

# Three Internal Barriers to Technology Integration in Education: Opinion, Attitude and Self-Confidence

## OPEN ACCESS

Volume: 9

Special Issue: 1

Month: May

Year: 2021

E-ISSN: 2582-1334

Received: 28.04.2021

Accepted: 05.05.2021

Published: 10.05.2021

Citation:

Ardıç, Mehmet Alper.  
“Three Internal Barriers to Technology Integration in Education: Opinion, Attitude and Self-Confidence.” *Shanlax International Journal of Education*, vol. 9, no. S1, 2021, pp. 81–96.

DOI:

<https://doi.org/10.34293/education.v9iS1-May.4004>



This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License

**Mehmet Alper Ardıç**

Adıyaman University, Turkey

 <https://orcid.org/0000-0001-9816-4422>

## Acknowledgement

The initial version of this paper has been presented at the 4th International Conference on Language, Education and Culture Conference which was held on 21-23 May 2021.

## Abstract

*It is known that teachers' negative opinions, attitudes and lack of self-confidence towards technology in education negatively affect the technology integration process as an internal barrier. In this study, in order to understand the holistic effect of these internal barriers, the relationship between teachers' views on students' use of technological tools, their attitudes towards technology and their Technological Pedagogical Content Knowledge (TPACK) self-confidence was investigated. 378 secondary school teachers participated in the study, in which relational screening model was used. The data of the study were collected through the Scale of Attitudes Towards Technology (SATT), TPACK Confidence Survey, and Personal Information Form. Multivariate Kruskal-Wallis H Test was employed in order to identify the relationships between teachers' opinions and the factors of the scales, Pearson Moments Multiplication Correlation Coefficient was used so as to identify the relationship of the factors with each other, and multiple linear regression analysis was performed in order to determine the level of teachers' attitudes predicting their TPACK confidence. It was determined that there was positive and significant relationships between the teachers' opinions about the students' benefiting from technological tools and their attitudes, and between the teachers' opinions about the students' benefiting from technological tools in the lessons and their TPACK confidence. In addition, it was understood that there were positive and significant relationships between all factors of the attitude scale and confidence scale, and that the teachers' attitudes towards technology was a significant predictor of their TPACK confidence.*

**Keywords:** Teachers' attitudes, Teachers' opinions, Teachers' self-confidence

## Introduction

The rapid developments experienced in the field of technology causes new working areas to emerge, and some customary professions to change and even disappear. In parallel with these developments, the need for qualified workforce that could adapt to the changes in question is increasing every passing day. Efforts to meet this increasing need makes it necessary for technological tools to be used in the educational processes. Besides this need, the COVID-19 pandemic, which started to take the whole world under its influence in late 2019, has destroyed the accustomed routines in the educational activities and made the use of technological tools in education an urgent necessity rather than a need. Due to the pandemic, face-to-face education was suspended in 85 countries, and in Turkey alone, where this study was conducted, 17.7 million students at K-12 level have been affected by this situation (United Nations Educational Scientific and Cultural Organization [UNESCO], 2021).

The pandemic forced many governments to review their education policies, and led to the implementation of distance education models, which has made the use of technology widespread as never before. This situation has made it essential for teachers, who play a key role in education, to conduct technology integration at a high level.

Technology integration in education is basically defined as the use of technological tools in the curriculum in order to achieve the objectives set in the learning-teaching process and to enhance students' learning (Bauer & Kenton, 2005; Cartwright & Hammond, 2003). Through enabling students to interact with technological tools such as computers, tablets, and smart (interactive) boards with appropriate software and content in educational activities, their high-level cognitive skills could be activated and thus they could realize their individual learning. Rather than replacing the objectives determined in the education process with technology, the aim here is to ensure that these objectives become accessible for all students regardless of their skill levels. Hence, by progressing at their own pace of learning, students will be able to use the time they save from here in areas such as reasoning, creative thinking, etc., and they will even be able to work on real/realistic problems in line with the requirements of the age (Republic of Turkey Ministry of National Education, 2013).

One of the main problems experienced in technological integration is that pedagogy and technology are handled as separate fields (Koehler & Mishra, 2008). According to this approach, pedagogy is only under the responsibility of teachers, while technology is under the responsibility of technology experts. However, in the process of technology integration, it is not only the teacher or only the technology expert who should be responsible. The responsibility is distributed among all components of the integration process, including technological tools. Given the relationships between these components, theoretical frameworks and models created to understand and improve the process can be utilized to solve the problems experienced during the technology integration process (Koehler, et al. 2004). "Technological Pedagogical Content Knowledge" (TPCK), which focuses on the components of

technology, pedagogy and content knowledge, is one of these frameworks. The TPCK framework asserts that technological integration will arise from the dynamic relationship between these components and describes how this interaction will happen (Mishra & Koehler, 2006). TPCK is essentially a theoretical framework developed with the addition of the Technology Knowledge (TK) component to the Pedagogical Content Knowledge (PCK) theory, first introduced by Shulman (1986). As a result of the interaction of the TK with the PCK, the components of the Technological Pedagogical Knowledge (TPK) and the Technological Content Knowledge (TCK) have emerged in addition to the TPCK. TK is a general knowledge and use skills of teachers ranging from standard technologies (such as blackboards) to advanced technologies (such as the Internet and computers) (Bingölbali, et al. 2012). TCK, on the other hand, is the knowledge of a teacher about the technology that s/he can use when teaching a subject, about which technology is more appropriate when teaching a particular subject, and about the possibilities and limitations of the technology to be used (Koehler & Mishra, 2009). On the other hand, TPK is the knowledge about how learning-teaching activities will be affected when certain technologies are used in certain ways (Koehler & Mishra, 2009). TPCK, which is composed of the interaction of the three main components (content, technology and pedagogical knowledge), can be defined as a teacher's knowledge about how to use the technological equipment for a specific subject in order to facilitate students' learning (Bingölbali, et al., 2012).

Achieving technology integration in education is, in addition to being dynamic, a complex, slow and long-term process, regardless of the level of technology integration desired (Groff & Mouza, 2008; Harris, et al. 2009; Koehler, et al. 2007). Ertmer (1999) suggests a two-level structure in order to identify the problems faced in this process. One of these levels is named as external barriers. The external barriers can briefly be expressed as teachers' inability to access the required technological tools (hardware) and computer programs (software), their not receiving the technical and administrative supports they need, and the curricula not being

appropriate for the use of technological tools, etc. The second level is called as internal barriers. Teachers' negative opinions, attitudes and low self-confidence about use of technology, about current learning-teaching and classroom routines, about innovations and changes can be given as examples to these barriers. Ertmer (1999) states that it is relatively more difficult to overcome the internal barriers in the integration process than the external barriers. In studies conducted, it has been understood that external barriers faced in this process have largely been overcome through projects and activities implemented towards the integration of technology in education in the last 30 years, but that internal barriers still have a determinant effect in this process (Ertmer, et al. 2012; Göktaş, et al. 2013, Ottenbreit-Leftwich, et al. 2018). In this context, it is important to investigate the effects of the teachers' opinions, attitudes, and self-confidence on the use of technology in education, and the relationship between these factors.

