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Investigation of the relationship among science teachers' perceptions of technology integration self-efficacy, attitudes towards distance learning and web pedagogical content knowledge during the pandemic

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ABSTRACT

This study aims to investigate the relationship among science teachers' perceptions of technology integration self-efficacy, attitudes towards distance learning and web pedagogical content knowledge during the pandemic. In this study, the descriptive correlational design was used. The sample consisted of 162 middle school science teachers working in the central districts of Ankara in the fall semester of the academic year 2020-2021. 84.57% of the sample consists of female teachers and 15.43% of male teachers. While teachers who graduated from the faculty of education constitute 78.40% of the sample, teachers who graduated from the faculty of arts and sciences constitute 21.60% of the sample. The scales used were administered via Google Forms. Attitude scale towards distance learning, self-efficacy perception scale for technology integration and web pedagogical content knowledge scale were used as data collection tools. In sum web pedagogical content knowledge was found to be the most important predictor in all regression analyses. It shows that with the increase in web pedagogical content knowledge of teachers while conducting distance education activities, their technology integration self-efficacy perceptions also increase.

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1. INTRODUCTION

The unexpected outbreak of the COVID-19 pandemic caused a change in education and training processes all over the world in 2020 (Daniel, 2020). With the World Health Organization's statement declaring COVID-19 a pandemic, face-to-face education was replaced by online teaching (Shivangi, 2020). During this period, more than 1.5 billion students were deprived of face-to-face education, having instead to rely on distance learning on platforms such as television and the internet (UNESCO, 2020). Authorities have issued recommendations during the process that all countries around the world should prioritise education for children and young people (OECD, 2020). In this context, distance-learning platforms have gained importance. In order for formal education to continue as planned in Turkey, distance learning was launched through the joint efforts of the Ministry of National Education and the Turkish Radio and Television Corporation (TRT), unpacking new

education models to cover all grades, like the EBA Primary School, TRT EBA Secondary School, TRT EBA High School, and EBA Live Lesson Streaming. EBA (Education Information Network) is a distance education platform used by the Ministry of National Education in Turkey. In addition to these platforms, various programmes and technologies were also used to avoid disruptions to the teaching process. Educational activities were supported via programmes and technologies such as Zoom (Zoom Video Communications, San Jose, California), Slack (Slack Technologies, San Francisco, California), and Microsoft Teams (Vela, 2018). A review of studies concerning educational processes during the pandemic reveals that distance learning will go on both in schools and universities both during and after the pandemic, in order to ensure the continuity of formal education and training programmes (Dikmen & Bahçeci, 2020; Gökbulut, Keserci, & Akyüz, 2021; Hall, Roman, Jovel-Arias, & Young, 2020; Telli & Altun, 2020; Trikoilis & Papanastasiou, 2020). Due to the dissemination of online learning practices, which will probably be integrated into future learning environments, it has become inevitable for teachers to have certain skills, attitudes, and competencies. Because teachers' knowledge, attitudes, and awareness of technological tools, as well as their ability to apply these competencies effectively (Koehler & Mishra, 2008; Niess, 2008; Timur & Taşar, 2011), are critical factors in increasing student success (Menzi, alşkan, & etin, 2012), some of the new competencies that teachers are expected to have are high technological aptitudes, positive attitudes towards distance learning, and awareness of online pedagogical tools.

Integration of technology refers to the adaptation of technology to the daily lives and school environments of individuals (Ogle et al., 2002). In other words, integration of technology can be defined as teachers enabling students to use their technology skills more meaningfully and efficiently and making the environment suitable for effective learning and teaching activities (Dockstader, 1999; Lim, 2007). In the process, teachers use all kinds of technological tools at their disposal so that students can learn (Hew & Brush, 2007). The use of these technologies enables students to access and process information auditorily and visually. These technologies improve students' cognitive skills, increase their motivation, and make them more active in the classroom (Osborne & Hennessy, 2003). Therefore, learning quality improves by integrating technology into learning environments (Varma, Husic & Linn, 2008). Teachers' self-efficacy in using technological tools has an important role in the effective integration of technology (Ertmer, 1999). Teachers tend to use technology more as they feel more confident in their technology skills (Holden & Rada, 2011). When incorporating technology into educational processes, it is important not only to develop technological infrastructure to increase quality and make it easier for teachers to access technology, but teachers must also be willing to use teaching technologies in their lessons (Özçakır & Aydın, 2019). Studies indicate that teachers who think they cannot use technology and resist innovations are reluctant to use technology in educational processes (Ertmer, 1999; Zbiek, Heid, Blume, & Dick, 2007).

Another trait teachers are expected to have is a positive attitude towards distance learning. Distance learning is an institutionally planned process that puts teachers and students in different places, which requires the use of certain technologies in combination with teaching methods depending on specially designed courses (Moore & Kearsley, 2005). According to Holmberg (2005), the flexibility that comes with distance learning has done away with the requirement of keeping students under constant surveillance. According to Uşun (2006), distance learning can meet the changing and evolving learning requirements of modern students and make significant contributions to the progress of developed and developing countries. It offers lifelong, individual, and independent learning opportunities. In addition, giving the responsibility of learning to the learners improves the entrepreneurial aspects of the students and their ability to make decisions on their own. In distance learning, teachers play various roles before, during, and after the teaching process, where their duties and responsibilities are not limited to only a certain period of time, in a similar way to face-to-face education (Ülkü, 2018). Teachers' attitudes towards distance learning greatly affect the effectiveness of educational environments. The more positive the attitudes, the more likely it is for distance learning to fulfill its purposes (Yenilmez, Turğut, & Balbağ, 2017).

Another professional trait teachers are expected to have is sufficient web pedagogical content knowledge. Web pedagogical content knowledge is the intersection of web pedagogical knowledge, pedagogical content knowledge, and web content knowledge. In other words, web pedagogical content knowledge refers to the teacher's knowledge of using web knowledge, content knowledge, and pedagogical knowledge as a whole in teaching (Lee & Tsai, 2010). Web pedagogical content knowledge is important in increasing teachers' self-efficacy perceptions. It is stated that it is important to use new learning approaches that will provide a combination of web, pedagogy, and content knowledge for a qualified and high-quality education and training system (Akgün, 2013).

