, the sample is selected from easily accessible, easy to implement units due to the limitations in time, money and labor (Büyüköztürk et al., 2014). The sample consisted of 616 pre-service teachers from all departments of the faculty of education in a western Anatolian university in the 2017-2018 academic year. Table 1 demonstrates the distribution of the pre-service teachers in the sample according to gender and the program.

Table 1. The distribution of the pre-service teachers according to gender and program

		Female	Male	Total
Type of program	Faculty of Education	355	143	498
	Pedagogical Formation	64	54	118
Total		419	197	616

Data collection tools

The Cognitive Flexibility Scale [CFS] (Altunkol, 2011, adapted from Martin & Rubin, 1995) was used to determine the pre-service teachers' cognitive flexibility levels. The scale, developed by Martin and Rubin (1995), consists of 12 items and aims to determine the cognitive flexibility levels of individuals. The Turkish adaptation of the scale which includes the awareness, the willingness and the self-efficacy sub-dimensions was done by Altunkol (2011). In the six-point likert type scale, from 12 to 72 points could be obtained and higher scores demonstrate higher levels of cognitive flexibility. The scale items are answered as "strongly disagree", "disagree", "slightly disagree", "slightly agree", "agree" and "totally agree". Higher scores on the scale indicate higher levels of cognitive flexibility. Because the items 2, 3, 5 and 10 included negative expressions, the points were reversed in the SPSS program through re-coding option. While the Cronbach's alpha coefficient was 0.81 and test-retest reliability coefficient was 0.73 after adaptation (Altunkol, 2011), the Cronbach's alpha coefficient was calculated to be 0.84 with the data obtained in this study. According to Büyüköztürk et al. (2014) values of 0.70 and above are the high level reliability indicators.

To determine the pre-service teachers' techno-pedagogical education competencies, Techno-pedagogical Education Competency Scale that was named as TPACK-deep Scale [TPACKS] developed by Kabakci Yurdakul et al. (2012) was used. The scale, which consists of 33 items, has four factors including the design, the implementation, the ethics and the expertise. The scale is a five-point likert type and answers are given as "I can easily do it", "I can do it", "I can partially do it", "I cannot do it" and "I definitely cannot do it". The lowest score to be obtained from the scale is 33 while the highest score is 165 and higher scores demonstrate higher techno-pedagogical education competency. While the Cronbach's alpha coefficient for the whole scale was 0.95 and the test-retest coefficient was 0.80 (Kabakci Yurdakul et al., 2012), the Cronbach's alpha coefficient in this study was calculated as 0.96 for the whole scale. According to Büyüköztürk et al. (2014), values above 0.70 and above indicate high reliability.

In addition to these scales, a form which included the demographic information about the gender, the type of program, and having a computer and internet access was applied to the participants. These questions and the two scales were arranged by writing a short instruction about the purpose of the study and how to complete it.

Data analysis

In the analysis of the data, as well as descriptive statistics, independent samples t-test and Pearson correlation coefficient were used as the data were normally distributed. In order to determine whether the data were normally distributed, the total scores obtained from the scales and sub-dimensions were calculated and histogram, box- line, Q-Q, detrended graphs, and the skewness and the kurtosis coefficients were examined according to the independent variables (Aminu & Shariff, 2014; Çokluk, Şekercioğlu, & Büyüköztürk, 2014; Drezner, Turel, & Zerom, 2010; Ghasemi & Zahediasl, 2011; Kline, 2011; Razali & Wah, 2011). The skewness and kurtosis coefficients obtained from the data are given in Table 2.

Table 2. The skewness and kurtosis coefficients

				Skewness		Kurtosis	
Scales	Variables		N	Value	SE	Value	SE
CFS	Gender	Female	419	-.332	.119	.743	.238
		Male	197	-.484	.173	.774	.345
	Type of program	Faculty of Education	498	-.345	.109	.627	.218
		Pedagogical Formation	118	-.533	.223	1.413	.442
	Does she/he have a computer?	Yes	516	-.485	.108	.994	.215
		No	100	.148	.241	-.293	.478
	Does she/he have internet access?	Yes	547	-.399	.104	.832	.209
		No	69	-.358	.289	-.116	.570
TPACKS	Gender	Female	419	-.521	.119	.701	.238
		Male	197	-.488	.173	1.369	.345
	Type of program	Faculty of Education	498	-.516	.109	.925	.218
		Pedagogical Formation	118	-.502	.223	.828	.442
	Does she/he have a computer?	Yes	516	-.541	.108	1.087	.215
		No	100	-.418	.241	.340	.478
	Does she/he have internet access?	Yes	547	-.531	.104	1.072	.209
		No	69	-.528	.289	-.158	.570

