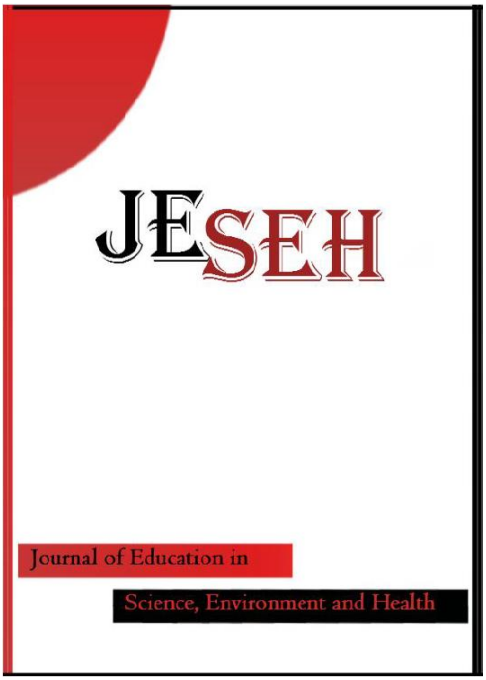

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Abstract

In this study, it was aimed to determine the relationship between digital literacy and digital citizenship and digital teaching material development self-efficacy of the STEM teacher candidates. In the study, a correlational model was used. The population of the study consists of teacher candidates studying in different teacher training programs (Science education, Technology education, Mathematics education, Engineering education) at state universities in Turkey in the 2022-2023 academic year. The sample of the study, as for that, consists of 1050 teacher candidates who are determined by simple random sampling from the population. The study data were collected with “Digital Literacy," “Digital Citizenship," and “Digital Teaching Material Development Self-Efficacy” scales. According to the hierarchical multiple regression analysis results, it was determined that the level of digital literacy and digital material development self-efficacy significantly predicted the digital citizenship level. Besides, in the study, it was determined that digital material development self-efficacy plays a partially mediating role in the relationship between digital literacy and digital citizenship behavior. According to the study results, it was suggested that the teacher candidates’ work on increasing digital literacy levels would be beneficial to improve their digital citizenship and digital material development self-efficacies.

Introduction

It is a century in which new discussions have been made regarding the concept of citizenship with the twenty-first century, the impact of globalization, and technological transformation. One of the prominent citizenship concepts in this period is the concept of digital citizenship (Dindar et al., 2013). Lyons (2012) describes the concept of digital citizenship as a subset of citizenship, Ribble (2011) describes it as a set of appropriate and responsible behavior norms for technology use, Vizenor (2013) describes it as the process of individuals’ participation in the virtual environment through technologies within the scope of political and social activities and Miles (2011), as for that, describes it as a responsible, sensitive and rational approach to the online interaction process.

Digital citizenship was subjected to many studies recently with rapid changes and developments in information and communication technologies. Some reasons make the concept of digital citizenship such important. According to Mossberger, Tolbert, and McNeal (2008), these are: 1) The change in the social life in line with the opportunities offered by the Internet and the risks and problems brought about by this change, 2) Opportunities provided by internet access for digital technology users to participate effectively and socialize in society from anywhere, 3) The effect of online activities to strengthen democracy, 4) The need for individuals who can use digital technologies effectively and efficiently with a sense of responsibility, 5) The equality of opportunity provided by the internet in learning-teaching activities and its effect on learning-teaching activities can be listed as the main reasons.

There are different discussions in the body of literature regarding digital citizenship. Changes in sociological structure (education, research, health, literacy, family, professional development, socialization, communication, etc.) with the effects of globalization and information technologies have also changed citizenship. For example, Mossberger, Tolbert, and McNeal (2008) were evaluated the abilities that an individual should have to participate in the online society within the scope of digital citizenship. In the evaluation conducted, digital skills for digital citizenship were thrown up. Digital citizenship has nine sub-dimensions be about digital literacy, digital commerce, digital security, digital rights and responsibilities, digital health, digital ethics, digital rule (law), digital communication, and digital access. The classification of these sub-dimensions was conducted

considering the use and misuse of technologies. Although not fixed, these classifications may change in due course depending on the impact of digital technologies on social life (Ribble, 2006). In the sense of the study, digital literacy, which is a sub-dimension of digital citizenship, was discussed.