In the pandemic period, teachers have great responsibilities in terms of providing effective and quality teaching. It has become necessary for teachers to design pedagogically appropriate subject matter in line with their educational goals, integrate technology into their lessons, and increase their competencies in using online tools to support teaching in a meaningful way. Because this requirement enables the creation of a productive learning and teaching environment (Bağcı & Atar, 2019). As a result, it is critical for science teachers to understand web/technology, integrate technology into their lessons, and have self-efficacy perceptions in order to achieve the curriculum's educational goals. This study aims to investigate the relationship among science teachers' perceptions of technology integration self-efficacy and their attitudes towards distance learning and web pedagogical content knowledge during the pandemic. Accordingly, the problem statement of the study is, 'Is there a relationship among science teachers' perceptions of technology integration self-efficacy, their attitudes towards distance learning, and their knowledge of web pedagogical content during the pandemic?' In order to answer this question, a set of sub-problems was determined.

1. Is there a relationship among science teachers' perceptions of technology integration self-efficacy, their attitudes towards distance learning, web pedagogical content knowledge, gender, faculty type and EBA usefulness?

2. Do science teachers' attitudes towards distance learning, web pedagogical content knowledge, gender, faculty type and EBA usefulness predict their perceptions of technology integration self-efficacy?

3. Do science teachers' attitudes towards distance learning, web pedagogical content knowledge, gender, faculty type and EBA usefulness predict their self-efficacy perceptions of using computer technologies?

4. Do science teachers' attitudes towards distance education, web pedagogical content knowledge, gender, the faculty type and EBA usefulness predict their self-efficacy perceptions of making students use computer technologies?.

2. METHOD

2.1 Research design and sample

In this study, the descriptive correlational design was used. The sample consisted of 162 middle school science teachers working in the central districts of Ankara in the fall semester of the academic year 2020-2021. The scales used were administered via Google Forms. Teachers were sent a link of scales and a text via various communication technologies inviting them to participate. Table 1 shows the distribution of teachers by gender, faculty type, and whether they find EBA useful or not.

Table 1. *Demographic characteristics of the sample*

		n	%
Gender	Female	137	84.57
	Male	25	15.43
	Total	162	100
Faculty type	Faculty of Education	127	78.40
	Department of Arts and Sciences	35	21.60
	Total	162	100
EBA usefulness	Useful	138	85.2
	Not	24	14.8
	Total	162	100

As seen in Table 1, 84.57% of the sample consists of female teachers and 15.43% of male teachers. While teachers who graduated from the faculty of education constitute 78.40% of the sample, teachers who graduated from the faculty of arts and sciences constitute 21.60% of the sample. Finally, 85.2% of the participants find EBA useful, while 14.8% do not.

2.2 Data collection tools

Three valid and reliable data collection tools were used in the study.

(a) Attitude Scale Towards Distance Learning. A 5-point Likert-type scale that was developed by Ağır, Gür, and Okçu (2007) was used in the study. The scale consists of 21 items. There are 14 positive and 7 negative items in the scale. The lowest score range of the scale is 21, and the highest is 105. The internal consistency coefficient of the scale was 0.835. In this study, the internal consistency coefficient of the scale was .91.

(b) Self-Efficacy Perception Scale for Technology Integration. The 21-item scale developed by Wang, Ertmer and Newby (2004) was adopted into Turkish by Ünal (2013). In the adapted version there were 19 items. As a result of the validity and reliability analysis, it was determined that it had a two-factor structure. These factors were self-efficacy perceptions of using computer technologies and self-efficacy perceptions of making students use computer technologies. The scale items are designed to reflect a 5-point Likert type scale ranging from "Strongly Disagree" to "Strongly Agree". The scores that can be obtained from the scale range from 19 to 95. The internal consistency coefficient of the scale was .93. In this study, the internal consistency coefficient of the scale was .94.

(c) Web Pedagogical Content Knowledge Scale. The scale was developed by Lee, Tsai, and Chang (2008) and adopted into Turkish by Horzum (2011). It is a 5-point Likert type scale. The degree of agreement with a given statement was scored on a range from 1 to 5. The scale consists of 30 items in total. The internal consistency coefficient of the scale was .94. In this study, the internal consistency coefficient of the scale was .98.

2.3 Data analysis

The data obtained from the research were analyzed with the SPSS 21 package program. For the first sub-problem of the study, the Pearson's product-moment correlation and Point Biserial correlation coefficients were calculated. Multiple linear regression analysis was used for the second, third and fourth sub-problems of the study.

2.4 Ethical aspects

The present study was approved by the Gazi University Ethics Committee (Reference Number: 2020-665). All participants were informed about the research objectives and read and signed an informed consent form. All data were collected anonymously.

3. FINDINGS AND ANALYSIS

Firstly, findings to the question, '*is there a relationship among science teachers' perceptions of technology integration self-efficacy, their attitudes towards distance learning, web pedagogical content knowledge, gender, faculty type and EBA usefulness?*' were given in Table 2.

Table 2: *Correlations between variables*

	1	2	3	4	5	6	7	8
1.Gender	1							
2. EBA usefulness	.062	1						
3. Faculty type	.149	.077	1					
4. Web pedagogical content knowledge	-.048	-.053	-.123	1				
5.Attitudes towards Distance Learning	-.174*	-.314**	.025	.122	1			
6. Perceptions of technology integration self-efficacy	.001	-.164*	.045	.664**	.193*	1		
7. Self-efficacy perceptions of using computer technologies	.059	-.108	.028	.619**	.161*	.918**	1	
8. Self-efficacy perceptions of making students use computer technologies	-.032	-.183*	.052	.643**	.198*	.976**	.808**	1

Note. The relationship between continuous variables and dichotomous variables was calculated using the Point Biserial correlation coefficient, while the relationships between continuous variables were calculated using Pearson's product moments correlation coefficient. * Significant at the 0.05 level, ** significant at the ** 0.01 level, EBA: Education Information Network