Note. CFS: Cognitive Flexibility Scale; TPACKS: TPACK-deep Scale; SE: standard error

Aminu & Shariff (2014) and Kline (2011) stated that if the absolute value of the skewness is greater than +3 and the absolute value of the kurtosis is greater than +10 in large samples (N>200), it is considered a problem in terms of normality. As the skewness and the kurtosis coefficients were in the range of -1.5 to +1.5 in the Table 2, it was determined that the data demonstrated normal distribution (Aminu & Shariff, 2014; Kline, 2011). The histogram, box-line, Q-Q and detrended graphs also demonstrated that the data had the normal distribution (Alpar, 2016).

Results and Discussion

To find the answer to the first sub-problem of the study "What are the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies?", total scores, minimum and maximum values, mean scores and standard deviations were calculated. The results are given in Table 3.

Table 3. Findings related to CFS, TPACKS and their sub-dimensions

Scale	Sub-dimensions	N	Min	Max	$\bar{x}$	SD.
CFS	Awareness	616	8	18	14.22	2.07
	Willingness	616	13	24	19.71	2.26
	Self-Efficacy	616	10	30	24.25	3.27
	Total	616	33	72	58.18	6.69
TPACKS	Design	616	14	50	40.57	5.76
	Application	616	21	60	49.94	6.56
	Ethic	616	10	30	24.86	3.63
	Expertise	616	7	25	19.34	3.36
	Total	616	54	165	134.72	17.42

Note. CFS: Cognitive Flexibility Scale; TPACKS: TPACK-deep Scale; $\bar{x}$: mean; SD: standard deviation; df: degree of freedom

When Table 3 is examined, it could be seen that the mean CFS scores of the pre-service teachers was 58.18. Considering that the lowest score that could be obtained from the scale is 12 and the highest score is 72, if the group average is assumed to be 42 points, it could be stated that the pre-service teachers' cognitive flexibility levels were quite high. The mean TPACKS scores of the pre-service teachers was 134.72. According to Kabakci Yurdakul et al. (2012), the scores calculated to be higher than 131 by using the scale were considered to have a high techno-pedagogical education competency. This finding could be interpreted as the pre-service teachers' techno-pedagogical education competencies were high. When the scores obtained from the sub-dimensions of the scales and the highest scores to be obtained in the sub-dimensions could be considered, it could be seen that the willingness sub-dimension of CFS and the application sub-dimensions of the TPACKS were higher, while the awareness sub-dimension of CFS and the expertise sub-dimension of TPACKS were found to be lower.

To answer to the second sub-problem of the research "Do the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies differ in terms of various variables (gender, type of program, and having a computer and internet access)?", the distribution of the total scores taken from the scales according to the independent variables was examined. In order to test the significance of the differences observed in the scores, independent samples t-test was performed. The results are given in Table 4.

Table 4. Independent samples t-test results of CFS and TPACKS scores according to various variables

Scales	Variables		N	$\bar{x}$	SD	df	t	p
CFS	Gender	Female	419	58.03	6.57	614	.776	.43
		Male	197	58.48	6.49			
	Type of program	Faculty of Education	498	58.06	6.78	614	.904	.36
		Pedagogical Formation	118	58.68	6.30			
	Does she/he have a computer?	Yes	516	58.29	6.67	614	.926	.35
		No	100	57.61	6.76			
	Does she/he have internet access?	Yes	547	58.36	6.73	614	1.956	.05
		No	69	58.70	6.17			
TPACKS	Gender	Female	419	135.00	17.46	614	.590	.55
		Male	197	134.11	17.34			
	Type of program	Faculty of Education	498	134.52	17.23	614	.585	.55
		Pedagogical Formation	118	135.56	18.24			
	Does she/he have a computer?	Yes	516	135.82	17.24	614	3.601	**.00**
		No	100	129.03	17.27			
	Does she/he have internet access?	Yes	547	135.62	17.31	614	3.677	**.00**
		No	69	127.52	16.65			