Developments in the field of digital technology rapidly gaining place both in government institutions and in all segments of society have been put forward the necessity to develop and disseminate digital literacy skills as well as traditional literacy. Digital literacy is known as one of the sub-dimensions that constitute digital citizenship. Ribble (2011) describes the concept of digital literacy as the skill of how and when digital technologies should be used in the process of individuals' training and accessing information, Kazakoff (2014) describes it as the process of individuals' participation in social and cultural activities through digital tools, Ba, Tally and Tsikalas (2002) describe it as a series of habits that students have acquired for learning, socialization, acculturation, and entertainment within the scope of computer technology use and Gilster (1997), as for that, describes it as the process of interpreting and evaluating the information presented in the digital environment with a critical perspective.

The widespread use of digital tools in the sectors such as education, health, service, which makes the concept of digital literacy a subject to be emphasized and examined, and the need to find solutions to the problems brought by the digital environment have been effective. However, it has been put forward the fact that the use of digital tools by almost all segments of the society, technology users should be trained and developed in digital literacy skills.

Effects of change and development in the age of information technologies are reflected in many areas of education such as school and teacher development, student learning, school, and environmental relations. Expectations for the competencies of teachers responsible for the change and development of education also suffer a change. Considering the effects of change/transformation in school, one of the most important resources that the teacher should provide to the school is technological developments (Hsieh, Yen & Kuan, 2014). Teachers need to demonstrate the continuity in technology systems and the transfer of existing knowledge to new technologies and situations in the digital society. In addition to this, existing and created digital tools should be used actively to reach information sources to contribute to learning, to analyze, synthesize, evaluate and use when necessary (ISTE, 2014). When considering that the current teacher candidates are generation Z individuals, they are seen by other generations as an expert in using technological tools. Applications installed on smartphones and computers and devices with internet connection leave this generation constantly connected to the network (Kotler & Armstrong, 2018). What level of digital literacy and digital citizenship skills of teacher candidates in generation Z are and how much they relate to each other or how much they affect each other was defined as a problem that is required in the study and needs to be answered.

It can be said that technologies that are constantly evolving affect digital citizenship and digital literacy as well as learning environments. At the same time, it can be told that constantly developing technology causes a change in the quality and variety of educational equipment used in learning environments. The fact that these changes created a suitable teaching environment for teachers online facilitated their own and course-based teaching materials development processes (Birişçi et al., 2018). To create an active and effective learning environment in digital teaching environments, teachers need to create digital teaching materials such as online presentations, digital games, and e-evaluation (Friesen, Fisher & Roberts, 2001).

It can be said that the ability of teacher candidates to use technological tools and equipment to be used within the scope of education and training activities has indispensable importance for educational activities in today's conditions. In addition to this, since teacher candidates' development of digital materials to aid teaching in the lesson has a significant effect on learners' interest in learning processes and their learning levels after they start practicing their teaching profession, they will need the materials they will develop in their professional lives (Bakaç & Özen, 2015). Using the materials to be developed with the use of technology to support the teaching process will contribute to ensuring that students are active in learning processes and increasing the permanence of learning (Seferoğlu & Yağcı, 2001; Yalın, 2007).

In conjunction with the development of technology by teachers, the use of technology-supported materials to create an effective classroom environment has ensued. To provide this and support the lessons, the necessity for teachers to know how to develop supplementary material eas ensued (Bakaç & Özen, 2015). One of the methods to determine the level at which teachers have material development skills is to determine at what level they feel competent in terms of these skills, namely, their self-efficacy level.

