



Examining English Teachers' Perspectives on Competency Levels in Technopedagogical Education

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Abstract

This study aimed at analyzing English teachers' technopedagogical education competence in Türkiye. This study was carried out as a quantitative design and survey model study. Within the scope of the study, the data collected from 218 English teachers were evaluated. This sample was chosen through the convenience sampling method among the teachers in the population. With the purpose of identifying the technopedagogical levels of English teachers, the "Technopedagogical Content Knowledge Scale" was used in the study. In the analysis of the data, descriptive statistics, frequency, percentage, average, Kruskal Wallis, Mann Whitney U tests were used. As a result of the study, it was determined that English teachers' technopedagogical education level is "Advanced". A significant difference was determined in Technopedagogical education competencies according to various personal characteristics of teachers. Within the scope of the research, it is recommended that future research should be carried out in-depth studies on the reasons why English teachers' technopedagogical education competency levels are high.

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Instructional technology, technopedagogy, English teachers

Introduction

With the speedy development of technology, the thought patterns of teachers have changed and pedagogies blended with new technologies replaced traditional pedagogies where teachers were the main focus. Pedagogies blended with this technology not only changed education methods but the temperament of teachers as well (Igbinsosa, 2023). Today's people are increasingly using technology and it is becoming an inseparable part of their lives. Regardless of which age group, the fact that students are surrounded by technology has greatly popularized the idea of making use of technology in educational environments as well (Başal, 2015). It is noteworthy that language and technology have nested in each other since the invention of writing about five thousand years ago (Chun et al., 2016). In the area of foreign language teaching, there is more need for both scientific and technological innovations compared to other social sciences branches as well as to be able to create visual and audio material in the target language and to use them in learning environments (Kartal, 2005). Information and communication technologies such as personal computers, laptops, printers, LCD projectors, handheld devices, iPods, cell phones, and the internet have increasingly become widespread and started being used in schools as well (Martinovic & Zhang, 2012).

The most important role in using these technologies in an accurate, efficient manner with successful results in education falls on the shoulders of foreign language teachers. At this point, it is extremely important that foreign language teachers acquire this competency in the related departments of universities (Başal, 2015).

With the purpose of allowing teachers to accurately understand the knowledge required to place technology in their learning environments in an efficient manner and use it in the area of educational research, the Technopedagogical Content Knowledge (TPCK) has been presented as a theoretical framework (Schmidt et al., 2009). TPCK, which has been given a place in the literature as a design model,

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has inspired numerous studies as well (Koehler & Mishra, 2005). This model is an approach that was borne out of the interaction of technological, pedagogical, and content knowledge with each other which is necessary for the efficient integration of technology (Yurdakul, 2011). In this respect, in the Turkish Education Association's (TED) (2009) study titled "General Competencies for Teaching Profession", it has been explained that the reason why teachers should have Technopedagogical Content Knowledge (TPCK) to achieve academic success is the need to be knowledgeable on how the integration of subject area and technology should be carried out.

When the literature is reviewed, it can be seen that studies on technopedagogical competency in Turkey have increased in recent years. When these studies are analyzed, it is possible to see that a majority of them focus on Turkish, pre-school, mathematics teachers and teacher candidates. For instance, Kaya (2019) has carried out a study on the technopedagogical competencies of social studies teachers and their smart-board self-sufficiency and Karasu (2019) has carried out a study on the analysis of the content knowledge of Turkish language and literature teachers (TPCK) in terms of various variables. Solmaz (2019) has carried out a study analyzing the relationship between the individual innovation levels of teachers and their pedagogic education competency, whereas Kimav (2019) has worked on an in-service education program plan which was designed to develop technopedagogical skills in English education.

When the international literature is reviewed, Swallow and Olofson (2017) analyzed the contextual factors which were considered to contribute to teachers' developing TPCK and teaching practices in a qualitative multiple case study. Young et al. (2019) have aimed to evaluate the results of mathematics teachers' three-week vocational education on TPCK. In another study, it was questioned whether different teacher training institutes in Holland were sufficient in terms of developing TPCK levels that the teacher candidates need for early technology literacy (Voogt & McKenney, 2017). However, a study that analyzed the technopedagogical education competency of English teachers was not found. It is considered that the data obtained in this study will contribute to both current English teachers' efficient use of technology and the development of new teachers in this area. Additionally, it is considered that it will be beneficial in terms of identifying the scope of the in-service training current English teachers need or updating the current training programs. In this light, the technopedagogical education competency of English teachers were analyzed in terms of the following: Gender, type of school, seniority, type of high-school graduated from, type of faculty graduated from, having completed pedagogical formation or not, academic education level, having completed English preparatory class or not.