Note. CFS: Cognitive Flexibility Scale; TPACKS: TPACK-deep Scale; $\bar{x}$: mean; SD: standard deviation; df: degree of freedom

When Table 4 is examined, the female pre-service teachers' mean score of CFS is lower than that of males, while the mean score of TPACKS is higher than that of males. When independent samples t-test was performed, it was seen that the differences in relation to gender were not statistically significant. Similarly, differences were found in the mean scores of CFS and TPACKS according to the program type, having a personal computer and having internet access variables, and independent samples t-tests were performed to test the significance of observed differences. As a result of the tests, it was found that the mean score of TPACKS differed significantly in favor of those who had their personal computer and internet access. The findings did not significantly differ according to other variables.

To answer the third sub-problem of the study "What is the relationship between the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies?", the Pearson correlation coefficients between the total scores taken from the scales and their sub-dimensions were analyzed. The results are given in Table 5.

Table 5. Correlation analysis results between CFS and TPACKS, and their subscales scores

Variables		N	P	r
CFS	TPACKS	616	.00	.569
CFS	TPACKS Design	616	.00	.558
	TPACKS Application		.00	.535
	TPACKS Ethics		.00	.461
	TPACKS Expertise		.00	.450

TPACKS	CFS Awareness		.00	.450
	CFS Willingness	616	.00	.470
	CFS Self-efficacy		.00	.552

Note. CFS: Cognitive Flexibility Scale; TPACKS: TPACK-deep Scale; r: correlation coefficient

When Table 5 is examined, it could be seen that the correlation coefficient between the CFS and the TPACKS scores of the pre-service teachers was moderate (r=.569, p<.05). According to Büyüköztürk et al. (2014), if the correlation coefficient is between 0.30 and 0.70, there is a moderate positive correlation between the variables. That is, there might be a moderate positive relationship between the cognitive flexibility and the techno-pedagogical education competencies. In Table 5, the correlation coefficients between the scales and the sub-dimensions are also given. Accordingly, it could be said that the correlations (r=.558 and r=.535; p<.05) between the cognitive flexibility, and the design and the application sub-dimensions of the techno-pedagogical education competency were higher than the correlations (r=.461 and r=.450; p<.05) between the cognitive flexibility, and the ethics and the expertise sub-dimensions of the techno-pedagogical education competency. Similarly, it could be interpreted that the relationship between the techno-pedagogical education competency and the self-efficacy sub-dimension of cognitive flexibility (r=.552, p<.05) was higher than the relationship between the techno-pedagogical education competency, and the willingness and the awareness sub-dimension of cognitive flexibility (r=.450 and r=.470; p<.05).

To find an answer to the fourth sub-problem of the study "Does the relationship between the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies differ in terms of various variables (gender, type of program, and having a computer and internet access)?", partial Pearson correlation coefficients between the total scores of the scales and their sub-dimensions were analyzed. The findings are given in Table 6.

Table 6. Partial correlation analysis results between CFS and TPACKS scores

Variables	Control Variables	df	p	r
TPACKS*CFS	Gender	613	.00	.570
	Type of program		.00	.569
	Having a computer		.00	.570
	Having internet access		.00	.565

Note. CFS: Cognitive Flexibility Scale; TPACKS: TPACK-deep Scale; df: degree of freedom

When Table 6 is examined, it was found that the correlation coefficient between the cognitive flexibility and the techno-pedagogical education competency did not change when program type variable was kept constant (r =.569, p<.05). A little change was observed (r=.570, p<.05) when gender and having computer variable was kept constant, and a slight change (r=.565, p<.05) was seen when having internet access variable was kept constant. This finding could be interpreted that the relationship between the cognitive flexibility and the techno-pedagogical education competency was not affected by any other variables except having internet access.

Discussion, Conclusion and Recommendations

In this study in which the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies were investigated, it was seen that both the cognitive flexibility levels and the techno-pedagogical education competencies were quite high. The finding of high levels of the cognitive flexibility could be interpreted as a high level of awareness of the pre-service teachers' choices for new situations, willingness to adapt to new situations, and self-determination to be flexible. Similar findings related to the cognitive flexibility levels in this study were found in the studies of Camcı Erdoğan (2019), Esen Aygün (2018), Günaydın and Öztürk (2016), and Gündüz (2013). More research could be conducted with the pre-service teachers studying in faculties of education in universities.