When the literature is reviewed, there is a positive relationship between the individual's persistence in trying to be successful in a job and his self-efficacy perception (Pajares, 1996; Roberts et al., 2001). Similarly, it is known that there is a relationship between teachers' self-efficacy and their effective teaching (Tschannen-Moran & Hoy, 2001; Özkan, Tekkaya & Çakıroğlu, 2002; Andersen et al., 2004). Teachers' self-efficacy in using technology is proportional to their ability to perform desired tasks at an appropriate level using web tools (Birişçi et al., 2018).

The descriptions expressed in the above paragraphs show that with the rapid development of technology, there are changes in learning environments in the sense of learner, teacher, and learning processes. This change was caused by the formation of digital citizenship; digital citizenship requires digital literacy, the formation of an opinion that it affects the use of digital materials in teaching processes in digital literacy. Based upon this thought, before starting the teaching profession, the level of digital literacy, digital citizenship, and digital material development self-efficacy of teacher candidates, how they relate to each other, and how they affect each other has been a problem of the study.

Purpose

The purpose of this study is to determine the relationship between digital literacy and digital citizenship and digital teaching material development self-efficacy of the teacher candidates. In line with the expressed purpose, answers to the following questions were sought:

1. Is there a significant relationship between digital literacy levels and digital citizenship levels of teacher candidates?
2. Is there a significant relationship between digital literacy levels and teaching material development self-efficacy levels of teacher candidates?
3. Is there a mediating role of digital teaching material development self-efficacy levels of teacher candidates in the relationship between digital literacy and digital citizenship levels?

Method

In this study, a correlational model in which relationships between multiple variables were investigated through applied scales was used. The correlational model presents an opinion about cause and effect relationships between variables (Karasar, 2012; Büyüköztürk et al., 2020).

Population and Sample

The population of the study consists of teacher candidates studying in different teacher training programs (Science education, Technology education, Mathematics education, Engineering education) at state universities in Turkey in the 2022-2023 academic year. The sample of the study, as for that, consists of 1050 STEM teacher candidates who are determined by simple random sampling from the population. Simple random sampling is the fact that a sample that is considered to have an equal chance as a result of statistical calculations in a population has a size that can represent the population and is selected by a completely random method (Yıldırım & Şimşek, 2013).

The sample of the study consisted of 1050 pre-service teachers, 72.1% of whom were female (n=757) and 27.9% (n=293) were male. 12.7% of the pre-service teachers forming the sample are 18 (n=133), 17.3% are 19 (n=182), 29% are 20 (n=304), 15.8% are 21 (n=166), 11.8% are 22 (n=124) and 4.7% are 23 (n=49). 8.8% (n=92) are 24 years old and over. 38.1% of the teacher candidates are in the first grade, 26% are in the second grade, 26.7% are in the third grade and 9.2% are in the fourth grade. 28.8% (n=302) of the prospective teachers are studying social studies teaching, 14.7% (n=154) primary school teacher, 10.3% (n=108) Turkish language teaching, 12.2% (n=128) mathematics teaching and 11% (n=115) physical education teaching. 6.4% (n=67) of the pre-service teachers study in pre-school teaching, 6% (n=63) in English teaching, 3.4% (n=36) in psychological counseling and guidance education, 3.3% (n=35) in art teaching, 2.7% (n=28) in science teaching, and 1.3% (n=14) in religious culture and moral knowledge teaching.