In the literature review conducted by Ertmer and Ottenbreit Leftwich (2010), in order to determine the internal barriers faced, teachers' self-sufficiency and self-confidence about the integration of technology in education come to the fore. Even if the teachers have adequate skills and technological knowledge, they cannot create the desired effect in the teaching process when they do not have self-confidence in this issue (Ertmer & Ottenbreit Leftwich, 2010; Voogt, et al. 2013). Bandura (1977) emphasizes the concept of self-sufficiency by stating that in order for an individual to be able to demonstrate his/her abilities effectively on a certain subject, s/he should have self-confidence in that subject. He defined the concept of self-sufficiency as an individual's belief in his/her ability to perform a specific task. In other words, self-sufficiency is an individual's belief in his/her ability to accomplish a specific task, or to overcome a problem s/he is faced with. Self-confidence, on the other hand, is an individual's subjective evaluation about to what degree his/her own characteristics are negative or positive. In this respect, self-confidence can be accepted as a measure of self-sufficiency (Bandura, 1986). In this context, it would prove useful to examine teachers' TPACK self-confidence in order to determine in what

components problems are experienced in the process of integration of technology in education. On the other hand, according to Buabeng-Andoh (2012), it can be inferred that when teachers' attitudes towards technology (ATT) are positive, they could easily adapt to the use of technology in learning-teaching processes and integrate technology into classroom practices. In addition, in many studies, it was concluded that ATT has a positive effect on predicting and improving TPACK competences, which have an important role in the effective use of technology in lessons (Albayrak-Sarı, et al. 2016; Atabek, 2020; Buabeng-Andoh, 2012; Çelik & Yeşilyurt, 2013; Kalemöğlü Varol, 2015; Yulisman, et al. 2019). In this respect, determining teachers' ATT levels and its possible relationship with their TPACK self-confidence could be informative in terms of the integration of technology in education.

Attitude is "a tendency that is attributed to an individual and that regularly shapes his/her thoughts, feelings and behaviours about a psychological object" (Kağıtçıbaşı & Üskül, 2006). Although ATT may seem abstract or phenomenological, they are mainly related to behaviours. In fact, according to Oskamp and Schultz (2005), attitude towards an individual, object, a situation or a case is composed of a three-dimensional structure; being cognitive, affective and behavioural, and thus, it is expressed with cognitive, emotional and behavioural reactions. In this context, the attitude of an individual towards a particular subject could be understood by reviewing his/her opinions and behaviours, in which s/he expresses his/her emotions, thoughts, beliefs. Accordingly, when the opinions of teachers in Turkey where the study was carried out regarding the use of technology in education are examined, it is seen that they generally found the use of technology necessary (Erbil & Kocabaş, 2019; Özçelik & Yıldız, 2019), and that they mostly used the smart board in their classes (Avcı, et al. 2019; Özçelik & Yıldız, 2019; Yılmaz, 2018). On the other hand, in studies conducted, it was determined that due to reasons such as incompatibility of the students' Tablets with the smart board (Demirer & Dikmen, 2018; Yılmaz, 2018), and inability to supervise students' use of their Tablets (Erbil & Kocabaş, 2019; Keleş, et al. 2013; Özdemir, 2017), teachers

experienced problems, and thus, found students' use of technological tools such as Tablets in classes unnecessary (Altın & Kalelioğlu, 2015; Keleş, et al. 2013). In this context, it has been stated in various studies that class organizations where students do not utilize technological tools left the students in a passive position (Keleş vd., 2013; Namdar & Küçük, 2018; Özdemir, 2017). It was emphasized in many other studies, on the other hand, that teachers' incompetence regarding technology affected the integration process negatively (Demirer & Dikmen 2018; Özdemir, 2017), and that especially, in-service training programs organized were insufficient in terms of eliminating these negative conditions (Erbil & Kocabaş 2019; Demirer & Dikmen, 2018; Keleş, et al. 2013; Keleş & Turan 2015; Yılmaz 2018). According to Hughes (2005), in order for teachers to implement technology integration in their classes at a high level, they should be able to move away from their class routines and prefer class organizations where they involve their students in the process. As a matter of fact, it was concluded in various studies that when teachers preferred class organizations in which students could interact with technological tools, they achieved technology integration at a more advanced level (Ardıç, 2021a, Ardıç & İşleyen, 2017). Accordingly, it is important to determine the relationship between teachers' opinions about students' using technological tools in classes and their ATT and self-confidence.

Briefly, practices adopting a theoretical framework such as TPCK and freed from external and internal barriers are needed in order to achieve technological integration at the desired level in teaching. It can be assumed that today, external barriers have been or are being overcome mostly. In this respect, in addition to the theoretical framework, teachers' self-confidence, attitudes and opinions come to the fore in the integration of technology process. In fact, the participating teachers' self-confidence (Ardıç, 2020), their ATT (Ardıç, 2021b), their opinions about the use of technology in education and their integration levels (Ardıç, 2021a) were examined separately from each other in a detailed way in the previous studies of the researcher. In the studies in question, in parallel to the literature, it was determined that teachers' negative

attitudes, opinions and self-confidence negatively affected the integration of technology in education. Because no studies that researched this situation in the context of secondary education teachers with a holistic view were encountered in the literature, in this study, the relationship of the components that have been proved to be effective in the integration of technology process with each other and their predictive levels were investigated. With this aspect, it is thought that the study will provide benefits in terms of holistically understanding and overcoming the internal barriers encountered in the integration of technology process. Besides, it is believed that the findings obtained in the study can offer some ideas to teachers, researchers, and governments in terms of using the time, money and human resources they will allocate more effectively for the integration of technology. In this context, answers to the following questions were sought in the study:

1. What is the nature of the relationship between secondary education teachers' ATT and TPCK self-confidence and their opinions about the use of technological tools by the students?
2. What is the relationship between secondary education teachers' ATT and TPCK self-confidence?

### Method

Relational screening model, which is one of the quantitative research methods, was employed in the study. With relational screening models, it is aimed to determine the presence and/or degree of mutual exchange between two or more variables (Karasar, 2015). In relational screening models, the correlational relationships between variables can be investigated, and comparative relational research can be used as well. Accordingly, the relationship of the teachers' opinions about the use of technology by the students with their ATT and TPCK self-confidence was examined through comparing the scale scores of teachers having different opinions. The relationship between teachers' ATT and TPCK self-confidence was examined by using correlation and regression analysis.

### Participants

The present study was conducted with the participation of 378 secondary education

teachers working in a province in the southeast of Turkey between 2018-2019. The participants were determined on a voluntary basis using the convenience sampling method. Some information about the participants is presented in Table 1.