According to Table 2, there is a moderately positive relationship between teacher's perceptions of technology integration self-efficacy and their web pedagogical content knowledge; there is a minor positive relationship between teacher's perceptions of technology integration self-efficacy and their attitudes towards distance learning, while there is a minor negative relationship between teacher's perceptions of technology integration self-efficacy and EBA usefulness. Similarly, there is a moderately positive relationship between teachers' self-efficacy perceptions of making students use computer technologies and their web pedagogical content knowledge; there is a minor positive relationship between teachers' self-efficacy perceptions of making students use computer technologies and their attitudes towards distance learning, while there is a minor negative relationship between teachers' self-efficacy perceptions of making students use computer technologies and EBA usefulness. Also, there is a moderately positive relationship between teachers' self-efficacy perceptions of using computer technologies and web pedagogical content knowledge, while there is a minor positive relationship between teachers' self-efficacy perceptions of using computer technologies and their attitudes towards distance learning. There is also a moderately negative relationship between teachers' attitudes towards distance learning and EBA usefulness and gender.

Secondly, the sub-problem, '*do science teachers' attitudes towards distance learning, web pedagogical content knowledge, gender, faculty type and EBA usefulness predict their perceptions of technology integration self-efficacy?*' was analyzed by multiple linear regression analysis. Regression analysis results are given in Table 3.

Table 3: *Model summary for the second sub-problem*

Model	R	R2	Adjusted R2	Std. Error of the Estimate	Change Statistics				
					R2 change	F	df 1	df 2	p
1	.664a	.441	.438	7.79657	.441	126.274	1	160	.000
2	.677b	.458	.451	7.70426	.017	4.857	1	159	.029
3	.690c	.477	.467	7.59295	.019	5.696	1	158	.018

a. Predictors: (Constant) Web pedagogical content knowledge.
b. Predictors: (Constant) Web pedagogical content knowledge, EBA usefulness.
c. Predictors: (Constant) Web pedagogical content knowledge, EBA usefulness, the faculty type.
d. Predicted variable: Perceptions of technology integration self-efficacy
Note. EBA: Education Information Network; df: degrees of freedom

When Table 3 is examined, it is seen that all three models are significant ($p<0.05$). Teachers' web pedagogical content knowledge, EBA usefulness and the faculty type together showed a significant relationship has ($R=.690$, $R2= .477$) with teachers' perceptions of technology integration self-efficacy ($F(3\text{-}161)= 47.945$, $p<0.01$). However, teachers' attitudes towards distance learning did not have a significant relationship with their perceptions of technology integration self-efficacy ($p>0.05$). These three predictors together account for 47.7% of the variance in teachers' perceptions of technology integration self-efficacy.

When Table 4 is examined, the best variable predicting teachers' perceptions of technology integration self-efficacy according to standardized regression coefficients is web pedagogical content knowledge ($\beta= .674$). In addition, the variables of EBA usefulness ($\beta= -.139$) and the faculty type ($\beta= .139$) were also variables that predicted teachers' perceptions of technology integration self-efficacy. However, teachers' attitudes towards distance learning did not predict their perceptions of technology integration self-efficacy.

According to the results of the regression analysis, the regression equation that predicts teachers' perceptions of technology integration self-efficacy is as follows.

Teachers' perceptions of technology integration self-efficacy = (0.387x web pedagogical content knowledge) + (-4.045x EBA usefulness) + (3.495x the faculty type) + 22.224

Thirdly, the sub-problem, '*do science teachers' attitudes towards distance learning, web pedagogical content knowledge, gender, faculty type and EBA usefulness predict their self-efficacy perceptions of using computer technologies?*' was analyzed by multiple linear regression analysis. Regression analysis results are given in Table 5.

Table 4: *Coefficients in the regression equation*

Model		Unstandardized Coefficients		Standardized coefficients	t	p
		B	Standard error	β		
1	(Constant)	22.550	4.435		5.085	.000
	Web pedagogical content knowledge	.381	.034	.664	11.237	.000
2	(Constant)	27.378	4.899		5.588	.000
	Web pedagogical content knowledge	.377	.034	.657	11.238	.000
	EBA usefulness	-3.761	1.706	-.129	-2.204	.029
3	(Constant)	22.224	5.290		4.202	.000
	Web pedagogical content knowledge	.387	.033	.674	11.606	.000
	EBA usefulness	-4.045	1.686	-.139	-2.399	.018
	The faculty type	3.495	1.464	.139	2.387	.018

Note. EBA: Education Information Network

Table 5: *Model summary for the third sub-problem*

Model	R	R2	Adjusted R2	Std. Error of the Estimate	Change Statistics				
					R2 change	F	df 1	df 2	p
1	.619a	.383	.379	3.04450	.383	99.364	1	160	.000

a. Predictors: (Constant) Web pedagogical content knowledge
b. Predicted variable: Self-efficacy perceptions of using computer technologies
Note. df: degrees of freedom

When Table 5 is examined, it is seen that only one of the models is significant ($p<0.05$). A significant relationship (R=.619, R2= .383) was found between web pedagogical content knowledge and teachers' self-efficacy perceptions of using computer technologies ($F(1\text{-}161) = 99.364$, $p<0.01$). However, teachers' attitudes towards distance learning, EBA usefulness and the faculty type did not have a significant relationship with teachers' self-efficacy perceptions of using computer technologies ($p>0.05$). Web pedagogical content knowledge account for 37.9% of the variance in teachers' self-efficacy perceptions of using computer technologies.

Table 6: *Coefficients in the regression equation*

Model		Unstandardized coefficients		Standardized coefficients	t	p
		B	Standard error	B		
1	(Constant)	5.526	1.732		3.191	.002
	Web pedagogical content knowledge	.132	.013	.619	.9.968	.000

When Table 6 is examined, the only variable predicting teachers' self-efficacy perceptions of using computer technologies according to standardized regression coefficients is web pedagogical content knowledge (β= .619). However, teachers' attitudes towards distance learning, EBA usefulness, and the faculty type did not predict teachers' self-efficacy perceptions of using computer technologies.