Method

This study was carried out as a quantitative design and survey model study. The sample of the study consists of a total of 218 English teachers who were working in Alteylül and Karesi central districts in the city of Balıkesir in the 2019-2020 academic year. This sample was chosen through the convenience sampling method among the teachers in the population. Convenience sampling is a method that is easy to access suitable and volunteering participants for the study and is advantageous both in terms of time and workforce (Gravetter & Forzano, 2012). In this study, 170 (78%) of the participants in the study group are female, and 48 (22%) are male.

Data Collection Tools

A personal information form and the Technopedagogical Content Knowledge Scale were used for the collection of the demographic data of the teachers who participated in the study. The other data collection tool used in the study, the Technopedagogical Content Knowledge Scale (TPACK), was developed by Yurdakul et al. (2012) and consists of 33 items and 4 factors as, "design, exertion, ethics, and proficiency". Cronbach's Alpha value of the "TPACK Scale" applied to the study group is 0.974.

The positive attitude items in the scale were scored as 5-4-3-2-1 and the negative attitude items as 1-2-3-4-5 and reverse coding was done in the analysis process. In the TPACK Scale, a (5-1)/3 evaluation interval was taken as the basis and it was accepted as low level when the arithmetic average score was within the

“1 – 2,33” interval; as medium level when it was within the “2,34 – 3,67” interval and as advanced level when it was within the “3,68 – 5,00” interval in terms of evaluation criteria (Yurdakul, 2011).

It includes information about the purpose, significance, conceptual – theoretical framework and study in general. Palatino Linotype style 10 font, single line spacing, the first line indented 1 cm, 6 nk space after paragraphs. References should be prepared based on APA 7 reference and citing displaying essences. Citing should be given like this example (Adams, 2014; Brown & Caste, 2004; Toran et al., 2019). Direct quotations are written within “”. If the direct quotation is longer than 40 words, then it should be written without using “” as a separate paragraph, indented and in 8 fonts.

Data Collection Process

The data collection tools used in the study were applied online to the English teachers working in Altteylül and Karesi districts in the city of Balıkesir. The scale was sent to the school principals working in Altteylül and Karesi districts through the digital environment and then forwarded to the English teachers by their principals. During the data collection process, the steps were carried out in line with the scientific research ethical rules, and the collected data were kept private within the personal data protection law by the researcher. Informed consent was obtained from all participants, and they were assured that their responses would be anonymized and treated confidentially throughout the research process.

Data Analysis

Various statistical methods were employed in the analysis of the data. Descriptive statistics, frequency distribution, percentage calculations, and mean values were utilized to reveal the general characteristics of the obtained data. Additionally, non-parametric tests such as the Kruskal-Wallis test and Mann-Whitney U test were applied to identify differences between groups.

Findings

It was concluded that the 0.001 significance level according to the Kolmogorov-Smirnov test and the 0.000 significance level according to the Shapiro-Wilk test done on the TPACK scale were smaller than the 0.05 value ($p < 0.05$). Therefore, the data set related to the TPACK scale does not display normal distribution either. As a result, non-parametric tests were made use of since the data did not display normal distribution in the analyses carried out with this data set.

The Score Averages of the English Teachers in Terms of the TPACK Scale

The score averages of the English Teachers in terms of the TPACK scale are given in Table 1.

Table 1. The score averages

TPACK Scale	N	Min.	Max.	X	SD
	218	2.21	5.00	4.18	.54468

It can be seen that the score average of the teachers in terms of the TPACK scale is 4.18. It is known that the “3.68 – 5.00” interval among the TPACK scale level intervals is advanced. This shows that the score averages of the English teachers in terms of the TPACK scale is within the “Advanced” level interval.