**Table 1 Demographic Information About Teachers**

		f	%
Gender	Female	118	31
	Male	260	69
Age	21-25	7	1.9
	26-30	42	11.1
	31-35	57	15.1
	36-40	126	33.3
	41+	146	38.6
Branch	Vocational Courses	78	20.6
	Maths	57	15.1
	Turkish Literature	50	13.2
	Foreign language	47	12.4
	Biology	34	9
	Physics	22	5.8
	Geography	21	5.6
	History	19	5
	Psychological Counselling	14	3.7
	Chemistry	13	3.4
	Philosophy	7	1.9
	Instructional Technology Education	5	1.3
	Physical education	5	1.3
	Music	4	1.1
Art	2	0.5	

**Data Collection Tools**

In order to obtain demographic information about the teachers and their opinions about students’ use of technology, personal information form was used in the study. Also, in order to determine the teachers’ attitudes towards technology, the Scale of Attitudes Towards Technology (SATT) developed by Yavuz (2005) was used, and in order to determine their

TPCK self-confidence in the context of technology components, Technological Pedagogical Content Knowledge Self-Confidence Scale (TPCK SCS) adapted to Turkish by Timur and Taşar (2011) was employed.

SATT is a 5-point Likert type scale consisting of 19 items. Of the 19 items, 6 are negative statements, while 13 include positive statements. The responses given to the negative items were reversely scored and included in the study. The components that constitute SATT and their related item numbers are as follows: “not using technological tools in education (Factor 1)” 5 items, “using technological tools in education (Factor 2)” 4 items, “the effects of technology on educational life (Factor 3)” 4 items, “teaching how to use technological tools (Factor 4)” 4 items, and “evaluating technological tools (Factor 5)” 2 items. While Cronbach’s Alpha reliability coefficient of SATT was calculated as “.87” by Yavuz (2005), it was found as “.83” in this study.

The TPCK SCS developed by Graham, Burgoyne, Cantell, Smith and Harris (2009) was adapted to Turkish and the necessary factor analysis and reliability studies were conducted (Timur and Tasar, 2011). The finalized scale is a 5-point Likert type scale consisting of 31 items. TPCK SCS is composed of four components that have a direct relationship with technology knowledge, which is among the basic knowledge types that form the TPCK framework. The components in question and their related item numbers are as follows: TPCK 8 items, TPK 7 items, TCK 5 items, and TK 11 items. While Cronbach’s Alpha reliability coefficient of the scale was determined as “.92” by Timur and Tasar (2011), it was calculated as “.96” in this study.

**Data Analysis**

The relationship of the teachers’ opinions about the use of technology by the students with their ATT and TPCK self-confidence was examined through comparing the scale scores of teachers having different opinions. In order to decide what tests to use in this comparison, it was checked whether the teachers’ SATT and TPCK SCS scores met the assumptions for parametric tests (outliers, homogeneity, skewness, kurtosis, normal distribution, etc.) was checked. As a result of this check, it was determined

that the scores from both scales did not have any outliers, that their variance was homogeneous, and that the data showed a distribution close to normal. However, it was seen that the scores of the teachers who were undecided about the students' use of technological tools in both scales were not distributed normally, and that accordingly they did not provide multivariate normality assumption, which is one of the assumptions for parametric tests such as variance analysis. Therefore, in the study, it was decided to use the non-parametric multivariate Kruskal-Wallis (MKW) H test, which is commonly used in studies where the multivariate normality assumption is not met (He, et al. 2017). In order to identify possible differences, MKW was applied to each factor of SATT and TPCK SCS, and total scale scores in the study. In the evaluation of recurrent MKWs, Bonferroni correction was used in order to avoid familywise error, and ".05" significance level was divided by the number of tests applied; thus, new significance levels were determined and indicated below the relevant Tables. In addition, in order to determine between which groups the significant differences that were detected as a result of MKWs existed, Dunn-Bonferroni post hoc test with Bonferroni adjustment was used. Bonferroni adjustment is obtained by multiplying each estimated p value by actual comparison number (Gignac, 2019). In this study, adjusted p values were reported as p'. In the study, the teachers' scores obtained from total scales and their factors were divided by the relevant item numbers, and mean scores were calculated separately ( $\bar{X}_p$ ). Thus, the scores were rendered suitable for 5-point scoring, and by considering score intervals in Table 2, the teachers' attitude and self-confidence levels were determined.

**Table 2 Level Intervals for SATT and TPCK SCS**

Intervals	Attitude level	Self-confidence level
1.00-1.79	Completely negative	Not confident at all
1.80-2.59	Negative	Slightly confident

2.60-3.39	Indecisive	Somewhat confident
3.40-4.19	Positive	Fairly confident
4.20-5.00	Completely positive	Completely confident

Pearson Moments Multiplication Correlation Coefficient was used in order to determine whether there existed a relationship between the teachers' ATT and TPCK self-confidence. Besides, multiple regression analysis was performed in order to identify at what level the teachers' ATT predicted their TPCK self-confidence. In this analysis, all SATT factors that were determined to have a relationship with TPCK SCS were included in the model as predictive variables. Prior to the regression analysis, it was checked whether the data and standard errors met the normality assumptions, and no violation was encountered. Moreover, in order to identify outliers, Centered Leverage Value, Mahalanobis and Cooks distances were checked, and no outliers were found. The scatter plots of the data between SATT factors and TPCK SCS were created and examined, and the scatter was seen to have an oval structure in such a way to form a linear relationship between the variables (Tabachnick & Fidell, 2013). Also, in order to determine whether there was multicollinearity between the variables tolerance (min.559, max.854) and VIF (min. 1.171, max. 1.789) values were checked, and no multicollinearity was found.

**Findings**

The findings of the study are presented under the headings formed by the research questions.

**What is the nature of the relationship between secondary education teachers' ATT and TPCK self-confidence and their opinions about the use of technological tools by the students?**

As a result of the descriptive analysis performed, it was observed that the overall SATT mean scores of the secondary education teachers was M=74.79, and that they had a "positive" attitude ( $\bar{X}_f=3.94$ ) towards technology (Table 3). It was also seen that the same result was valid for all factors of the scale.

**Table 3 Teachers' ATT**

	F1	F2	F3	F4	F5	SATT
M	20.54	15.27	15.32	15.66	8.00	74.79
SD	3.83	3.01	2.51	2.98	1.60	9.63
$\bar{X}_r$	4.11	3.82	3.83	3.91	4.00	3.94
Attitude	Positive	Positive	Positive	Positive	Positive	Positive

Similarly, it was determined that the teachers' TPCK SCS mean score was  $M=110.37$ , and that they were "fairly confident" ( $\bar{X}_r=3.56$ ) self-confident (Table 4). When the sub dimensions of the scale are examined, it is seen that similarly the participant teachers had "fairly confident" self-confidence in

TPCK, TPK and TK dimensions. Besides, it was determined that with a mean score of  $M=16.96$ , TCK was the component in which the teachers had the least self-confidence at a moderate "somewhat confident" ( $\bar{X}_r=3.39$ ) level.