Similar findings related to the pre-service teachers' techno-pedagogical education competencies in this study were found in the studies of Akgün (2013), Akgün, Özgür and Çuhadar (2016), Erdemir et al. (2009), Kabakçı Yurdakul (2011), and Karalar and Altan (2016), suggesting that the pre-service teachers' techno-pedagogical education competencies were high. The finding that the techno-pedagogical education competencies have been found to be high could be interpreted as the pre-service teachers benefiting from technology in the design and application of the courses, paying attention to ethical principles while using technology and trying to find solutions when they face problems. At the same time, the fact that the participants are intertwined with technology due to the characteristics of their age group might result in high techno-pedagogical education

competencies (Kabakci Yurdakul, 2018). On the other hand, the present study demonstrated that the pre-service teachers had lower scores in the expertise dimension of TPACKS than other dimensions. Similar findings were found in the studies of Kabakçı Yurdakul (2011), and Karalar and Altan (2016). The reason why the pre-service teachers had lower scores in the expertise dimension might be that they did not consider themselves sufficient in solving technological problems. It could be stated that more research is needed to investigate the reasons for the decrease in the expertise dimension seen in three studies (present study, Kabakçı Yurdakul, 2011, and Karalar & Altan, 2016), and to increase the level in this dimension.

In the study, it was found that the pre-service teachers' cognitive flexibility levels did not demonstrate a significant difference according to the variables that was gender, type of program, having a personal computer and having internet access. In the study of Camcı Erdoğan (2019), Doğan Laçin and Yalçın (2019), Günaydın and Öztürk (2016), and Üzümcü and Müezzin (2018) there was a similar finding, supporting that the cognitive flexibility levels did not differ according to gender. It could be stated that the pre-service teachers' cognitive flexibility would not change depending on whether the individual is male or female. Accordingly, it could be concluded that the cognitive flexibility levels are not specific to gender. In a study conducted with university students, Altunkol (2011) found that the cognitive flexibility levels of male students were higher than that of female students. Further investigations could be suggested to reveal the differentiation of the cognitive flexibility levels according to gender and the reasons for the differentiation.

In the study, it was found that the pre-service teachers' techno-pedagogical education competencies differed statistically in favor of those with personal computers and internet access. Gender and program type variables were not found to be different. The finding that the pre-service teachers' techno-pedagogical education competencies did not differ according to their gender are similar to the findings obtained from the studies of Akgün (2013), Ersoy et al. (2016), Karakaya and Avgin (2016), Karalar and Altan (2016), and Şimşek et al. (2013). In the study of Erdemir et al. (2009), it was concluded that there was a difference in favor of the female pre-service teachers in terms of having self-confidence in using instructional technology. While there is no significant relationship between gender and the techno-pedagogical education competency in the majority of studies, it could be concluded that gender variable should be considered in future research because there are a few studies indicating a relationship between gender and the techno-pedagogical education competency. Because the finding that the pre-service teachers' techno-pedagogical education competencies differed statistically in favor of those with their personal computer and internet access are similar to the findings obtained from Akgün (2013), Kabakçı Yurdakul (2011), Kabakci Yurdakul and Coklar (2014), and Karalar and Altan (2016), it could be concluded that the techno-pedagogical education competency and having a computer and internet access are positively related. The reason why the techno-pedagogical education competencies were high in favor of those who had their personal computer and internet access might be that the pre-service teachers used technology effectively to access all kinds of information inside and outside the school.

In the literature, it has been theoretically stated that pre- or in-service teachers with the cognitive flexibility could use the technological pedagogical content knowledge appropriately (Kereluik et al., 2011; Koehler et al., 2013; Mishra et al., 2010), but there has been no study investigating the relationship between the cognitive flexibility and technological pedagogical content knowledge. In this study, which was conducted to investigate the relationship between the pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies, it was seen that there was a moderate positive relationship between the scores of the cognitive flexibility and the techno-pedagogical education competencies. Based on this finding, it could be concluded that the relationship which was emphasized in theoretical studies (Kereluik et al., 2011; Koehler et al., 2013; Mishra et al., 2010) between the cognitive flexibility and techno-pedagogical content knowledge is moderate. In other words, this study is one of the pioneering studies supporting the theory. Accordingly, the cognitive flexibility could provide the development and use of the techno-pedagogical content knowledge which has an important role in teacher education. Similar to the study conducted by Karadeniz (2008), it is possible to develop the pre-service teachers' cognitive flexibility as well as the development of techno-pedagogical content knowledge by utilizing environments designed according to the cognitive flexibility theory.