Table 1. Sampling data

		f	%
Gender	Female	757	72,1
	Male	293	27,9
Age	18	133	12,7
	19	182	17,3
	20	304	29,0
	21	166	15,8
	22	124	11,8
	23	49	4,7
	24 years and older	92	8,8
Class	1	400	38,1
	2	273	26,0
	3	280	26,7
	4	97	9,2
Department	Social Sciences Teaching	302	28,8
	Classroom Teaching	154	14,7
	Turkish Teaching	108	10,3
	Math Teaching	128	12,2
	Pre-School Teaching	67	6,4
	Science Teaching	28	2,7
	Religious Culture And Moral Knowledge Teaching	14	1,3
	Psychological Counseling And Guidance	36	3,4
	English Teaching	63	6,0
	Physical Education Teaching	115	11,0
	Art Teaching	35	3,3
Digital Tool	Personal Computer	138	13,1
	Tablet	45	4,3
	Smart Phones	867	82,6
Purpose Of Using Digital Platforms	Entering Social Media	396	37,7
	Listening To Music	60	5,7
	Watch Videos	209	19,9
	Conduct Research	171	16,3
	Following The Daily News Flow	97	9,2
	Other	117	11,1
Usage Time	Less Than 2 Hours	361	34,4
	Between 2 Hours And 4 Hours	60	5,7
	Between 4 Hours And 6 Hours	340	32,4
	More Than 6 Hours	289	27,5
Usage Level of Digital Platforms	Weak	61	5,8
	Medium	708	67,4
	Good	281	26,8

It was determined that 13.1% via personal computers (n=138), 4.3% via tablets (n=45), and 82.9% via smart phones (n=867) of 1050 teacher candidates in the sample group of the study benefited from digital platforms. It was determined that 37.7% for entering social media (n=396), 5.7% for listening to music (n=60), 19.9% for watch videos (n=209), 16.3% for conduct research (n=171), and 9.2% for following the daily news flow (n=97) of teacher candidates made use of digital platforms via personal computers, tablets, and smartphones.

It was determined that 34.4% spent less than 2 hours (n=361), 5.7% spent between 2 hours and 4 hours (n=60), 32.4% spent between 4 hours and 6 hours (n=340), 27.5% spent more than 6 hours (n=289) on the internet of the teacher candidates in the sample of the study. Besides, 5.8% were stated that the level of digital platforms usage was weak (n = 61), 67.4% were stated that the level of digital platforms usage at a medium level (n = 708), and 26.8% were stated that the level of digital platforms usage at a good (n = 281) level of the teacher candidates in the sample.

Data Collection Tools

The study data were collected through three scales. “Digital Literacy Scale," “Digital Citizenship Scale," and “Digital Teaching Material Development Self-Efficacy Scale” are included in the data set of the study. The scales used are five-point Likert type. The scales are scored as "(1) Strongly Disagree"; "(2) Disagree"; "(3) Neither Agree nor Disagree"; "(4) Agree"; and "(5) Strongly Agree". Information on the scales in the data set of the research is given below.

Digital Literacy Scale: It is developed by Hamutoğlu, Güngören, Uyanık, and Erdoğan (2017). Within the scope of this study, the data matrix is suitable for factor analysis since the result of the Bartlett test is significant and Kaiser-Meyer-Olkin (KMO) coefficient is “.869”. In consequence of the exploratory factor analysis made with the data set of this research, the load value among the items of the measuring tool was found between “.402 and .788”. It was observed that the measurement tool has four factors. The first factor of these four factors describes 21.746% of the total variance in the measuring tool, the second factor describes 20.029%, the third factor describes 10.004%, and the fourth factor describes 9.579%. Four factors of the digital literacy scale describe 61.358% of the total variance in the measuring tool. Cronbach’s Alpha Reliability of Co-efficient value of the scale was calculated as “.874”. In CFA conducted with the data set of the digital literacy scale, it was determined that the four-dimensional factor structure produces acceptable fit values (X2=583.792, sd=106, X2/sd=5.507, P=0.000, RMSEA=0.066, GFI=.939, IFI=.935, TLI=.917, CFI=.935).

Digital Citizenship Scale: The digital citizenship scale developed by Choi, Glassman, and Cristol (2017) was adapted into Turkish by Erdem and Koçyiğit (2019). Within the scope of this study, the data matrix is suitable for factor analysis since the result of the Bartlett test is significant and the KMO coefficient is “.852”. In consequence of the exploratory factor analysis made with the data set of this research, the load value among the items of the measuring tool was found between “.366 and .872”. It was observed that the measurement tool has five factors. The first factor of these five factors describes 19.039% of the total variance in the measuring tool, the second factor describes 12.164%, the third factor describes 10.724%, the fourth factor describes 10.310%, and the fifth factor describes 9.839%. Five factors of the digital citizenship scale describe 62.076% of the total variance in the measuring tool. Cronbach’s Alpha Reliability of Co-efficient value of the scale was calculated as “.877”. In CFA conducted with the data set of the digital citizenship scale, it was determined that the five-dimensional factor structure produces acceptable fit values (X2=983.074, sd=113, X2/sd=8.700, P=0.00, RMSEA=0.08, GFI=.90, IFI=.91, TLI=.89, CFI=.91).