According to the results of the regression analysis, the regression equation that predicts teachers' self-efficacy perceptions of using computer technologies.

Teachers' self-efficacy perceptions of using computer technologies = (.132 x web pedagogical content knowledge) + 5.526.

Finally, the sub-problem, '*do science teachers' attitudes towards distance education, web pedagogical content knowledge, gender, the faculty type and EBA usefulness predict their self-efficacy perceptions of making students use computer technologies?*' was analyzed by multiple linear regression analysis. Regression analysis results are given in Table 7.

Table 7: *Model summary for the fourth sub-problem*

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics				
					R^2 change	F	df 1	df 2	p
1	.643	.413	.409	5.39550	.413	112.640	1	160	.000
2	.660	.435	.428	5.30880	.022	6.269	1	159	.013
3	.675	.456	.445	5.22882	.020	5.902	1	158	.016

a. Predictors: (Constant) Web pedagogical content knowledge

b. Predictors: (Constant) Web pedagogical content knowledge, EBA usefulness

c. Predictors: (Constant) Web pedagogical content knowledge, EBA usefulness, the faculty type

d. Predicted variable: Self-efficacy perceptions of making students use computer technologies

Note. EBA: Education Information Network; df: degrees of freedom

Table 8: *Coefficients in the regression equation*

Model	Unstandardized coefficients		Standardized coefficients	t	p
	B	Standard error	β		
1 (Constant)	17.024	3.069		5.547	.000
Web pedagogical content knowledge	.249	.023	.643	10.613	.000
2 (Constant)	20.803	3.376		6.162	.000
Web pedagogical content knowledge	.246	.023	.635	10.638	.000
EBA usefulness	-2.944	1.176	-.149	-2.504	.013
3 (Constant)	17.191	3.643		4.719	.000
Web pedagogical content knowledge	.253	.023	.652	11.013	.000
EBA usefulness	-3.143	1.161	-.160	-2.707	.008
The faculty type	2.450	1.008	.144	2.429	.016

Note. EBA: Education Information Network

When Table 7 is examined, it is seen that all three models are significant ($p<0.05$). Web pedagogical content knowledge, EBA usefulness, and the faculty type together showed a significant relationship (R=.675, R2= .456) with teachers' self-efficacy perceptions of making students use computer technologies (F (3-161) = 44.100, $p<0.01$). However, teachers' attitudes towards distance learning did not have a significant relationship with teachers' self-efficacy perceptions of making students use computer technologies ($p>0.05$). These three predictors together account for 45.6% of the variance in teachers' self-efficacy perceptions of making students use computer technologies.

When Table 8 is examined, the best variable predicting teachers' self-efficacy perceptions of making students use computer technologies according to standardized regression coefficients is web pedagogical content knowledge (β= .652). In addition, the variables of EBA usefulness (β= -.160) and the faculty type (β= .144) were also variables that predicted teachers' self-efficacy perceptions of making students use computer technologies. However, teachers' attitudes towards distance learning did not predict teachers' self-efficacy perceptions of making students use computer technologies.

According to the results of the regression analysis, the regression equation that predicts teachers' self-efficacy perceptions of making students use computer technologies is as follows.

Teachers' self-efficacy perceptions of making students use computer technologies = (0.253 x web pedagogical content knowledge) + (-3.143 x EBA usefulness) + (2.450 x the faculty type) + 17.191.

4. DISCUSSION AND CONCLUSION

On the basis of the results from the first sub-problem of the study, there is a moderately positive relationship between teachers' perceptions of technology integration self-efficacy and their web pedagogical content knowledge; there is a minor positive relationship between teachers' perceptions of technology integration self-efficacy and their attitudes towards distance learning; and there is a minor negative relationship between perceptions of technology integration self-efficacy and EBA usefulness. Similarly, there was a moderately positive relationship between teachers' self-efficacy perceptions of making students use computer technologies and their web pedagogical content knowledge; there is a minor positive relationship between teachers' self-efficacy perceptions of making students use computer technologies and their attitudes towards distance learning; and there is a minor negative relationship between teachers' self-efficacy perceptions of making students use computer technologies and EBA usefulness. Also, there was a moderately positive relationship between teachers' self-efficacy perceptions of using computer technologies and web pedagogical content knowledge, while there is a minor positive relationship between teachers' self-efficacy perceptions of using computer technologies and their attitudes towards distance learning. There is also a moderately negative relationship between teachers' attitudes towards distance learning, the usefulness of EBA, and gender. Ünal (2013), who conducted a similar study with teacher candidates, determined that there was a significant, positive, and high-level relationship between prospective teachers' perceptions of technology integration self-efficacy, and their competencies in using technological tools for pedagogical purposes. The study found a weak positive correlation between science teachers' perceptions of technology integration self-efficacy and their attitudes towards distance learning. Most technology integration studies contend that teachers' lack of positive attitudes and self-confidence have an impact on technology integration (Gülbahar & Güven, 2008; Zdemir & Klç, 2007; Teo, 2012). Açıkgül and Aslaner (2015) and Akar and Karadeniz (2014) revealed that teachers' use of software-supported technologies contributes to the integration of technology into their lessons. The study also found a moderately negative correlation between teachers' attitudes towards distance learning and gender. Contrary to the results of this study, there are other studies reporting no differences between teachers' attitudes towards distance education and the gender variable (Ağır, 2007; Ateş & Altun, 2008; Barış, 2015; Birişçi, 2013; Gündüz, 2013; Horzum, 2003; Karaoğlu, 2008; Kışla, 2005; Şimşek, İskenderoğlu ve İskenderoğlu, 2010; Tırnovalı, 2012; Yalman & Kutluca, 2013; Yıldız, 2016). It is possible that being in a pandemic period has an impact on this result. A study by Kundu and Bhowmik (2020) stated that the pandemic period allowed parents to spend more quality time with their children and inculcate a sense of responsibility in children, partly thanks to the flexibility afforded by remote work. These opportunities may have accentuated the positive attitude towards distance learning among female teachers who are also parents. It has also been demonstrated that emotions such as stress, anxiety, and worry (Mazza et al., 2020), anger, depression, insomnia, and disappointment were the most dominant emotions in individuals during the pandemic (Brooks et al., 2020). This situation may have caused teachers to be more willing to teach through distance education rather than attend classes in crowded environments.