The convenience sampling method was used in this study, which could be considered as a limitation of the study. Pre-service teachers from different universities might be included in prospective studies. It is a limitation that in-service teachers were not included in the study. Therefore, a similar study could be executed with in-service teachers. The study is limited to use of the scales developed by Altunkol (2011) and Kabakci Yurdakul et al. (2012). Different scales might be used in future studies. In addition, an in-depth study might be conducted by interviewing with a group of the pre-service teachers to be selected from the sample. Considering that the pre-service teachers' techno-pedagogical education competencies are lower in the expertise sub-dimension, experimental studies might be executed to increase their competencies in this dimension.

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References

Akgün, F. (2013). Preservice teachers' web pedagogical content knowledge and relationship between teachers' perceptions of self efficacy. *Trakya University Journal of Education*, *3*(1), 48-58.

Akgün F., Özgür, H., & Çuhadar, C. (2016). The investigation of technopedagogical knowledge competencies of teacher candidates and pedagogical formation students. *Adiyaman University Journal of Social Sciences, 24*, 837-872. Retrieved from https://dergipark.org.tr/tr/pub/adyusbd/issue/37218/429580

Algozzine, B., Bateman, L. R., Flowers, C. P., Gretes, J. A., Hughes, C. D., & Lambert, R. (1999). Developing technology competencies in a college of education. *Current Issues in Education*, *2*(3), 1-12. Retrieved from http://cie.ed.asu.edu/volume2/number3/

Altunkol, F. (2011). *The analysis of the relation between cognitive flexibility and perceived stress levels of college students* (Unpublished master's thesis). Çukurova University Institute of Social Sciences Department of Educational Sciences, Adana, Turkey.

Aminu, I. M., & Shariff, M. N. M. (2014). Strategic orientation, access to finance, business environment and SMEs performance in Nigeria: Data screening and preliminary analysis. *European Journal of Business and Management*, *6*(35), 124-132.

Asıcı, E., & İkiz, F. (2015). A pathway to happiness: Cognitive flexibility. *Mehmet Akif Ersoy University Journal of Education Faculty, 1*(35), 191-211. Retrieved from https://dergipark.org.tr/en/pub/maeuefd/issue/19408/206375

Baran, E., & Bilici, S. C. (2015). A review of the research on technological pedagogical content knowledge: The case of Turkey. *H. U. Journal of Education*, *30*(1), 15-32.

Bilgin, M. (2009a). Developing a cognitive flexibility scale: Validity and reliability studies. *Social Personality and Behavior*, *37*(3), 343-354.

Bilgin, M. (2009b). Some variables predicting cognitive flexibility. *Cukurova University Faculty of Education Journal*, *3*(36), 142–157.

Bilgin, M. (2017). Relations to five factor personality model with cognitive flexibility in adolescents. *Electronic Journal of Social Sciences, 16*(62), 945-954.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2014). *Bilimsel araştırma yöntemleri* (17. baskı) [*Scientific research methods* (17th ed.)]. Ankara: Pegem Akademi.

Camcı Erdoğan, S. (2018). The relationship between problem solving perceptions and cognitive flexibility skills of pre-service teachers of gifted students. *Celal Bayar University Journal of Social Sciences, 16*(3), 77-96. doi: 10.18026/cbayarsos.465710

Chen, X., He, J., & Fan, X. (2019). Relationships between openness to experience, cognitive flexibility, self-esteem, and creativity among bilingual college students in the U.S., *International Journal of Bilingual Education and Bilingualism*, doi: 10.1080/13670050.2019.1688247

Cox, R. J. (2000). The information age and history looking backward to see us. *Ubiquity, 2000* (September). Retrieved from https://ubiquity.acm.org/article.cfm?id=352537

Çikrıkci, Ö. (2018). The predictive roles of cognitive flexibility and error oriented motivation skills on life satisfaction. *International Journal of Eurasia Social Sciences, 9*(31), 717-727.