The Score Averages of the English Teachers in Terms of the TPACK Scale

The answer to the second sub-problem of the study, “Do the technopedagogical education competency of the English teachers display differences in terms of gender?” was sought. The findings related to the results of the Mann Whitney U Test analysis are shown in Table 2.

Table 2. Comparison of the gender

	Gender	N	Mean rank	Mean total	U	p
Design	Female	170	109.48	18612.00	4077.000	.994
	Male	48	109.56	5259.00		
	Total	218				
Exertion	Female	170	112.17	19069.50	3625.500	.238
	Male	48	100.03	4801.50		
	Total	218				
Ethics	Female	170	114.74	19506.50	3188.500	.020
	Male	48	90.93	4364.50		
	Total	218				
Proficiency	Female	170	112.69	19158.00	3537.000	.155
	Male	48	98.19	4713.00		
	Total	218				

As it can be seen from Table 2, a significance difference as found in the ethics sub-dimension of the English teachers' technopedagogical education competency in favor of female English teachers ($p = .020 < 0.05$).

English Teachers' Technopedagogical Competency in Relation to School Types

In the study, the answers to the question, "Do the technopedagogical education competency of the English teachers display differences in terms of the type of school they worked in?" was sought. The findings related to the Kruskal Wallis Test analysis results are given in Table 3.

Table 3. Comparison of the type of school

	Type of school	N	Mean rank	H	p
Design	State Primary School	22	117.23	10.231	0.69
	State Middle-school	123	107.33		
	State High-school	55	98.95		
	Private Primary school	10	158.10		
	Private Middle-school	5	151.20		
	Private High-school	3	103.83		
	Total	218			
Exertion	State Primary school	22	99.36	8.594	.126
	State Middle-school	123	110.34		
	State High-school	55	100.32		
	Private Primary school	10	136.95		
	Private Middle-school	5	170.90		
	Private High-school	3	124.00		
	Total	218			
Ethics	State Primary school	22	113.89	3.638	.603
	State Middle-school	123	109.41		
	State High-school	55	101.38		
	Private Primary school	10	119.00		
	Private Middle-school	5	148.10		
	Private High-school	3	133.83		
	Total	218			
Specialty	State Primary school	22	106.45	10.932	.53
	State Middle-school	123	115.37		
	State High-school	55	90.25		
	Private Primary school	10	125.60		
	Private Middle-school	5	164.20		
Private High-school	3	99.33			

When Table 3 is analyzed, it can be seen that the technopedagogical competency of English teachers' does not display any differences in terms of school type the teachers work in in any of the sub-dimensions ($p > .05$).

English Teachers' Technopedagogical Competency and Professional Seniority

In the study, the answer to the question, "Do the technopedagogical education competency of the English teachers display differences in terms of their Professional seniority?" was sought in relation to another sub-problem. The findings related to the Kruskal Wallis Test analysis results are given in Table 4.

Table 4. Comparison of the professional seniority

	Seniority	N	Mean Rank	H	p
Design	1-5 years	53	125.64	6.809	.078
	6-10 years	53	114.75		
	11-15 years	47	97.96		
	16 years and over	65	100.41		
	Total	218			
Exertion	1-5 years	53	111.08	3.675	.299
	6-10 years	53	119.68		
	11-15 years	47	95.73		
	16 years and over	65	109.87		
	Total	218			
Ethics	1-5 years	53	122.11	3.654	8.114
	6-10 years	53	111.68		
	11-15 years	47	103.44		
	16 years and over	65	101.82		
	Total	218			
Proficiency	1-5 years	53	126.57	8.114	0.44
	6-10 years	53	113.48		
	11-15 years	47	92.27		
	16 years and over	65	104.80		
	Total	218			

As it can be seen in Table 4, a significant difference was found in the specialty sub-dimension of the technopedagogical education competency of the English teachers whose professional seniority was between 6-10 years ($p = .044 < 0.05$).

English Teachers' Technopedagogical Competency and High School Graduation

In the study, the answer to the question, "Do the technopedagogical education competency of the English teachers display differences in terms of the high-school they graduated from?" was sought in relation to another sub-problem. The findings related to the Kruskal Wallis Test analysis results are given in Table 5.