With the second sub-problem, it was concluded that the best variable predicting teachers' perceptions of technology integration self-efficacy, is web pedagogical content knowledge. In addition, the variables of EBA usefulness and faculty type were also variables that predicted perceptions of technology integration self-efficacy. However, teachers' attitudes towards distance learning did not predict their perceptions of technology integration self-efficacy. Similar results were reported by Nathan (2009) and Abbitt (2011). Abbitt (2011)'s study examined the relationship between the participants' perceptions of technology integration self-efficacy and their web pedagogical content knowledge. The study found a positive and high level of correlation between these two variables. It is indicated that technology should be integrated into lessons that focus on pedagogical methods during teacher education in order to ensure technology integration and increase teachers' self-efficacy

perceptions (Anderson & Maninger, 2007). In addition, teacher training programmes should provide sufficient opportunities for teachers to increase their competencies and self-confidence by integrating technology into the teaching process and to improve their skills as teachers from a pedagogical standpoint (Angeli, 2005). It can also be argued that the reasons why teachers' attitudes towards distance learning do not predict their perceptions of technology integration self-efficacy might be related to the pandemic. Although teachers have a high self-perception of integrating technology into their lessons, they may not have a positive attitude towards online courses during the pandemic. Studies show that teachers face some challenges with distance learning (Baek, Jones, Bulger, & Taliaferro, 2018; Kavuk & Demirtaş, 2021; Johnson, 2020; Mohan et al., 2020). Problems with the internet connection at home, problems with the camera and sound system, power cuts, and problems logging in to EBA are some of these (Asmara, 2020; Dias, Lopes & Teles, 2020; Kavuk & Demirtaş, 2021). In addition, it has been stated that other siblings or children at home can be obstacles to the quiet environment required for distance learning (Mohan et al., 2020). Despite all this, Russell (1999) stated that well-structured distance learning supplemented with educational technologies would not be different from face-to-face education. Looking at perceptions of technology integration self-efficacy depending on how useful they find EBA, teachers who do not find EBA useful have higher self-perceptions of their competency in integrating technology into their classes. This may be due to the fact that teachers with higher self-perceptions of their competency in integrating technology into their classes are more critical of EBA and have higher expectations. From the point of view of the faculty type, it was found that the perception of technology integration self-efficacy increased with teachers who were graduates of the faculty of arts and sciences and were more likely to have higher self-perceptions of their competency in integrating technology into their classes. This can be explained by the fact that there are more laboratory courses in science and literature faculties compared to education faculties, not to mention the necessity of making preparations for and conducting experiments and typing up laboratory reports by using technology both before, during, and after laboratory courses.

According to another result of the study, it was determined that the only variable that predicts teachers' self-efficacy perceptions of using computer technologies, which is a sub-dimension of teachers' perceptions of technology integration self-efficacy, is web pedagogical content knowledge. However, teachers' attitudes towards distance learning, EBA usefulness, and faculty type failed to predict teachers' self-efficacy perceptions of using computer technologies. The fact that teachers' self-efficacy perceptions of using computer technologies can predict 'web pedagogical content knowledge' is also referred to in the works of Nathan (2009) and Abbitt (2011). Abbitt (2011)'s study found a significant relationship between participants' perceptions of technology integration self-efficacy and their web pedagogical content knowledge.

Finally, it was determined that the variable that most predicts teachers' self-efficacy perceptions of making students use computer technologies, which is another sub-dimension of teachers' perceptions of technology integration self-efficacy, is web pedagogical content knowledge. In addition, the variables of EBA usefulness and faculty type were also variables that accurately predicted teachers' self-efficacy perceptions of making students use computer technologies. However, teachers' attitudes towards distance learning did not predict teachers' self-efficacy perceptions of making students use computer technologies. The fact that the best variable predicting teachers' self-efficacy perceptions of making students use computer technologies is web pedagogical content knowledge corroborates the results from Abbitt's study (2011). According to Abbitt (2011), teachers with a higher self-perception of competency in integrating technology into teaching practises had higher web pedagogical content knowledge. As stated in the second sub-problem, teachers with a higher self-efficacy perception of making students use computer technologies are less likely to be satisfied with EBA. This situation may also be due to the fact that such teachers are more critical of EBA and have higher expectations. It was found that graduates of the faculty of arts and sciences had a higher self-efficacy perception of making students use computer technologies. This can be explained by the fact that since there are more laboratory courses offered by the faculty of arts and sciences with more utilisation of computer technologies, teachers that are graduates of such faculties tend to make students use these technologies in their own classes. This study, looking at the relationship among science teachers' perceptions of technology integration self-efficacy and their attitudes towards distance learning and web pedagogical content knowledge during the pandemic, also looked at teachers' gender, the faculty type, and EBA usefulness. Future research can be conducted with variables such as professional seniority, socioeconomic status of the area where the school is located, educational status, etc.

REFERENCES

Asmara, R. (2020). Teaching English in A Virtual Classroom Using Whatsapp During COVID-19 Pandemic. Language and Education Journal, 5(1), 16-27. https://doi.org/10.52237/lej.v5i1.152

Abbitt, J. T. (2011). An Investigation of the Relationship between Self-Efficacy Beliefs about Technology Integration and Technological Pedagogical Content Knowledge (TPACK) Among Preservice Teachers. Journal of Digital Learning in Teacher Education, 27(4), 134-143. https://doi.org/10.1080/21532974.2011.10784670

Açıkgül, K., & Aslaner, R. (2015). Öğretmen Adaylarının Kâğıt Kalem Ve Dinamik Geometri Yazılımı Kullanarak Geometrik Yer Problemlerini Çözüm Süreçlerinin Incelenmesi [An Investigation of Prospective Teachers' Problem Solving Processes Regarding Locus Problems in Paperpencil And Dynamic Geometry Environments]. Adiyaman University Journal of Social Sciences, (2), 468-512. https://doi.org/10.14520/adyusbd.96576

Ağır, F. (2007). Özel Okullarda Ve Devlet Okullarında Çalışan Ilköğretim Öğretmenlerinin Uzaktan Eğitime Karşı Tutumlarının Belirlenmesi [Determining the Teachers' Attitudes towards Distance Education in Public Primary School and Private Primary School]. Master's Thesis, Balıkesir University Institute of Science And Technology, Balıkesir.