Digital Teaching Material Development Self-Efficacy Scale: It was developed by Korkmaz, Arıkaya, and Altıntaş (2019). Within the scope of this study, the data matrix is suitable for factor analysis since the result of the Bartlett test is significant and Kaiser-Meyer-Olkin (KMO) coefficient is “.943”. In consequence of the exploratory factor analysis made with the data set of this research, the load value among the items of the measuring tool was found between “.503 and .744”. It was observed that the measurement tool has three factors. The first factor of these three factors describes 31.588% of the total variance in the measuring tool, the second factor describes 19.493%, and the third factor describes 11.546%. Five factors of the digital material development self-efficacy scale describe 62.627% of the total variance in the measuring tool. Cronbach’s Alpha Reliability of Co-efficient value of the scale was calculated as “.942”. In CFA conducted with the data set of the digital citizenship scale, it was determined that the five-dimensional factor structure produces acceptable fit values (X2=73.720.919, sd=631, X2/sd=11.602, P=0.00, RMSEA=0.08, GFI=.90, IFI=.95, TLI=.90, CFI=.95).

Statistical Analysis

After collecting the data of the study with three scales, outliers were cleared, skewness and kurtosis values were calculated. In consequence of the calculations, the skewness and kurtosis values are in the range of “±1.5”, it is accepted that the data meet the normal distribution criteria (Hopkins & Weeks, 1990; DeCarlo, 1997; Tabachnick & Fidell, 2013).

Data reached with three scales used for the study were analyzed in terms of validity and reliability at the first stage. Cronbach’s Alpha coefficient calculations were made to determine whether the exploratory factor analysis for the conformity of scales to construct validity (Field, 2009; Büyüköztürk, 2020) met the reliability criteria. In the study model, while examining the effect of independent variables such as perceived digital literacy and digital citizenship that predict digital teaching material development self-efficacy behavior of pre-service teachers as dependent variables, a hierarchical multiple regression analysis was conducted in which the

variables of gender, age, the teaching program and class, the tools used while benefiting from digital platforms, the purpose of benefiting, the duration of use and the level of utilization were controlled.

To describe whether the third variable mediates or has an indirect effect on the relationship between two variables, some conditions must occur (Baron & Kenny, 1986).