Table 5. Comparison of high school graduation

	Type of high-school graduated from	N	Mean Rank	H	p
Design	Anatolian High-school	75	106.54	4.058	.541
	Anatolian Teacher Training High-school	47	112.06		
	Super High-school	48	100.02		
	Super High-school	35	115.33		
	Collage	10	137.00		
	Vocational High-school	3	135.33		
	Total	218			
Exertion	Anatolian High-school	75	100.33	10.247	.069

	Anatolian Teacher Training High-school	47	100.61		
	Super High-school	48	113.54		
	General High-school	35	120.30		
	Collage	10	159.85		
	Vocational High-school	3	119.50		
	Total	218			
Ethics	Anatolian High-school	75	116.07	4.048	.543
	Anatolian Teacher Training High-school	47	97.32		
	Super High-school	48	113.61		
	General High-school	35	102.76		
	Collage	10	125.55		
	Vocational High-school	3	95.50		
	Total	218			
Specialty	Anatolian High-school	75	111.83	3.677	.597
	Anatolian Teacher Training High-school	47	105.94		
	Super High-school	48	104.70		
	General High-school	35	111.00		
	Collage	10	137.75		
	Vocational High-school	3	72.17		
	Total	218			

As it can be seen from Table 5, a significant difference was not observed in the technopedagogical education competency of the English teachers in terms of the type of high-school they graduated from ($p > .05$).

English Teachers' Technopedagogical Competency and College Graduation

In the study, the answer to the question, "Do the technopedagogical education competency of the English teachers display differences in terms of the faculty they graduated from?" was sought. The findings related to the Kruskal Wallis Test analysis results are given in Table 6.

Table 6. Comparison of faculty type

	Type of faculty graduated from	N	Mean Rank	H	p
Design	Faculty of Education	161	101.25	11.628	.003
	Faculty of Science and Letters	55	131.19		
	Faculty of Engineering	2	177.00		
	Total	218			
Exertion	Faculty of Education	161	98.46	19.150	.000
	Faculty of Science and Letters	55	141.35		
	Faculty of Engineering	2	122.25		
	Total	218			
Ethics	Faculty of Education	161	101.44	12.858	.002
	Faculty of Science and Letters	55	134.81		
	Faculty of Engineering	2	62.50		
	Total	218			
Specialty	Faculty of Education	161	102.54	8.780	.012
	Faculty of Science and Letters	55	130.85		
	Faculty of Engineering	2	83.00		
	Total	218			

As it can be seen from Table 5, a significant difference was found in the technopedagogy design sub-dimension of the English teachers who graduated from the faculty of engineering ($p = .003 < .05$). On the other hand, a significant difference was found in the technopedagogy sub-dimensions of exertion ($p = .000 < .05$), ethics ($p = .002 < .05$) and specialty ($p = .012 < .05$).

English Teachers' Technopedagogical Competency and Pedagogical Formation Completion

In the study, the answer to the question, “Do the technopedagogical education competency of the English teachers display differences in terms of having completed pedagogical formation or not?” The findings related to the Mann Whitney U Test analysis results are given in Table 7.

Table 7. Comparison of having completed pedagogical formation

	Pedagogical formation	N	Mean Rank	Mean Total	U	p
Design	Yes	211	108.14	22818.00	452.000	.080
	No	7	150.43	1053.00		
	Total	218				
Exertion	Yes	211	108.47	22888.00	522.000	.186
	No	7	140.43	983.00		
	Total	218				
Ethics	Yes	211	109.29	23060.50	694.500	.787
	No	7	115.79	810.50		
	Total	218				
Specialty	Yes	211	110.48	23310.50	532.500	.205
	No	7	80.07	560.50		
	Total	218				

As it can be seen in Table 6, a significant difference was not seen in the English teachers’ technopedagogical education competency in terms of having completed pedagogical formation or not ($p>.05$).

English Teachers’ Technopedagogical Competency and Academic Education Level

In the study, the answer to the question, “Do the technopedagogical education competency of the English teachers display differences in terms of their academic education level?” The findings related to the Kruskal Wallis Test analysis results are given in Table 8.