**Table 4 Teachers' TPCK Self-Confidence**

	TPCK	TPK	TCK	TK	TPCK SCS
M	28.85	25.85	16.96	38.71	110.37
SD	5.70	5.37	5.30	9.34	22.36
$\bar{X}_r$	3.61	3.69	3.39	3.52	3.56
Self-confidence	Fairly confident	Fairly confident	Somewhat confident	Fairly confident	Fairly confident

In addition, it was understood that the teachers were mostly negative towards the use of technological tools by the students in their lessons (48.9%), or they were undecided in this regard (7.4%). Nevertheless, it was observed that these negative thoughts decreased (25%) when it came to the use of the technological

tools by the students for lesson preparation outside the classroom.

SATT mean scores and MKW test results according to the teachers' opinions about the use of technology by the students in the lessons are presented in Table 5.

**Table 5 SATT Mean Scores and MKW Test Results According to the Teachers' Opinions about the use of Technology by the Students in the Lessons**

Factors	Opn.	N	M	SD	M Rank	df	H	p*	$\eta^2$	Post Hoc	p'
F1	0.Negative	185	19.65	4.21	165.95	2	17.060	.000	.045	2>0	.000
	1.Undecided	28	20.93	4.36	208.75						
	2.Positive	165	21.47	2.98	212.64						
F2	0.Negative	185	14.69	3.15	170.08	2	11.633	.003	.031	2>0	.003
	1.Undecided	28	15.75	2.19	205.43						
	2.Positive	165	15.84	2.87	208.57						
F3	0.Negative	185	14.92	2.71	175.31	2	8.71	.013	.023		
	1.Undecided	28	16.29	1.82	232.86						
	2.Positive	165	15.61	2.30	198.05						
F4	0.Negative	185	15.09	3.23	170.43	2	12.036	.002	.032	2>0	.0079
	1.Undecided	28	16.75	2.24	224.57						
	2.Positive	165	16.11	2.68	204.93						

F5	0.Negative	185	7.89	1.71	183.61	2	1.153	.562	.003		
	1.Undecided	28	8.11	1.62	198.96						
	2.Positive	165	8.10	1.48	194.50						
SATT	0.Negative	185	72.24	10.35	164.36	2	19.672	.000	.052	2>0	.000
	1.Undecided	28	77.82	6.99	226.54						
	2.Positive	165	77.13	8.39	211.40						

\* $\alpha = .008$

According to MKW test results, it was determined that there were significant differences in Factor 1 ( $H(2)=17.060, p<.008, \eta^2 =.045$ ), Factor 2 ( $H(2)=11.633, p<.008, \eta^2 =.031$ ) and Factor 4 ( $H(2)=12.036, p<.008, \eta^2 =.032$ ) and the total SATT ( $H(2)=19.672, p<.008, \eta^2 =.052$ ). As a result of Post Hoc tests, it was seen that all differences in question between the teachers who had a positive opinion

about the use of technology by the students in classes and those with negative opinions were in favor of the teachers with positive opinions ( $p'<.008$ ).

SATT means scores and MKW test results according to the teachers' opinions about the use of technological tools by the students in order to study and prepare for the lessons outside the classroom are presented in Table 6.

**Table 6 SATT mean Scores and MKW Test Results According to the Teachers' Opinions About the use of Technological Tools by the Students Outside the Classroom**

Factors	Opn.	f	M	SD	M Rank	df	H	p*	$\eta^2$	Post Hoc	p'
F1	0.Negative	96	18.81	4.66	148.93	2	19.117	.000	.051	2>0	.000
	1.Undecided	17	22.00	2.96	230.85						
	2.Positive	265	21.08	3.33	201.55						
F2	0.Negative	96	14.83	2.83	172.48	2	4.491	.106	.012		
	1.Undecided	17	14.88	1.90	165.94						
	2.Positive	265	15.46	3.12	197.18						
F3	0.Negative	96	14.89	2.55	170.43	2	4.039	.133	.011		
	1.Undecided	17	15.24	2.86	190.71						
	2.Positive	265	15.49	2.46	196.33						
F4	0.Negative	96	14.93	3.29	165.29	2	6.476	.039	.017		
	1.Undecided	17	15.94	3.27	202.47						
	2.Positive	265	15.90	2.81	197.44						
F5	0.Negative	96	8.01	1.47	184.85	2	.404	.817	.001		
	1.Undecided	17	7.88	2.06	201.06						
	2.Positive	265	7.99	1.63	190.44						
SATT	0.Negative	96	71.45	10.54	158.40	2	10.656	.005	.028	2>0	.005
	1.Undecided	17	75.94	10.48	211.94						
	2.Positive	265	75.93	8.97	199.33						

\* $\alpha = .008$

According to MKW test results, it was determined that there were significant differences in Factor 1 ( $H(2)=19.117, p<.008, \eta^2 =.051$ ) and the total SATT ( $H(2)=10.656, p<.008, \eta^2 =.028$ ). As a result of Post Hoc tests, it was seen that all differences in question

between the teachers who had a positive opinion about the use of technological tools by the students outside the classroom and those with negative opinions were in favor of the teachers with positive opinions ( $p'<.008$ ).

TPCK Self-confidence mean scores and MKW test results according to the teachers' opinions about the use of technological tools by the students in the lessons are presented in Table 7.

**Table 7 TPCK mean Scores and MKW Test Results According to the Teachers' Opinions about the use of Technological Tools by the Students in the Lessons**

Factors	Opn.	f	M	SD	M Rank	df	H	p*	η2	Post Hoc	p'
TPCK	0.Negative	185	27.47	5.64	164.44	2	22.786	.000	.060	2>0	.000
	1.Undecided	28	28.39	4.83	177.18						
	2.Positive	165	30.47	5.50	219.69						
TPK	0.Negative	185	24.95	5.60	172.92	2	10.714	.005	.028	2>0	.004
	1.Undecided	28	25.61	3.99	176.52						
	2.Positive	165	26.90	5.14	210.30						
TCK	0.Negative	185	16.35	4.98	173.00	2	8.805	.012	.023		
	1.Undecided	28	17.11	4.66	192.43						
	2.Positive	165	17.62	5.68	207.51						
TK	0.Negative	185	36.89	9.53	168.78	2	13.502	.001	.036	2>0	.001
	1.Undecided	28	39.57	6.91	196.41						
	2.Positive	165	40.61	9.13	211.55						
TPCKSCS	0.Negative	185	105.66	22.08	167.73	2	15.889	.000	.042	2>0	.000
	1.Undecided	28	110.68	17.46	186.98						
	2.Positive	165	115.59	22.36	214.34						

\*α = .01

According to MKW test results, it was determined that there were significant differences in TPCK (H(2)=22.786, p<.01, η2= .060), TPK (H(2)=10.714, p<.01, η2= .028) and TK (H(2)=13.502, p<.01, η2= .036) components, and the total TPCK SCS (H(2)=15.889, p<.01, η2= .042). As a result of Post Hoc tests, it was seen that all differences in question between the teachers who had a positive opinion about the use of technology by the students in classes

and those with negative opinions were in favor of the teachers with positive opinions (p'<.01).