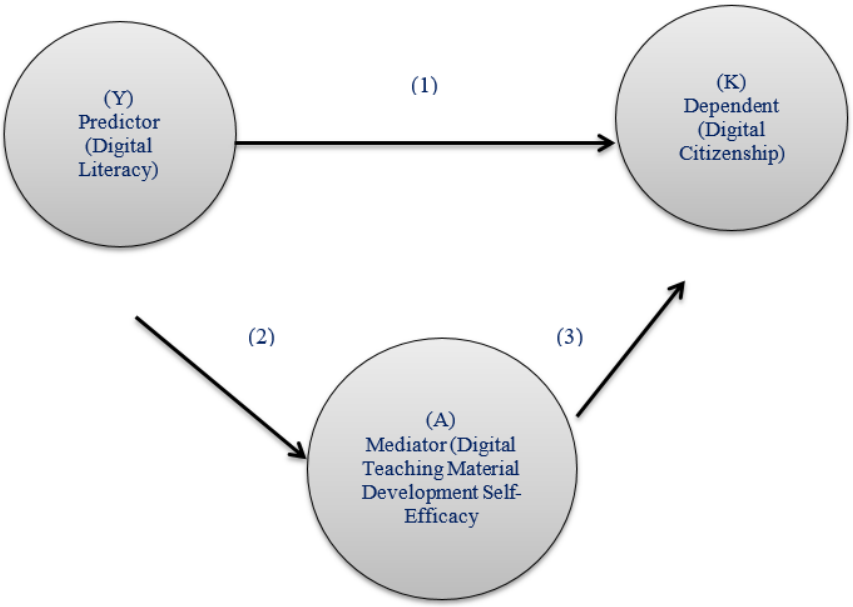

Figure 1. Mediation effect in the Baron and Kenny model

As seen in Figure 1 (Y) is Predictor, (K) is dependent/criterion, and (A) is mediator variable: (1) Digital Literacy meaningfully predicts Digital Citizenship; (2) Digital Literacy significantly predicts Digital Material Development Self-Efficacy; (3) Digital Material Development Self-Efficacy predicts Digital Citizenship by controlling the impact of Digital Literacy and (4) By controlling the effect of Digital Material Development Self-Efficacy, Digital Literacy predicts Digital Citizenship or this relationship becomes statistically insignificant. In the fourth step, if Digital Literacy predicts Digital Citizenship is meaningless, Digital Material Development Self-Efficacy is called the "complete mediator" variable, and if there is a significant decrease in Digital Literacy's prediction of Digital Citizenship, Digital Material Development Self-Efficacy is called the "partial mediator" variable (Frazier, Tix & Barron, 2004). To test the significance of mediation effects, the Sobel test, which is used extensively in the body of literature and has been found to produce high-reliability results, was preferred (Şimşek, 2007). For the use of the Sobel test, the Med-Graph-I program, developed by Jose (2003) and available on the website, was utilized.

FINDINGS

Descriptive Analysis Related to Variables and Correlation Matrix

The data regarding the arithmetic mean standard deviation, standard error values, and correlations between variables regarding digital literacy, digital citizenship, and digital material development self-efficacy of the teacher candidates studying in different teacher training programs who voluntarily participate in the study are presented in Table 2.

Table 2. The arithmetic mean standard deviation, standard error, and correlation values of the variables examined within the scope of the study

Variables	Mean	Standard Deviation	Standard Error	1	2	3
1.Digital Literacy	3.68	.527	.016	1		
2.Digital Citizenship	3.33	.597	.018	.461**	1	
3.Digital Teaching Material Development Self-Efficacy	3.46	.519	.016	.553**	.455**	1

**p<.01

According to Table 2, while teacher candidates' perceptions of digital literacy and digital material development self-efficacy are at the level of "Agree (4)", their digital citizenship levels are at the "Neither agree nor disagree" level. Considering the relationships in the correlation matrix, perceptions of digital literacy are in a moderate positive correlation (r=.553, p<.001) with perceptions of digital citizenship (r=.461, p<.001) and digital material development self-efficacy. Besides, the digital citizenship variable and the digital material development self-efficacy variable have a moderate positive correlation (r=.353, p<.001).

The Effect of Digital Literacy and Digital Teaching Material Development Self-efficacy on Digital Citizenship Behavior

Findings and results of the hierarchical multiple linear regression analysis conducted to investigate the mediating effect of digital material development self-efficacy levels on the effect of digital literacy perceived by teacher candidates on the digital citizenship level of teacher candidates are present. In the mediation test analysis conducted below, while examining the effect of digital literacy levels of teacher candidates on digital citizenship behavior, digital material development self-efficacy levels were modeled as a control variable.