Table 8. Comparison of the academic education levels

	Academic education level	N	Mean Rank	H	p
Design	Undergraduate	191	105.87	5.655	0.59
	Graduate	26	136.87		
	Doctorate	1	90.50		
	Total	218			
Exertion	Undergraduate	191	110.43	.737	.692
	Graduate	26	104.38		
	Doctorate	1	64.00		
	Total	218			
Ethics	Undergraduate	191	112.71	5.751	.056
	Graduate	26	89.85		
	Doctorate	1	7.50		
	Total	218			
Specialty	Undergraduate	191	107.99	2.149	.341
	Graduate	26	122.79		
	Doctorate	1	51.50		
	Total	218			

As it can be seen in Table 8, the technopedagogical education competency of the English teachers do not display any differences in terms of their academic education levels ($p>.05$).

English Teachers’ Technopedagogical Competency and Completion of English Preparatory Class

In the study, the answer to the question, “Do the technopedagogical education competency of the English teachers display differences in terms of having completed English preparatory class or not?” The findings related to the Mann Whitney U Test analysis results are given in Table 9.

Table 9. Comparison of the having completed English preparatory class

	English preparatory class education	N	Mean rank	Mean total	U	p
Design	Yes	166	105.37	17491.00	3630.000	.083
	No	52	122.69	6380.00		
	Total	218				
Exertion	Yes	166	104.97	17425.00	3654.000	.057
	No	52	123.96	6446.00		
	Total	218				
Ethics	Yes	166	109.95	18251.00	4242.000	.851
	No	52	108.08	5620.00		
	Total	218				
Specialty	Yes	166	108.57	18022.00	4161.000	.693
	No	52	112.48	5849.00		
	Total	218				

As it can be seen in Table 9. the technopedagogical education competency of the English teachers do not display any differences in terms of having completed English preparatory class or not ($p>.05$).

Discussion and Conclusion

In this study, the TPACK levels of English teachers were analyzed in terms of various variables and 218 English teachers participated in the study. It was seen that the technopedagogical education competency of the English teachers according to the scores averages they received from the TPACK scale is in the “Advanced Level” interval. When the literature is reviewed. it can be seen that while Bağra (2022). Kaya (2019). Keleş (2019) and Sağlam-Kaya (2007) indicated similar results in their studies. there is a study in which the opposite results are shown (Özgün-Koca et al, 2010). The teachers’ high level of TPACK can be explained with technology’s existence in all area of our lives and the widespread of its use. The difference in the study results might be related with different samples.

It was analyzed whether the teachers’ technopedagogical education competency displays differences in terms of the gender variable and the analysis results show that there is a significant difference in terms of the ethics sub-dimension of the English teachers’ technopedagogical education competency, in favor of the female English teachers. Similarly, there are other studies in the literature which show that female teachers are more ethical compared to male teachers in terms of use of technology (Turan, 2018). In addition, according to the results of Kaya’s study (2019), it was determined that the technopedagogical education competency of social studies teachers are at an advanced level and that their competency does not display any significant differences in terms of gender, age and seniority. Similarly, according to the findings of Keleş’s study (2019), it was determined that the competency of social studies teachers is high according to their TPACK sub-dimensions.

It was analyzed whether the teachers’ technopedagogical education competency displays differences in terms of the type of school they work in and the analysis results show that none of the sub-dimensions of the English teachers’ technopedagogical education competency display differences according to the type of school the teachers work in. While there are no other studies with such a finding in the literature, it can be stated that this is an expected result.

Teachers’ technopedagogical education competency displays differences in terms of the professional seniority variable and according to the analysis results, a significant difference was found in the specialty sub-dimension of the technopedagogical education competency of the English teachers, whose professional seniority is between 6-10 years. Similarly, Bağra (2022) has reached the conclusion in his study that as professional seniority increases, technopedagogical education competency decreases. There are other studies with similar findings (Kocaoğlu & Akgün, 2013; Yılmaz, 2015). This can be explained with changing

with age and resistance to innovations. There is a study with opposite results as well (Topaloğlu, 2008).

It was analyzed whether the teachers' technopedagogical education competency displays differences in terms of the type of high-school they graduated from and according to the analysis results, a significant difference was not found in terms of this variable. While there are no similar studies in the literature, it can be stated that this is an expected result.