In addition, when TPCK SCS mean scores and MKW test results according to the teachers' opinions about the use of technological tools by the students outside the classroom were examined (Table 8), it was determined that the teachers' self-confidence did not differ (p>.01).

**Table 8 TPCK SCS Mean Scores and MKW Test Results According to the Teachers' Opinions about the use of Technological tools by the Students Outside the Classroom**

Factors	Opn.	f	M	SD	M Rank	df	H	p*	η2
TPCK	0.Negative	96	27.56	5.75	169.19	2	4.625	.099	.012
	1.Undecided	17	29.94	4.60	206.65				
	2.Positive	265	29.24	5.69	195.76				
TPK	0.Negative	96	24.80	5.75	171.90	2	3.576	.167	.009
	1.Undecided	17	26.00	4.58	183.74				
	2.Positive	265	26.22	5.24	196.25				
TCK	0.Negative	96	16.44	4.67	173.54	2	3.080	.214	.008
	1.Undecided	17	16.76	4.68	180.74				
	2.Positive	265	17.16	5.55	195.84				

TK	0.Negative	96	36.76	9.81	168.94	2	5.358	.069	.014
	1.Undecided	17	37.29	8.89	173.62				
	2.Positive	265	39.51	9.12	197.97				
TPCKSCS	0.Negative	96	105.56	22.35	169.94	2	4.438	.109	.012
	1.Undecided	17	110.00	19.93	181.76				
	2.Positive	265	112.13	22.33	197.08				

\* $\alpha = .01$

**What is the relationship between secondary education teachers’ ATT and TPCK self-confidence?**

scores in the context of total scales and their sub dimensions are presented in Table 9.

The relationships between ATTS and TPCK SCS

**Table 9 The Relationship between the Teachers’ ATT and TPCK Self-Confidence**

	1	2	3	4	5	6	7	8	9	10
<b>F1</b>	-									
<b>F2</b>	,282*	-								
<b>F3</b>	,272*	,467*	-							
<b>F4</b>	,307*	,288*	,460*	-						
<b>F5</b>	,153*	,274*	,394*	,594*	-					
<b>6.SATT</b>	,677*	,682*	,723*	,741*	,599*	-				
<b>7.TPCK</b>	,276*	,235*	,226*	,292*	,213*	,368*	-			
<b>8.TPK</b>	,282*	,288*	,252*	,334*	,251*	,413*	,792*	-		
<b>9.TCK</b>	,178*	,181*	,182*	,244*	,246*	,291*	,674*	,703*	-	
<b>10.TK</b>	,260*	,315*	,208*	,280*	,162*	,370*	,690*	,659*	,553*	-
<b>TPCKSCS</b>	,289*	,304*	,248*	,329*	,240*	,416*	,893*	,884*	,808*	,883*

\* $p < .01$  (2 tailed)

When the statistics in Table 9 were examined, it was understood that all factors of SATT had a positive and significant relationship with all components of TPCK SCS ( $p < .01$ ). When the scale scores were evaluated in general, it was seen that there was a “moderate” and positive correlation between SATT and TPCK SCS ( $r = .416$ ,  $p < .001$ ). Besides, when the correlations between SATT factors and TPCK SCS are examined (Table 10), it is seen that there is positive and low-level relationship between Factor 1 and TPCK SCS, and when the other variables are controlled, the correlation between the two variables is calculated as  $pr = .169$  at a low level. There is a positive and moderate-level correlation ( $r = .304$ ) between Factor 2 and TPCK SCS. However, when

the other variables are controlled, it is seen that this correlation is calculated as  $pr = .173$  at a weak level. It is seen that there is a positive and low-level correlation ( $r = .248$ ) between Factor 3 and TPCK SCS, but when the other variables are controlled, it is seen that this correlation is calculated as  $pr = .008$  at quite a low level. There is a positive and moderate-level correlation ( $r = .304$ ) between Factor 2 and TPCK SCS. However, when the other variables are controlled, it is seen that this correlation is calculated as  $pr = .158$  at a weak level. In addition, there is a positive and low-level correlation ( $r = .248$ ) between Factor 3 and TPCK SCS, but when the other variables are controlled, it is seen that this correlation is calculated as  $pr = .040$  at quite a low level.

**Table 10 Regression Analysis Regarding the Teachers’ ATT Predicting their TPCK Self-Confidence**

	B	Std. Error	$\beta$	t	p	r	Partial r
<b>Constant</b>	40.323	8.327		4.842	.000		
<b>F1</b>	.981	.297	.168	3.307	.001	.289	.169
<b>F2</b>	1.362	.403	.184	3.383	.001	.304	.173
<b>F3</b>	.083	.519	.009	.160	.873	.248	.008
<b>F4</b>	1.450	.471	.193	3.080	.002	.329	.158
<b>F5</b>	.641	.829	.046	.773	.440	.240	.040
<b>R=.426</b>	R2=.181						
<b>F(5,372)=16.463</b>	p=.000						

When the statistics related to the established regression analysis model are examined (Table 10), it is seen that SATT factors are a significant predictor of TPCK SCS ( $F(5.372)=16.463, p<.001$ ). In this respect, it was determined that the scores obtained from SATT factors had a “moderate” level relationship with the scores obtained from TPCK SCS ( $R=.426, R^2=.181, p<.001$ ), and they predicted 17% of the total variance in TPCK SCS ( $R^2_{adjusted}=.170$ ). When t-test results related to the significance of regression coefficients were examined, it was determined that Factor 1, 2, and 4 are significant predictors of TPCK SCS ( $p<.05$ ), but that Factor 3 and 5 did not have a significant effect ( $p>.05$ ). In fact, the relative significance order of SATT factors according to the standardized regression coefficient ( $\beta$ ) is as Factor 4, 2, 1, 5, and 3. In this context, it was understood that a one-point increase in Factor 4 of SATT would increase the teachers’ TPCK SCS scores by 1.450 points, a one-point increase in Factor 2 would increase the teachers’ TPCK SCS scores by 1.362 points, and a one-point increase in Factor 1 would increase the teachers’ TPCK SCS scores by .981 points.

**Discussion, Conclusion and Suggestions**

Looking at the scores obtained by the secondary education teachers from SATT total and its factors, it was understood that their ATT were at a positive level. Similarly, when the scores of the teachers obtained from the total TPCK SCS, and the components of TPCK, TPK and TK were considered, it was understood that they were highly confident, and moderately confident in TCK components. Similar findings obtained in various studies about the participants’ TYT (Birkollu, et al.,

2017; Çakır & Oktay, 2013; Kayalar, 2018; Paşa et al., 2015; Üstün & Akman, 2015) and TPCK self-confidence (Bozkurt, 2016; Köseoğlu, 2012; Saltan & Arslan, 2017; Sancar Tokmak, et al. 2013; Tuysuz, 2014) support the results achieved in the study. Additionally, it was understood that despite their self-confident and positive attitudes, a considerable majority of the teachers were either negative or undecided regarding the utilization of technological tools by students in the class. As a matter of fact, in previous studies conducted, it was determined that the teachers had negative attitudes about the students’ use of technological tools in their classes as they found it distracting, and the students were engaged in activities other than the lessons (Altın & Kalelioğlu, 2015; Demirer & Dikmen, 2018; Keleş, et al., 2013). On the other hand, when it comes to the use of technological tools by the students in order to study and doing homework, etc. outside the classroom, the balance strikingly shifts in favor of positive opinion. Besides, this change in teachers’ opinions is also reflected in their ATT and TPCK self-confidence levels.