Ağır, F., Gür, H., & Okçu, A. (2007). Uzaktan Eğitime Karşı Tutum Ölçeği Geliştirmesine Yönelik Geçerlik Ve Güvenirlik Çalışması [Development of the Attıtude Scale toward Dıstance Learnıng: Reliability and Validity]. New World Sciences Academy, 3(2), 128-139.

Akar, Ü., & Karadeniz, M. H. (2014). Dinamik Geometri Yazılımının Açıortay Ve Kenarortay Öğretiminde Meslek Lisesi Öğrencilerinin Başarılarına Etkisi [The Effect of Dynamic Geometry Software on the Vocational High School Students' Succes for Teaching Bisector and the Median Concepts]. Journal of Computer and Education Research, 2(4), 74-90.

Akgün, F. (2013). Öğretmen Adaylarının Web Pedagojik Içerik Bilgileri Ve Öğretmen Özyeterlik Algıları Ile Ilişkisi [Preservice Teachers' Web Pedagogical Content Knowledge and Relationship between Teachers' Perceptions of Self-Efficacy]. Trakya University Journal of Education, 3(1), 48-58.

Anderson, S. E., & Maninger, R. M. (2007). Preserviceteachers' Abilities, Beliefs, and Intentions Regarding Technology Integration. Journal of Educational Computing Research, 37(2), 151-172. https://doi.org/10.2190/H1M8-562W-18J1-634P

Angeli, C. (2005). Transforming a Teacher Education Method Cours Ethrough Technology: Effects on Preservice Teachers' Technology Competency. Computers & Education, 45, (4), 383-398. https://doi.org/10.1016/j.compedu.2004.06.002

Ateş, A., & Altun, E. (2008). Bilgisayar Öğretmeni Adaylarının Uzaktan Eğitime Yönelik Tutumlarının Çeşitli Değişkenler Açısından Incelenmesi [Investigating Preservice Computer Teachers' Attitudes towards Distance Learning Regarding Various Variables]. Gazi University The Journal of Gazi Education Faculty, 28(3). 125-145.

Baek, J. H., Jones, E., Bulger, S., & Taliaferro, A. (2018). Physical Education Teacher Perceptions of Technologyrelated Learning Experiences: A Qualitative Investigation. Journal of Teaching in Physical Education, 37(2), 175-185. https://doi.org/10.1123/jtpe.2017-0180

Bağcı, H., & Atar, C. (2019). An Investigation of Pre-Service English Teachers' Self-Efficacy In Web Pedagogical Content Knowledge. Sakarya University Journal of Education, 9(3), 550-566. https://doi.org/10.19126/suje.591804

Barış, M. F. (2015). Üniversite Öğrencilerinin Uzaktan Öğretime Yönelik Tutumlarının Incelenmesi: Namık Kemal Üniversitesi Örneği [Analyzing the University Students' Attitudes towards Distance Education: Namık Kemal University Case Study]. Sakarya University Journal of Education, 5(2) 36-46. https://doi.org/10.19126/suje.38758

Birişçi, S. (2013), Video Konferans Tabanlı Uzaktan Eğitime Ilişkin Öğrenci Tutumları Ve Görüşleri [Attitudes and Opinions of Students On Video Conference Based Distance Education]. Journal Of Instructional Technologies & Teacher Education, I(2), 24-40.

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The Psychological Impact of Quarantine and How To Reduce It: Rapid Review Of The Evidence. The Lancet, (395), 912-920. https://doi.org/10.1016/S0140-6736(20)30460-8

Daniel, S. J. (2020). Education And the COVID 19 Pandemic. Prospects, 49, 91-96 https://doi.org/10.1007/s11125-020-09464-3

Dias, M. D. O., Lopes, R. D. O. A., & Teles, A. C. (2020). Will Virtual Replace Classroom Teaching? Lessons From Virtual Classes Via ZOOM In The Times Of COVID-19. Journal of Advances in Education and Philosophy, 4(5), 208-213. https://doi.org/10.36348/jaep.2020.v04i05.004

Dikmen, S., & Bahçeci, F. (2020). Covid-19 Pandemisi Sürecinde Küresel Çapta Uygulanan Yükseköğretim Kurumlarındaki Uzaktan Eğitim Süreçleri Hakkında Durum Çalışması: Fırat Üniversitesi Örneği

[Strategies of Higher Education Institutions for Distance Education in the Covid-19 Pandemic Process: Example of Fırat University]. Turkish Journal of Educational Studies, 7(2), 78-98. https://doi.org/10.33907/turkjes.721685

Dockstader, J. (1999). Teachers of the 21st Century Know the What, Why, and How of Technology Integration. THE Journal, 26 (6).

Ertmer, P. A. (1999). Addressing First-And Second-Order Barriers to Change: Strategies for Technology Integration. Educational Technology Research and Development, 47(4), 47-61. https://doi.org/10.1007/BF02299597

Gökbulut, B., Keserci, G., & Akyüz, A. (2021). Eğitim Fakültesinde Görev Yapan Akademisyen Ve Öğretmenlerin Dijital Materyal Tasarım Yeterlikleri [Digital Material Design Competencies of Academicians Working At the Faculty of Education and Teachers]. Journal of Social Sciences and Education, 4(1), 11-24. https://doi.org/10.53047/josse.917536

Gülbahar, Y., & Güven, I. (2008). A Survey on ICT Usageandthe Perceptions of Social Studies Teachers in Turkey. Educational Technology & Society, 11(3), 37-51.