Çoklar, A. N., & Özbek, A. (2017). Analyzing of relationship between teachers' individual innovativeness levels and their TPACK self-efficacies. *Journal of Human Sciences*, *14*(1), 427-440.

Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2014). *Sosyal bilimler için çok değişkenli istatistik, SPSS ve LISREL uygulamaları (3. baskı)* [*Multivariate statistics, SPSS and LISREL applications for social sciences* (3rd ed.)]. Ankara: Pegem Akademi.

Çuhadar, C., Bülbül, T., & Ilgaz, G. (2013). Exploring of the relationship between individual innovativeness and techno-pedagogical education competencies of pre-service teachers. *Elementary Education Online*, *12*(3), 797 - 807. Retrieved from http://ilkogretim - online.org.tr

Roussinos, D., & Jimoyiannis, A. (2019). Examining primary education teachers' perceptions of TPACK and the related educational context factors. *Journal of Research on Technology in Education, 51*(4), 377-397. doi: 10.1080/15391523.2019.1666323

Doğan Laçin, B. G., & Yalçın, İ. (2019). Predictive roles of self-efficacy and coping strategies in cognitive flexibility among university students. *Hacettepe University Journal of Education, 34*(2), 358-371. doi: 10.16986/HUJE.2018037424

Drezner, Z., Turel, O., & Zerom, D. (2010). A modified Kolmogorov-Smirnov test for normality. *Communications in Statistics-Simulation and Computation®*, *39*(4), 693-704.

Duman, E. (2018). Flexible thinking as a kind of thinking. *Turkish Studies Social Science, 13*(26), 547-561. doi: 10.7827/TurkishStudies.14432

Erdemir, N., Bakırcı, H., & Eyduran, E. (2009). Determining of student teachers' self-confidence using technology in instruction. *Journal of Turkish Science Education*, *6*(3), 99-108.

Ersoy, M., Kabakçı Yurdakul, I., & Ceylan, B. (2016). Investigating preservice teachers' TPACK competencies through the lenses of ICT Skills: An experimental study. *Education and Science*, *41*(186), 119-135. doi: 10.15390/EB.2016.6345

Dennis, D. J., & Vander Wal, J. S. (2010). The cognitive flexibility inventory: instrument development and estimates of reliability and validity. *Cognitive Therapy and Research, 34,* 241-253. doi:10.1007/s10608-009-9276-4

Esen Aygün, H. (2018). The relationship between pre–service teachers' cognitive flexibility and interpersonal problem solving skills. *Eurasian Journal of Educational Research*, *77*, 105-128. doi: 10.14689/ejer.2018.77.6

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education (6th ed.).* New York, NY: McGraw-Hill.

Ghasemi, A., & Zahediasl, S. (2011). Normality tests for statistical analysis: A guide for non-statisticians. *International Journal of Endocrinology Metabolism, 10*(2), 486–489. doi: 10.5812/ijem.3505

Gabrys, R. L., Tabri, N., Anisman, H., & Matheson, K. (2018). Cognitive control and flexibility in the context of stress and depressive symptoms: The cognitive control and flexibility questionnaire. *Frontiers in Psychology, 9*, 2219. doi: 10.3389/fpsyg.2018.02219

Günaydın, S., & Öztürk, G. (2016). *The relationship between computer teacher candidates' perceptions towards self-efficacy and their cognitive flexibility level*. In İcbay, M. A., Arslan, H., & Jacobs, F. (Eds.), *Research on social studies* (pp. 35-45). Frankfurt, Germany: Peter Lang.

Gündüz, B. (2013). Emotional intelligence, cognitive flexibility and psychological symptoms in pre-service teachers. *Educational Research and Reviews*, *8*(13), 1048-1056.

Hacıömeroğlu, G., Şahin, Ç., & Arcagök, S. (2014). Turkish adaptation of preservice teachers' technological pedagogical content knowledge assessment instrument. *Journal of Theory and Practice in Education*, *10*(2), 297-315.