When teachers’ ATT are examined, it is observed that there are significant differences in favor of the teachers who had a positive opinion about the use of technological tools by the students in their classes in terms of the total SATT and Factor 1, 2 and 4. However, when the teachers’ ATT are considered in terms of the students’ use of technological tools outside the classroom, there are differences in favor of the teachers with a positive opinion only in Factor 1 and the total SATT. The differences observed in Factor 1 and 2 in favor of the teachers with a positive opinion mean that they found the use of technological tools in education significant and necessary, and that

they had a positive attitude believing that this use of technology would contribute to the attainment of the targeted gains. In addition, the difference observed in Factor 4 implies that the teachers had a positive attitude believing that training on current technological tools should be provided to teacher candidates studying in teacher training programs, and that the students also should be provided with information about the current technology use competences. In this context, it can be claimed that there was a significant and positive relationship between the teachers' opinions about the students' benefiting from technological tools and their ATT. While there was no significant difference in TPCK self-confidence levels of the teachers in terms of their opinions about whether students should use technological tools to prepare for their lessons, there were significant differences in favor of those who supported students' using technological tools in classes. When the differences observed in the total TPCK SCS and TPCK, TPK and TK components in favor of the teachers who had positive opinions about the use of technological tools in classes are evaluated together, it is understood that the teachers in question had higher self-confidence than other teachers in terms of how to use the technologies to be employed in teaching a certain subject in order to facilitate the students' learning. In this context, it can be claimed that there was a significant and positive relationship between the teachers' opinions about the students' benefiting from technological tools in their classes and their TPCK self-confidence. It is also interesting that TPCK self-confidence of teachers (unlike their ATT) did not show a significant difference according to their opinions about whether students should use technological tools outside the classroom. In this context, it can be claimed that there was not a significant relationship between the teachers' opinions about the students' benefiting from technological tools outside the classroom and their TPCK self-confidence.

On the other hand, SATT mean scores of the teachers who were undecided about the students' use of technological tools both in class and outside the classroom were higher than those of the teachers with a positive opinion, albeit with a very little difference. Based on this, it can be claimed that although the

teachers in general had a positive attitude towards the use of technological tools by the students, they experienced indecision regarding this issue. When their TPCK self-confidence was examined in order to understand why the teachers experienced indecision despite their positive attitudes, it was seen that the teachers in question had lower self-confidence compared to the teachers with a positive opinion. Thus, it can be claimed that the indecision experienced by the teachers regarding the students' use of technological tools in class may have resulted from their low TPCK self-confidence.

When the significant contributions made by Factor 1, 2 and 4 of SATT to the regression model established in the study are considered, it is understood that the attitudes of the teachers were a significant predictors of their TPCK self-confidence. In fact, the fact that ATT was found to be the most effective predictor of the technology integration process (Farjon, et al. 2019), and to have a positive effect in terms of predicting and improving TPCK competences in many studies supports this finding (Albayrak-Sarı, et al. 2016; Atabek, 2020; Buabeng-Andoh, 2012; Çelik & Yeşilyurt, 2013; Kalemoglu Varol, 2015; Yulisman, et al. 2019). When the results obtained in the study are evaluated as a whole, it can be argued that in the integration of technology process in education, there is a positive relationship between the teachers' opinions, attitudes and self-confidence. As a matter of fact, the teachers who had a positive opinion about the use of technological tools by the students, especially in classes, had high levels of ATT and TPCK self-confidence. Besides, Factor 1, 2 and 4 of ATT, in which differences were observed in favor of the teachers with a positive opinion, are also the predictors of TPCK SCS. The factors in question indicate that the teachers found the use of technological tools in education necessary, and that they had a positive attitude believing that this use of technology would contribute to the attainment of the targeted gains, and that training should be provided for both teachers and students in this regard. Based on this, it can be recommended that in order to create classroom settings where the integration of technology in education is achieved at a high level with the students interacting with technological tools, in-service training programs

should be organized to increase the teachers' both attitudes and self-confidence. However, these in-service training activities to be organized should not just focus on technical dimensions and not aim to only educate the teachers about how to use technological tools. This is because it has been emphasized in many studies that in-service training activities designed in this fashion have been insufficient in terms of eliminating the participants' concerns or prejudices about the use of technology (Erbil & Kocabaş 2019; Demirer & Dikmen, 2018; Keleş, et al. 2013; Keleş & Turan 2015; Yılmaz 2018). In training programs to be conducted in this context, it might be beneficial to consider the teachers' needs for technological, pedagogical and content knowledge. Besides, in these training programs, hands-on training can be provided on technological tools and software through which the teachers can get their students involved in the process. With the help of these training programs, it can be ensured that teachers perform technology applications in their lessons, where their students could interact with technological tools. It was determined in previous studies that the participants who received proper training implemented technology integration in their lessons at higher levels and performed classroom applications in which the students were able to interact with technological tools, which supports this suggestion (Akkoç, et al. 2011; Ardiç & İşleyen, 2017; Bozkurt, et al. 2014; Demir, 2011; Özmantar, et al. 2010).

The results obtained are limited to the data collected from 378 teachers working in a province. By conducting similar studies in this context with a larger sample group, more generalizable results can be obtained. Also, the fact that the data collection phase of the study was carried out before the COVID-19 pandemic makes it hard to understand and explain the ongoing "emergency" distance education activities. To overcome this difficulty, it can be suggested that similar studies be conducted within and after the pandemic process. The data to be obtained from the studies to be conducted can be evaluated with the findings of the present study in a longitudinal perspective, and the effects of the pandemic on the use of technology in education can be understood better. Despite the mentioned limitations, when the

fact that teachers and especially students are in more interaction with technological tools in classes during the pandemic period is considered, changes in the opposite direction in the teachers' opinions about the use of technological tools in classes can be observed.