Table 3. Hierarchical multiple regression analysis results on the effect of Teacher Candidates' Digital Literacy and Digital Material Development Self-Efficacy on Digital Citizenship behavior

Model		Dependent variable: Digital citizenship					
Independent variables		B	Std. Error	Beta	t	p	F
1	(Constant)	1.433	.155		9.262		42.879
	Digital Literacy	.491	.033	.434	14.703	.000	
	Gender	.069	.037	.052	1.885	.060	
	Age	-.011	.013	-.033	-.912	.362	
	Department	-.009	.005	-.050	-1.745	.081	
	Class	-.078	.022	-.132	-3.525	.000	
	internet usage time	.079	.014	.160	5.676	.000	
	vehicle*	.016	.024	.019	.683	.495	
	purpose**	-.013	.009	-.038	-1.390	.165	
	level***	.017	.034	.015	.510	.610	
2	(Constant)	.962	.159		6.032	.000	48.574
	Digital Literacy	.338	.037	.299	9.159	.000	
	Digital Teaching Material Development Self-Efficacy	.317	.037	.276	8.549	.000	
	gender	.066	.036	.050	1.862	.063	
	age	-.004	.012	-.011	-.307	.759	
	department	-.003	.005	-.014	-.509	.611	
	class	-.080	.021	-.135	-3.749	.000	
	internet usage time	.066	.013	.135	4.907	.000	
	vehicle*	.033	.023	.038	1.408	.160	
	purpose**	-.016	.009	-.048	-1.786	.074	
	level***	-.034	.033	-.030	-1.020	.308	
R^2 *change = .312*							

** Tool used to enter digital platforms;*
*** The purpose of entering digital platforms;*
**** The level of use of digital platforms.*

As seen in Table 3, in the first step, after checking the demographic variables such as gender, age, the class of education, department, for what purpose, with which tool, for how long, internet usage level and perceived digital literacy variables, in the second step, teacher candidates' Digital Material Development Self-Efficacy score was added to the model with the direct identification (enter) method. In consequence of the hierarchical multiple linear regression analysis, after Digital Material Development Self-Efficacy is added to the model, the effect of digital literacy on digital citizenship decreases from $\beta = .434$ to $\beta = .299$. The decrease in the effect of digital literacy after the Digital Material Development Self-Efficacy was added to the model, but the fact that this effect is still significant indicates that Digital Material Development Self-Efficacy is a partial mediator variable in this relationship. That is, digital literacy has an impact on digital citizenship behavior, both directly and via Digital Material Development Self-Efficacy. To apply the Sobel test for the significance of the

mediating effect found, some data in Table 3 were entered into Jose's (2003) MedGraph-I program, and Table 4 below was obtained.

Table 4. The results of the Sobel test analysis

Mediation Type	Partial
Sobel Z Value	49.422
Significance	.000
Direct effect	.161
Indirect effect	.055
Total effect	.216

As can be seen in Table 4, in the Sobel test conducted by entering some data in Table 3 into the MedGraph-I program for the significance of the mediating effect, the mediating effect of digital material development self-efficacy is significant at p<.01 level. Considering the results of the analyzes conducted to determine the effects of mediation in general, the total effect of digital literacy on digital citizenship behavior becomes β=.216, and when digital material development self-efficacy is controlled, the direct effect of digital literacy on digital citizenship behavior becomes β=.161. The difference is β=.055 as an indirect effect, resulting from the mediating effect of digital material development self-efficacy. These mediation effects and the general model can be seen in Figure 1. In the figure, the variables that predict each other are shown with a one-way arrow. The standardized beta coefficients in the regression table are indicated above the arrows.