It was analyzed whether the teachers' technopedagogical education competency displays differences in terms of the type of faculty they graduated from and according to the analysis results, a significant difference was found in the design sub-dimension of the technopedagogical education competency of the English teachers who are faculty of engineering graduates. This result shows that the English teachers who are graduates of the faculty of engineering can design their lessons better by making use of technology. A significant difference was determined in the exertion, ethics and specialty sub-dimensions of the technopedagogy for English teachers who are graduates of the faculty of science and letters. This shows that the English teachers who are graduates of the faculty of science and letters are more dependent on ethical rules and more competent in areas which require specialty.

It was analyzed whether the teachers' technopedagogical education competency displays differences in terms of the having completed pedagogical formation or not variable and according to the analysis results, a significant difference was not found. This result can be explained with the fact that technology lessons exist in both education faculties and in formation programs (Çelikkaya, 2017).

It was analyzed whether the teachers' technopedagogical education competency displays differences in terms of academic education level and according to the analysis results, a significant difference was not found. This result is similar to the result of Erbaş et al (2016)'s study, while it is not similar to Bağra (2022) and Karamustafaoğlu's (2006) results. The widespread of use of and familiarity with technology in society might be the reason why technopedagogical education competency does not change according to academic education level. Achieving different results in studies might be due to different samples.

It was analyzed whether the teachers' technopedagogical education competency displays differences in terms of having completed English preparatory class or not variable and according to the analysis results, a significant difference was not found. This is an expected result in terms of teachers' technopedagogical education competency.

Implications

As a result of the scores the English teachers received from the TPACK scale, it was seen that their technopedagogical education competency is "Advanced level". It is considered that studies on the reasons why English teachers' level is advanced might be beneficial to increase the levels of other branch teachers. Female English teachers received higher scores in the "ethics" sub-dimension of technopedagogical education competency compared to male teachers. Male teachers might be given in-service training to raise their competency in terms of ethics. It was seen that the English teachers with 6-10 years of professional seniority were at a more advanced level in the specialty sub-dimension of their technopedagogical education competency. The necessary in-service training can be planned by studying the reasons why the other teachers serving in the same seniority interval are not at the same level. It was found that the English teachers who were graduates of Faculty of Science and Letters were at a higher level in the "exertion, ethics and specialty" sub-dimensions. The reasons for the low levels of English teachers who are graduates of different faculties can be analyzed and this lack can be corrected. In addition, the reasons why English teachers who are graduates of Faculty of Engineering have a higher level in the "design" sub-dimension compared to the teachers who are graduates from other faculties.