## References

- Akkoç, Hatice, et al. *Project Development for Bring Mathematics Teachers Candidates in TPACK*. The Scientific and Technological Research Council of Turkey, Project Number 107K531, 2011.
- Albayrak-Sari, Aylin, et al. "Investigating the Relationship between Teachers' Technological Pedagogical Content Knowledge (TPACK) Competencies and Attitudes towards Information and Communication Technologies." *Educational Technology Theory and Practice*, vol. 6, no. 1, 2016, pp. 1-21.
- Altın, Hüseyin Melih, and Filiz Kalelioğlu. "Perceptions of Students and Teachers about Fatih Project." *Başkent University Journal of Education*, vol. 2, no. 1, 2015, pp. 89-105.
- Ardıç, Mehmet Alper. "Examination of Secondary Education Teachers' Technological Pedagogical Content Knowledge Confidence." *Journal of Uludağ University Faculty of Education*, vol. 33, no. 3, 2020, pp. 653-695.
- Ardıç, Mehmet Alper. "Determination of the Secondary Education Teachers' Views Regarding the Utilization of Technology in Education and Technology Integration Levels." *Journal of Kazım Karabekir Faculty of Education*, 2021a, forthcoming.
- Ardıç, Mehmet Alper. "Examination of Secondary Education Teachers' Attitudes towards Technology Use in Education." *Cumhuriyet International Journal of Education*, 2021b, forthcoming.
- Ardıç, Mehmet Alper, and Tevfik İşleyen. "High School Mathematics Teachers' Levels of Achieving Technology Integration and In-Class Reflections: The Case of Mathematica." *Universal Journal of Educational Research*, vol. 5, no. 12B, 2017, pp. 1-17.
- Atabek, Oguzhan. "Associations between Emotional States, Self-Efficacy for and Attitude towards Using Educational Technology." *International*

- Journal of Progressive Education*, vol. 16, no. 2, 2020, pp. 175-194.
- Avci, Ümmühan, et al. "Teachers' Opinions on Technology that They Want to Integrate into the Learning-Teaching Process." *Acta Infologica*, vol. 3, no. 1, 2019, pp. 13-21.
- Bandura, Albert. "Self-efficacy: Toward a Unifying Theory of Behavioral Change." *Psychological Review*, vol. 84, no. 2, 1977, pp. 191-215.
- Bandura, Albert. *Social Foundations of Thought and Action*. Prentice Hall, 1986.
- Bauer, John, and Jeffrey Kenton. "Toward Technology Integration in the Schools: Why It isn't Happening." *Journal of Technology and Teacher Education*, vol. 13, no. 4, 2005, pp. 519-546.
- Bingölbali, Erhan, et al. *Professional Development Model for Primary Education Teachers in Science and Mathematics Fields*. The Scientific and Technological Research Council of Turkey, Project Number 108K330, 2012.
- Birkollu, Sibel Suzek, et al. "Investigating the Attitudes of Pre-service Teachers towards Technology based on Various Variables." *TEM Journal*, vol. 6, no. 3, 2017, pp. 578-583.
- Bozkurt, Ali, et al. "Comparison of Different Roles that Teachers give to Technology in Pre and Post-training." *International Online Journal of Educational Sciences*, vol. 6, no. 3, 2014, pp. 591-602.
- Bozkurt, Necati. "Determination of Self-confidence for Technological Pedagogical Content Knowledge of pre-service History Teacher." *Mustafa Kemal University Journal of Graduate School of Social Sciences*, vol. 13, no. 33, 2016, pp. 153-167.
- Buabeng-Andoh, Charles. "Factors Influencing Teachers' Adoption and Integration of Information and Communication Technology into Teaching: A Review of the Literature." *International Journal of Education and Development using ICT*, vol. 8, no. 1, 2012, pp. 136-155.
- Cartwright, Victoria, and Michael Hammond. "The Integration and Embedding of ICT into the School Curriculum: More Questions than Answers." *ITTE 2003 Annual Conference of the Association of Information Technology for Teacher Education, Trinity and All Saints College*, 2003.
- Çakir, Recep, and Senem Oktay. "Teachers' Use of Technology as becoming Information Society." *Gazi University Industrial Arts Education Faculty Journal*, 2013, pp. 35-54.
- Celik, Vehbi, and Etem Yesilyurt. "Attitudes to Technology, Perceived Computer Self-efficacy and Computer Anxiety as Predictors of Computer Supported Education." *Computers & Education*, vol. 60, no. 1, 2013, pp. 148-158.
- Demir, Servet. "Two Inseparable Facets of Technology Integration Programs: Technology and Theoretical Framework." *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 7, no. 2, 2011, pp. 75-88.
- Demirer, Veysel, and Cemal Hakan Dikmen. "Investigation of Teachers' Opinions Concerning FATİH Project in the Context of Technological Pedagogical Content Knowledge." *Elementary Education Online*, vol. 17, no. 1, 2018, pp. 26-46.
- Erbil, Deniz Gökçe, and Ayfer Kocabaş. "Primary Teachers' Views on Using Technology in Education, Flipped Classroom and Cooperative Learning." *Elementary Education Online*, vol. 18, no. 1, 2019, pp. 31-51.
- Ertmer, Peggy A., and Anne T. Ottenbreit-Leftwich. "Teacher Technology Change: How Knowledge, Confidence, Beliefs, and Culture Intersect." *Journal of Research on Technology in Education*, vol. 42, no. 3, 2010, pp. 255-284.
- Ertmer, Peggy A. "Addressing First-and Second-order Barriers to Change: Strategies for Technology Integration." *Educational Technology Research and Development*, vol. 47, 1999, pp. 47-61.
- Ertmer, Peggy A., et al. "Teacher Beliefs and Technology Integration Practices: A Critical Relationship." *Computers & Education*, vol. 59, no. 2, 2012, pp. 423-435.
- Farjon, Daan, et al. "Technology Integration of Pre-service Teachers explained by Attitudes and Beliefs, Competency, Access, and Experience." *Computers & Education*, vol. 130, 2019, pp. 81-93.