ISSU, & Ulmer, D. J. (2006). *Beyond the information age: It's time for a change.* Retrieved from http://www.vias.org/beyinfoage/

Kabakci Yurdakul, I., & Coklar, A. N. (2014). Modeling preservice teachers' TPACK competencies based on ICT usage. *Journal of Computer Assisted Learning*, *30*(4), 363-376. doi: 10.1111/jcal.12049

Kabakci Yurdakul, I., Odabasi, H. F., Kilicer, K., Coklar, A. N., Birinci, G., & Kurt, A. A. (2012). The development, validity and reliability of TPACK-deep: A technological pedagogical content knowledge scale. *Computers & Education*, *58*(3), 964-977. doi:10.1016/j.compedu.2011.10.012

Kabakçı Yurdakul, I. (2011). Examining technopedagogical knowledge competencies of preservice teachers based on ICT usage. *Hacettepe University Journal of Education*, *40*, 397-408.

Kabakçı Yurdakul, I. (2013). *Teknopedagojik eğitime dayalı öğretim teknolojileri ve materyal tasarımı* [*Instructional technologies and material design based on technopedagogical education*]. Ankara: Anı Yayıncılık.

Kabakci Yurdakul, I. (2018). Modeling the relationship between pre-service teachers' TPACK and digital nativity. *Educational Technology Research and Development, 66*(2), 267-281. doi: 10.1007/s11423-017-9546-x

Kabakçı Yurdakul, I., Odabaşı, H. F., Kılıçer, K., Çoklar, A. N., Birinci, G., & Kurt, A. A. (2014). Constructing technopedagogical education based on teacher competencies in terms of national standards. *Elementary Education Online*, *13*(4), 1185-1202. doi: http://dx.doi.org/10.17051/io.2014.76490

Kaptanbaş Gürbüz, E., & Sezgin Nartgün, Ş. (2018). Cognitive flexibility and self efficacy levels of pedagogical formation program students. *The Journal of International Social Research, 11*(55), 629-640. doi: 10.17719/jisr.20185537235

Karadeniz, Ş. (2004). Bilişsel esneklik hiper metinleri ve hiper ortamları [Cognitive flexibility hypertext and hyper environments]. *The Turkish Online Journal of Educational Technology - TOJET*, *3*(2), 119-124.

Karadeniz, Ş. (2008). Hypertext application based on cognitive flexibility: Virtual PC hospital. *The Journal of Turkish Educational Sciences*, *6*(1), 135-152.

Karakaya, S., & Avgin, S. S. (2016). Investigation of teacher science discipline self-confidence about their technological pedagogical content knowledge (TPACK). *European Journal of Education Studies*, *2*(9), 1-20. doi: 10.5281/zenodo.165850

Karalar, H., & Altan, B. A. (2016). Examining pre-service primary education teachers' TPACK competencies and teacher self-efficacies. *Cumhuriyet International Journal of Education-CIJE*, *5* (USOS special issue), 15-30.

Kercood, S., Lineweaver, T. T., Frank, C. C., & Fromm, E. D. (2017). Cognitive flexibility and its relationship to academic achievement and career choice of college students with and without attention deficit hyperactivity disorder. *Journal of Postsecondary Education and Disability, 30(*4), 327-342.

Kereluik, K., Mishra, P., & Koehler, M. J. (2011). On learning to subvert signs: Literacy, technology and the TPACK framework. *California Reader*, *44*(2), 12-18.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York: The Guilford Press.

Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research*, *32*(2), 131-152.

Koehler, M. J., & Mishra, P. (2008). *Introducing TPCK. Handbook of technological pedagogical content knowledge (TPCK) for educators*, In the AACTE Committee on Innovation and Technology (Eds.), *Handbook of technological pedagogical content knowledge (TPCK) for educators* (1st ed., pp. 2-29). New York, USA: Routledge/Taylor & Francis Group for American Association of Colleges for Teacher Education.

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary issues in technology and teacher education*, 9(1), 60-70.

Koehler, M., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *The Journal of Education, 193*(3), 13-19. Retrieved from http://www.jstor.org/stable/24636917

Krueger, K., Hansen, L., & Smaldino, S. (2000). Preservice teacher technology competencies: A model for preparing teachers of tomorrow to use technology. *TechTrends*, *44*(3), 47-50.

Kul, U., Aksu, Z., & Birisci, S. (2019). The relationship between technological pedagogical content knowledge and web 2.0 self-efficacy beliefs. *International Online Journal of Educational Sciences, 11*(1),198-213.