Declarations

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References

- Bağra, A., & Kılınç, H. H. (2022). *Öğretmenlerin teknopedagojik eğitim yeterlikleri ve bilişim teknolojisi destekli materyal tasarlama ve kullanma yeterliklerinin incelenmesi* (Unpublished master's thesis). Hacı Bektaş University, Nevşehir.
- Basal, A. (2015). The implementation of a flipped classroom in foreign language teaching. *Turkish Online Journal of Distance Education*, 16(4), 28-37.
- Çelikkaya, T. (2017). Formasyon dersi alan tarih öğretmen adaylarının öğretim teknolojisi ve materyal tasarımı dersine ilişkin görüşleri. *Adıyaman Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 25, 20-52.
- Chun, D., Kern, R., & Smith, B. (2016). Technology in language use, language teaching, and language learning. *The Modern Language Journal*, 100(S1), 64-80.
- Erbaş, M. K., & Ünlü, H. (2017). *Beden eğitimi öğretmen adaylarının tekno-pedagojik eğitim yeterliklerinin incelenmesi*. 26th International Conference on Educational Sciences, Antalya, Türkiye.
- Igbinosa, V. O. (2023). A comparative study of computed aided learning and traditional teaching method on the understanding of linear and quadratic functions in mathematics. *International Journal of Educational Research*, 12(1), 96-106.
- Karamustafaoğlu, O. (2006). Fen ve teknoloji öğretmenlerinin öğretim materyallerini kullanma düzeyleri: Amasya ili örneği. *Atatürk Üniversitesi Bayburt Eğitim Fakültesi Dergisi*, 1(1), 90-101.
- Karasu, F. (2019). *Türk dili ve edebiyatı öğretmenlerinin teknopedagojik alan bilgisi (tpab) yeterliliklerinin çeşitli değişkenler bakımından incelenmesi* (Unpublished master's thesis). Atatürk University, Erzurum.
- Kartal, E. (2005). Bilişim-iletişim teknolojileri ve dil öğretim endüstrisi. *Eğitim Fakültesi Dergisi*, 18(2), 383-393.
- Kaya, M. T. (2019). *Sosyal bilgiler öğretmenlerinin teknopedagojik eğitim yeterlilikleri ve akıllı tahta öz-yeterliliklerinin incelenmesi: Afyonkarahisar örneği* (Unpublished master's thesis). Afyon Kocatepe University, Afyon.
- Keleş, H. (2019). *Sosyal bilgiler öğretmenlerinin teknopedagojik alan bilgisi yeterlilikleri ve web 2.0 teknolojileri hakkında görüşlerinin incelenmesi* (Unpublished master's thesis). Aksaray University, Aksaray.
- Kimav, A. U. (2019). *İngilizce öğretiminde teknopedagojik becerileri geliştirmeye yönelik harmanlanmış bir hizmet içi eğitim programı tasarısı* (Unpublished doctoral dissertation). Anadolu University, Eskişehir.
- Kocaoğlu, B. Ü., & Akgün, Ö. E. (2015). Lise öğretmenlerinin Fatih projesi teknolojilerini kullanmaya yönelik öz-yeterlilik inançları. *Uluslararası Eğitim Bilimleri Dergisi*, 4, 259-276.
- 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.
- Martinovic, D., & Zhang, Z. (2012). Situating ICT in the teacher education program: Overcoming challenges, fulfilling expectations. *Teaching and Teacher Education*, 28(3), 461-469.
- Özgün-Koca, S. A., Meagher, M., & Edwards, M. T. (2011). A teacher's journey with a new generation handheld: Decisions, struggles, and accomplishments. *School Science and Mathematics*, 111(5), 201-224.
- Sağlam-Kaya, Y. (2019). Öğretmen adaylarının teknopedagojik eğitim yeterliklerinin çeşitli değişkenler ve öğretmen öz yeterlikleri bağlamında incelenmesi. *Journal of Theoretical Educational Science*, 12(1), 185-204.
- Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical

- content knowledge (TPACK) the development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, 42(2), 123-149.
- Solmaz, İ. (2019). *Öğretmenlerin bireysel yenilikçilik düzeyleri ile teknopedagojik eğitim yeterlikleri arasındaki ilişki* (Unpublished Doctoral dissertation). Sakarya Üniversitesi, Sakarya.
- Swallow, M. J., & Olofson, M. W. (2017). Contextual understandings in the TPACK framework. *Journal of Research on Technology in Education*, 49(3-4), 228-244.
- Topaloğlu, S. (2008). *Bilgi teknolojisi sınıflarının kullanımına yönelik öğretmen tutumları: adapazarı örneği* (Unpublished Doctoral dissertation). Sakarya Üniversitesi, Sakarya.
- Turan, Z. A. (2018). *İngilizce öğretmenlerinin mesleki öz-yeterlik algıları ve tercih ettikleri yabancı dil öğretim yöntemlerinin incelenmesi* (Unpublished doctoral dissertation). Adıyaman University, Adıyaman.
- Voogt, J., & McKenney, S. (2017). TPACK in teacher education: Are we preparing teachers to use technology for early literacy?. *Technology, Pedagogy and Education*, 26(1), 69-83.
- Yılmaz, G. K. (2015). Türkiye'deki teknolojik pedagojik alan bilgisi çalışmalarının analizi: bir meta-sentez çalışması. *Eğitim ve Bilim*, 40(178), 103-122
- Young, J. R., Young, J., Hamilton, C., & Pratt, S. S. (2019). Evaluating the effects of professional development on urban mathematics teachers TPACK using confidence intervals. *REDIMAT*, 8(3), 312-338.
- Yurdakul, İ. K. (2011). Öğretmen adaylarının teknopedagojik eğitim yeterliklerinin bilgi ve iletişim teknolojilerini kullanımları açısından incelenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 40(40), 397-408.