Gündüz, A. Y. (2013). Öğretmen Adaylarının Uzaktan Eğitim Algısı [Preservice Teachers' Perception of Distance Education]. Master's Thesis, Sakarya University Institute of Educational Sciences, Sakarya.

Hall, J., Roman, C., Jovel-Arias, C., & Young, C. (2020). Pre-Service Teachers Examine Digital Equity Amidst Schools' Covid-19 Responses. Journal of Technology and Teacher Education, 28(2), 435-442.

Hew, K. F., & Brush, T. (2007). Integrating Technology into K-12 Teaching And Learning: Current Knowledge Gaps and Recommendations for Future Research. Educational Technology Research and Development, 55(3), 223-252. https://doi.org/10.1007/s11423-006-9022-5

Holden, H., & Rada, R. (2011). Understanding the Influence of Perceived Usability and Technology Self-Efficacy on Teachers' Technology Acceptance. Journal of Research on Technology in Education, 43(4), 343-367. https://doi.org/10.1080/15391523.2011.10782576

Holmberg, B. (2005). Uzaktan Eğitim Teorisi Ve Uygulaması. Routledge.

Horzum, M. B. (2003). Öğretim Elemanlarının Internet Destekli Eğitime Yönelik Düşünceleri (Sakarya Üniversitesi Örneği) [Ideas of Lectures about Internet Based Education (Sakarya University Examples)]. Master's Thesis, Sakarya University Institute of Educational Sciences, Sakarya.

Horzum, M. B. (2011). Web Pedagojik Içerik Bilgisi Ölçeğinin Türkçeye Uyarlaması [Adaptation Of Web Pedagogical Content Knowledge Survey To Turkish]. Elementary Education Online, 10(1), 257-272.

Johnson, A. (2020). Online Teaching with ZOOM: A Guide for Teaching and Learning with Video Conference Platforms. Aaron Johnson.

Karaoğlu, A. (2008). İlköğretim Bilgisayar Derslerinde Web Tabanlı Eğitimin Öğrenci Başarı Düzeyine Etkisi [The Effect of Web-Based Education on the Achievement Level of Computer Course at Primary Level]. Master's Thesis, Bahçeşehir University Institute of Sciences And Technology, İstanbul.

Kavuk, E., & Demirtaş, H. (2021). COVID-19 Pandemisi Sürecinde Öğretmenlerin Uzaktan Eğitimde Yaşadığı Zorluklar [Difficulties Experienced By Teachers in the Distance Education during COVID-19 Pandemic]. E-International Journal of Pedandragogy(E-Ijpa),1(1), 55-73.

Kışla, T. (2005). Üniversite Öğrencilerinin Uzaktan Eğitime Yönelik Tutumları [University Students' Attitudes towards Distance Education]. Master's Thesis, Ege University Institute of Social Sciences, İzmir.

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. https://doi.org/10.2190/0EW7-01WB-BKHL-QDYV

Kundu, B., & Bhowmik, D. (2020). Societal Impact of Novel Corona Virus (COVID-19 Pandemic) In India. https://doi.org/10.31235/osf.io/vm5rz

Lee, M. H., & Tsai, C. C. (2010). Exploring Teachers' Perceived Self-Efficacy and Technological Pedagogical Content Knowledge With Respect To Educational Use of the World Wide Web. Instructional Science, 38(1), 1-21. https://doi.org/10.1007/s11251-008-9075-4

Lee, M. H., Tsai, C. C., & Chang, C. Y. (2008). Exploring Teachers' Self-Efficacy toward the Web Pedagogical Content Knowledge in Taiwan. Annual Meeting of the American Educational Research Association. New York City, 24-28 March.

Lim, C. P. (2007). Effective Integration of ICT in Singapore Schools: Pedagogical and Policy Implications. Educational Technology Research and Development, 55(1), 83-116. https://doi.org/10.1007/s11423-006-9025-2

Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., & Roma, P. (2020). A Nationwide Survey of Psychological Distress among Italian People during the COVID-19 Pandemic: Immediate

Psychological Responses and Associated Factors. International Journal of Environmental Research and Public Health. 17, 3165. https://doi.org/10.3390/ijerph17093165

Menzi, N., Çalışkan, E., & Çetin, O. (2012). Öğretmen Adaylarının Teknoloji Yeterliliklerinin Çeşitli Değişkenler Açısından Incelenmesi [Examination of the Competencies of Pre-Service Teachers In Terms Of Some Variables]. Anadolu Journal of Educational Sciences International, 2(1), 1-18.

Mohan, G., Mccoy, S., Carroll, E., Mihut, G., Lyons, S., & Domhnaill, C. M. (2020). Learning For All? Second-Level Education in Ireland during COVID-19. ESRI Survey and Statistical Report Series Number 92. https://doi.org/10.26504/sustat92.pdf

Moore, M. G., & Kearsley, G. (2011). Distance Education: A Systems View of Online Learning. Cengage Learning.

Nathan, E. J. (2009). An Examination of the Relationship between Preservice Teachers' Level of Technology Integration Self-Efficacy (TISE) and Level of Technological Pedagogical Content Knowledge (TPACK). Doktora Tezi, University Of Houston, Houston.

Niess, M. L. (2008). Guiding Preservice Teachers in Developing TPCK. In Silverman, N. (Ed.). Handbook of Technological Pedagogical Content Knowledge (TPCK) For Educators. New York: Routledge.

OECD (2020). A Framework to Guide an Education Response to the COVID-19 Pandemic of 2020. Paris: OECD Publishing.

Ogle, T., Branch, M., Canada, B., Christmas, O., Clement, J., Fillion, J., Goddard, E., Loudat, N.B., Purwin, T., Rogers, A., Schmitt, C., & Vinson, M. (2002). Technology in Schools: Suggestions, Tools and Guidelines for Assessing Technology in Elementary and Secondary Education. Washington, DC: National Center for Education Statistics.

Osborne, J., & Hennessy, S. (2003). Literature Review in Science Education and the Role of ICT: Promise, Problems and Future Directions (Vol. 6). London, United Kingdom: Futurelab.