- Gignac, G. E. (2019). "How2statsbook (pp. C16.12-C.16.13, Online Edition 1)." Perth, Australia: Author. Retrieved on 05 January 2021 from <http://www.how2statsbook.com/>
- Goktas, Yuksel, et al. "Enablers and Barriers to the Use of ICT in Primary Schools in Turkey: A Comparative Study of 2005-2011." *Computers & Education*, vol. 68, 2013, pp. 211-222.
- Graham, Charles, R., et al. "Measuring the TPACK Confidence of Inservice Science Teachers." *TechTrends*, vol. 53, no. 5, 2009, pp. 70-79.
- Groff, Jennifer, and Chrystalla Mouza. "A Framework for Addressing Challenges to Classroom Technology Use." *AACE Journal*, vol. 16, no. 1, 2008, pp. 21-46.
- Harris, Judith, et al. "Teachers' Technological Pedagogical Content Knowledge and Learning Activity Types: Curriculum-based Technology Integration Reframed." *Journal of Research on Technology in Education*, vol. 41, no. 4, 2009, pp. 393-416.
- He, Fanyin, et al. "Non-parametric MANOVA Approaches for Non-normal Multivariate Outcomes with Missing Values." *Communications in Statistics - Theory and Methods*, vol. 46, no. 14, 2017, pp. 7188-7200.
- Hughes, Joan. "The Role of Teacher Knowledge and Learning Experiences in Forming Technology-Integrated Pedagogy." *Journal of Technology and Teacher Education*, vol. 13, no. 2, 2005, pp. 277-302.
- Kağıtçıbaşı, Çiğdem, and Ayşe Üskül. *Yeni İnsan ve İnsanlar: Sosyal Psikolojiye Giriş*. Evrim Publishing, 2006.
- Kalemoğlu-Varol, Yaprak. "Predictive Power of Prospective Physical Education Teachers' Attitudes towards Educational Technologies for their Technological Pedagogical Content Knowledge." *International Journal of Progressive Education*, vol. 11, no. 3, 2015, pp. 7-19.
- Karasar, Niyazi. *Bilimsel Araştırma Yöntemi*. Nobel Publishing, 1995.
- Kayalar, Murat Tolga. "Examining Pre-service Teachers' Attitudes and Interests in Technology in terms of Various Variables." *Journal of Social And Humanities Sciences Research*, vol. 5, no. 27, 2018, pp. 2753-2760.
- Keleş, Esra, and Ebru Turan. "Teachers Views on Increasing Opportunities and Improving Technology Movement (FATİH)." *Turkish Journal of Education*, vol. 4, no. 2, 2015, pp. 17-28.
- Keleş, Esra, et al. "Teachers' Opinions Regarding the Use of Technology in Education: Fatih Project Example." *Gaziantep University Journal of Social Sciences*, vol. 12, no. 2, 2013, pp. 353-366.
- Koehler, Matthew J., et al. "Tracing the Development of Teacher Knowledge in a Design Seminar: Integrating Content, Pedagogy and Technology." *Computers & Education*, vol. 49, no. 3, 2007, pp. 740-762.
- Koehler, Matthew J., and Punya Mishra. "Introducing TPCK." *Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators*, edited by AACTE Committee on Innovation and Technology, Routledge, 2008, pp. 3-29.
- Koehler, Matthew J., and Punya Mishra. "What is Technological Pedagogical Content Knowledge (TPACK)?" *Contemporary Issues in Technology and Teacher Education*, vol. 9, no. 1, 2009, pp. 60-70.
- Koehler, M.J., et al. *Content, Pedagogy, and Technology: Testing a Model of Technology Integration*. Annual Meeting of the American Educational Research Association, 2004.
- Koseoglu, Pinar. "Hacettepe University prospective Biology Teachers' Self-confidence in Terms of Technological Pedagogical Content." *Procedia - Social and Behavioral Sciences*, vol. 46, 2012, pp. 931-934.
- Mishra, Punya, and Matthew J. Koehler. "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge." *Teachers College Record*, vol. 108, no. 6, 2006, pp. 1017-1054.
- Namdar, Bahadır, and Arzu Küçük. "A Descriptive Content Analysis of Research on Technology Integration in Science Education: The Case of Turkey." *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, no. 48, 2018, pp. 355-383.
- Oskamp, Stuart, and P. Wesley Schultz. *Attitudes and Opinions*. Psychology Press, 2005.

- Ottenbreit-Leftwich, Anne, et al. "Evolution of Teachers' Technology Integration Knowledge, Beliefs, and Practices: How can we Support Beginning Teachers Use of Technology?." *Journal of Research on Technology in Education*, vol. 50, no. 4, 2018, pp. 282-304.
- Özçelik, Ahmet, and Yıldız Kaya. "School Administrators and Teachers Opinions on their Evaluation of Self as a Technology Literacy." *Journal of World of Turks*, vol. 11, no. 2, 2019, pp. 341-360.
- Özdemir, Serpil. "Teacher Views on Barriers to the Integration of Information and Communication Technologies (ICT) in Turkish Teaching." *International Journal of Environmental and Science Education*, vol. 12, no. 3, 2017, pp. 505-521.
- Özmantar, Mehmet Fatih, et al. "Pre-service Mathematics Teachers' Use of Multiple Representations in Technology-Rich Environments." *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 6, no. 1, 2010, pp. 19-36.
- Paşa, Salih, et al. "Changes of the Chemistry Teacher Candidates' Attitudes towards and Views about Information and Communication Technologies: ChemBioDraw Application." *Journal of Computer and Education Research*, vol. 3, no. 6, 2015, pp. 71-98.
- Ortaöğretim Matematik Dersi (9-12.Sınıflar) Öğretim Programı. MEB Publishing, 2013.
- Saltan, Fatih, and Kürşat Arslan. "A Comparison of In-service and Pre-service Teachers' Technological Pedagogical Content Knowledge Self-confidence." *Cogent Education*, vol. 4, no. 1, 2017.
- Sancar Tokmak, et al. "An investigation of Mersin University early Childhood Pre-service Teachers' Self-Confidence about their Technological Pedagogical Content Knowledge (TPACK)." *Ahi Evran University Journal of Kirsehir Education Faculty*, vol. 14, no. 1, 2013, pp. 35-51.
- Shulman, Lee S. "Those Who Understand: Knowledge Growth in Teaching." *Educational Researcher*, vol. 15, no. 2, 1986, pp. 4-14.
- Tabachnick, Barbara G., and Linda S. Fidell. *Using Multivariate Statistics vol. 6*. Pearson, 2013.
- Timur, Betül, and Mehmet Fatih Taşar. "The Adaptation of the Technological Pedagogical Content Knowledge Confidence Survey into Turkish." *Gaziantep Üniversitesi Sosyal Bilimler Dergisi*, vol. 10, no. 2, 2011, pp. 839-856.
- Tuysuz, Cengiz. "Determination of Pre-service Teachers' Self-confidence Levels towards Technology Subdimension of Technological Pedagogical Content Knowledge." *International Journal of Academic Research*, vol. 6, no. 1, 2014, pp. 34-41.
- "COVID-19 Impact on Education." *UNESCO*, 2021.
- Üstün, Ahmet, and Emrah Akman. "Private School Teachers' Attitudes and Ideas about the Utilization of Technological Tools in Education (The Example of Samsun Province)." *Journal of Educational Sciences*, vol. 3, no. 4, 2015, pp. 94-103.
- Voogt, Joke, et al. "Technological Pedagogical Content Knowledge - A Review of the Literature." *Journal of Computer Assisted Learning*, vol. 29, no. 2, 2013, pp. 109-121.
- Yavuz, Soner. "Developing a Technology Attitude Scale for Pre-service Chemistry Teachers." *Turkish Online Journal of Educational Technology*, vol. 4, no. 1, 2005, pp. 17-25.
- Yılmaz, Eray. "Physics Teachers' Opinions Regarding the Use of Technology in Teaching." *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, vol. 47, 2018, pp. 27-37.
- Yulisman, Hendra, et al. "Moderated Effect of Teachers' Attitudes to the Contribution of Technology Competencies on TPACK." *JPBI (Jurnal Pendidikan Biologi Indonesia)*, vol. 5, no. 2, 2019, pp. 185-196.

#### Author detail

**Mehmet Alper Ardiç**, Adıyaman University, Turkey **Email ID:** mardic@adiyaman.edu.tr.