Lau, W. W. F. (2018). Relationships between pre-service teachers' social media usage in informal settings and technological pedagogical content knowledge. *Eurasia Journal of Mathematics, Science and Technology Education, 14*(12), 1-12. doi: 10.29333/ejmste/94228

Lange, F., & Dewitte, S. (2019). Cognitive flexibility and pro-environmental behaviour: A multimethod approach. European Journal of Personality, *33*, 488-505. doi: 10.1002/per.2204

Martin M. M, & Rubin R. B. (1995). A new measure of cognitive flexibility. *Psychological Reports*, *76*(2), 623-626.

Martin, M. M., & Anderson, C. M. (1998). The cognitive flexibility scale: Three validity studies. *communication reports*, *11*(1), 1-9. doi: 10.1080/08934219809367680

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017-1054.

Mishra, P., Koehler, M. J., & Henriksen, D. (2010). The 7 transdisciplinary habits of mind: Extending the TPACK framework towards 21st century learning. *Educational Technology*, *51*(2), 22-28.

Orhaner, E., & Tunç, A. (2003). *Ticaret ve turizm eğitiminde özel öğretim yöntemleri [Special teaching methods in trade and tourism education]*. Ankara: Gazi Kitabevi.

Önen, A. S., & Koçak, C. (2015). The effect of cognitive flexibility on higher school students' study strategies. *Procedia - Social and Behavioral Sciences*, *191*, 2346-2350. doi: 10.1016/j.sbspro.2015.04.680

Özgür, H., & Çuhadar, C. (2015). *Investigation the relationship between self-efficacy perceptions on computer programming and cognitive flexibility levels of information technology pre-service teachers*. 9th International Computer & Instructional Technologies Symposium - ICITS 2015, Afyonkarahisar, Turkey.

Razali, N. M., & Wah, Y. B. (2011). Power comparison of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics*, *2*(1), 21–33.

Sapmaz, F., & Doğan, T. (2013). Assessment of cognitive flexibility: Reliability and validity studies of Turkish version of the cognitive flexibility inventory. *Ankara University, Journal of Faculty of Educational Sciences, 46*(1), 143-162. doi: 10.1501/Egifak0000001278

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

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). *Cognitive flexibility, constructivism, and hypertext: random access instruction for advanced knowledge acquisition in ill-structured domains*. In

Duffy, T. M., & Jonassen, D. H. (Ed.), Constructivism and the technology of instruction: A conversation (pp. 57-80). New York: Routledge.

Şimşek, Ö., Demir, S., Bağçeci, B., & Kınay, İ. (2013). Examining technopedagogical knowledge competencies of teacher trainers in terms of some variables. *Ege Journal of Education*, *1*(14), 1-23.

Turan, N., Durgun, H., Kaya, H., Ertaş, G., & Kuvan, D. (2019). The relationship between stress status and cognitive flexibility levels of nursing students. *Journal of Academic Research in Nursing (JAREN), 5*(1), 59-66. doi:10.5222/jaren.2019.43265

Üzümcü, B., & Müezzin, E. (2018). Investigation of the level of cognitive flexibility and job satisfaction of teachers. *Sakarya University Journal of Education, 8*(1), 8-25. doi: 10.19126/suje.325679

Valtonen, T, Sointu, E., Kukkonen, J., Mäkitalo, K., Hoang, N., Häkkinen, P., … Tondeur, J. (2019). Examining pre-service teachers' technological pedagogical content knowledge as evolving knowledge domains: A longitudinal approach. *Journal of Computer Assisted Learning, 35*(4), 491-502. doi: 10.1111/jcal.12353

Yaşar, O. (2019). Managerial decisions and cognitive flexibility: How do managers make decisions? What does neuroscience say about? *Journal of Social Sciences, 18*(71), 1176-1194. doi:10.17755/esosder.491522

Yaşar Ekici, F., & Balcı, S. (2019). Examination of the cognitive flexibility and emotional reactivity levels of preschool teacher candidates. *Journal of Higher Education & Science*, *9*(1), 65-77. doi: 10.5961/jhes.2019.310

Yelpaze, İ., & Yakar, L. (2019). The investigation of life satisfaction and cognitive flexibility of university students. *Turkish Psychological Counseling and Guidance Journal, 9*(54), 913-935.