Özçakır, B., & Aydın, B. (2019). Artırılmış Gerçeklik Deneyimlerinin Matematik Öğretmeni Adaylarının Teknoloji Entegrasyonu Öz-Yeterlik Algılarına Etkisi [Effects Of Augmented Reality Experiences On Technology Integration Self-Efficacy Of Prospective Mathematics Teachers]. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 10 (2), 314-335.

Özdemir, S., & Kılıç, E. (2007). Integrating Information and Communication Technologies in the Turkishprimary School System. British Journal of Educational Technology, 38(5), 907-916. https://doi.org/10.1111/j.1467-8535.2006.00678.x

Russell, T. (1999). The No Significant Difference Phenomenon. Office of Instructional Telecommunications, North Carolina State University. Raleigh, NC.

Shivangi, D. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. J. Educ. Technol. Syst. 49, 5-22. https://doi.org/10.1177/0047239520934018

Şimşek, A., İskenderoğlu, T., & İskenderoğlu, M. (2010). Investigating Preservice Computer Teachers' Attitudes towards Distance Education. Procedia Social and Behavioral Sciences, C. IX, 324-328. https://doi.org/10.1016/j.sbspro.2010.12.158

Telli, S. G., & Altun, D. (2020). Coronavirüs Ve Çevrimiçi (Online) Eğitimin Önlenemeyen Yükselişi [The Coronavirus and the Rising of Online Education]. Journal of University Research, 3(1), 25-34. https://doi.org/10.32329/uad.711110

Teo, T. (2012). Examining the Intention Touse Technology among Pre-Service Teachers: An Integration of the Technology Acceptance Model and Theory of Planned Behavior. Interactive Learning Environments, 20(1), 3-18. https://doi.org/10.1080/10494821003714632

Tırnovalı, A. (2012). Uzaktan Eğitimde Internet Tabanlı Eğitim Programlarının Temel Boyutlarına Yönelik Öğrenci Ve Öğretim Elemanlarının Görüşleri Ve Öneriler [Student and Teaching Staff Views and Suggestions on the Basic Dimensions of Web-Based Programs in Distance Education]. Ph.D. Thesis Mersin University University Institute of Educational Sciences, Mersin.

Timur, B., & Taşar, M. F. (2011). Teknolojik Pedagojik Alan Bilgisi Öz Güven Ölçeğinin (TPABÖGÖ) Türkçe 'Ye Uyarlanması [The Adaptation of the Technological Pedagogical Content Knowledge Confidence Survey into Turkish]. Gaziantep University Journal of Social Sciences, 10(2), 839-856.

Trikoilis, D., & Papanastasiou, E. C. (2020). The Potential of Research for Professional Development in Isolated Settings during the Covid-19 Crisis and Beyond. Journal of Technology and Teacher Education, 28(2), 295-300.

UNESCO (2020). National Education Responses to COVID-19 Summary Report of UNESCO'S Online Survey. UNESCO. Https://Unesdoc.Unesco.Org/Ark:/48223/Pf0000373322. Sayfasından Erişilmiştir.

Uşun, S. (2006). Uzaktan Eğitim [Distance Learning]. Ankara: Nobel Yayınları

Ülkü, S. (2018). İlkokullarda Görev Yapan Öğretmenlerin Uzaktan Eğitime Yönelik Tutumları [Ilkokullarda Görev Yapan Öğretmenlerin Uzaktan Eğitime Yönelik Tutumları]. Master's Thesis, Abant İzzet Baysal University University Institute of Educational Sciences, Bolu.

Ünal, E. (2013). Öğretmen Adaylarının Teknoloji Entegrasyonu Öz-Yeterlik Algıları Ve Teknolojik Pedagojik Içerik Bilgisi Yeterlikleri Arasındaki Ilişkinin Incelenmesi [An Examination of the Relationship between Preservice Teachers' Perceptions of Technology Integration Self-Efficacy and Technological Pedagogical Content Knowledge Competencies]. Master's Thesis, Ankara University University Institute of Educational Sciences, Ankara.

Varma, K., Husic, F., & Linn, C. M. (2008). Targeted Support for Using Technologyenhanced Science Inquiry Modules. Jounal of Science Education Technology, 17, 341- 356. https://doi.org/10.1007/s10956-008-9104-8

Vela, K. (2018). Using Slack to Communicate With Medical Students. J. Med. Libr. Assoc, 106(4): 504-507. https://doi.org/10.5195/jmla.2018.482

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing Preservice Teachers' Selfefficacy Beliefs for Technology Integration. Journal of Research on Technology in Education, 36(3), 231-250. https://doi.org/10.1080/15391523.2004.10782414

Yalman, M., & Kutluca, T. (2013). Matematik Öğretmeni Adaylarının Bölüm Dersleri Için Kullanılan Uzaktan Eğitim Sistemi Hakkındaki Yaklaşımları [Mathematics Prospective Teachers' Approaches towards the Distance Education System Used For the Department Courses]. Dicle University, the Journal of Ziya Gökalp Educational Faculty, 21, 197-208.

Yenilmez, K., Turğut, M., & Balbağ, M. (2017). Öğretmen Adaylarının Uzaktan Eğitime Yönelik Tutumlarının Bazı Değişkenler Açısından Incelenmesi [Investigation of Prospective Teachers' Perceptions on Distance Education With Respect To Certain Variables]. Erzincan University Journal of Education Faculty, 19(2), 91-107. https://doi.org/10.17556/erziefd.305902

Yıldız, S. (2016). Pedogojik Formasyon Eğitimi Alan Öğrencilerin Uzaktan Eğitime Yönelik Tutumları [The Attitudes of the Students Having Pedagogical Formation Training towards Distance Education]. AIBU Journal of Social Sciences, 16(1), 301-329. https://doi.org/10.11616/basbed.vi.455852

Zbiek, R. M., Heid, M. K., Blume, G. W., & Dick, T. P. (2007). Research on Technology in Mathematics Education: The Perspective of Constructs. In F. Lester (Ed.), Handbook of Research on Mathematics Teaching and Learning, 2, 1169-1207. Charlotte, NC: Information Age Publishing.

Notes

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