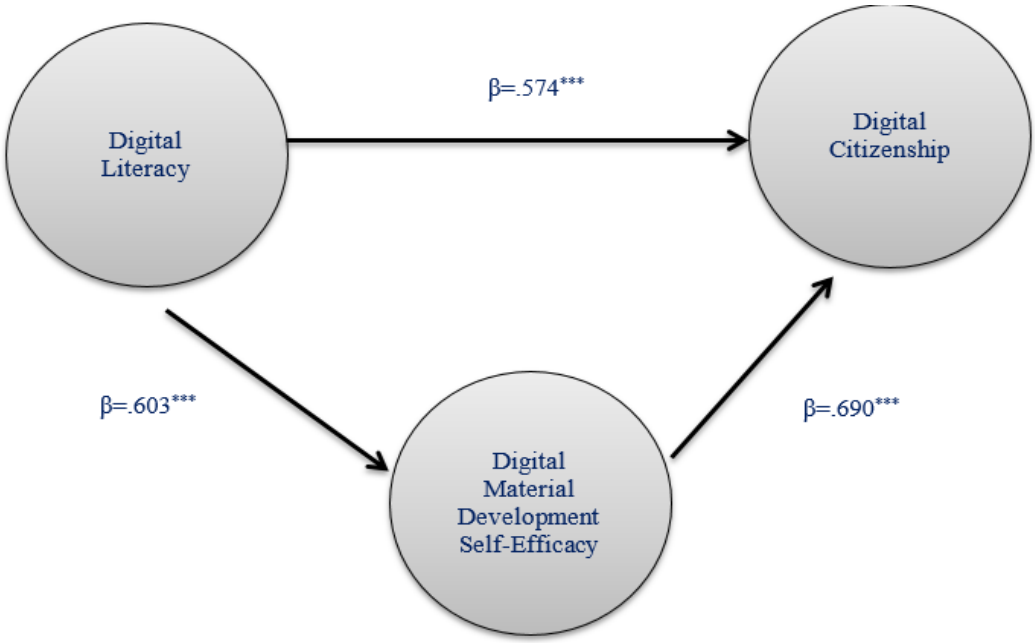

Figure 2. The mediating effect of digital material development self-efficacy level on the effect of perceived digital literacy on teacher condidates' digital citizenship behavior and standardized beta coefficients (***p<.001)

As can be seen in Figure 2, digital material development self-efficacy levels have a partial mediating effect on the prediction of perceived digital literacy on teacher candidates' digital citizenship (Z=49.422, p<.001). The high level of digital literacy of teacher candidates will increase their digital citizenship behaviors both indirectly and directly through their digital material development self-efficacy levels.

Discussion

In the study, digital literacy was examined together with digital citizenship and digital material development self-efficacy, and some important results were reached. According to the hierarchical multiple regression analysis results, it was determined that the digital literacy levels of teacher candidates increase their digital citizenship and digital material development self-efficacies. It was determined that digital material development self-efficacy plays a partial mediating role in the relationship between digital literacy and digital citizenship

behaviors. It can be said that in line with the increase in digital literacy levels of teacher candidates, digital citizenship and digital material development self-efficacy increased.

In the study conducted, findings regarding the high digital literacy levels of teacher candidates are supported by other study findings in the body of literature. Kozan (2018), Üstündağ et al. (2017) reported that the digital literacy skills of pre-service teachers studying in different teacher training programs were at a good level in their studies. Özerbaş and Kuralbayeva (2018) also found that the digital literacy levels of prospective teachers in Turkey were high in their study. This result may be since teacher candidates in Turkey represent a young population, and their integration into digital platforms is faster and easier because they are in the Z generation; as stated by Prensky (2001), students in the generation Z may be due to their innate ability to use new technologies and their ability to adapt easily to emerging technologies. Besides this result obtained, as stated in the study conducted by Menzi, Çalışkan, and Çetin (2012), it can be supported by the result that teacher candidates who use the internet more frequently in their study, which examines the technology competencies of teacher candidates in terms of various variables, see themselves more competent in the field of technology than others. In other saying, the high level of digital literacy of teacher candidates who see themselves as sufficient in technology use can be described as a natural situation.

According to "Information Society Statistics" published by Turkey Statistical Institute (TSI) in 2020, internet access in Turkey was determined as 94.9%. Web site ownership was 53.7%, and internet access in households was 90.7%. According to the results of the same research, the e-government usage rate in Turkey was 51.5%. These data showing the current digital view of Turkey are an indication that Turkey is not behind the age in digitalization. Besides, according to these data, the adaptation of Turkey to digital citizenship, which comes with digitalization, is understood from the rate of entry to e-government applications. All these data support the finding of the high levels of digital literacy and digital citizenship of teacher candidates obtained in the study.

In the study conducted, findings regarding the high digital citizenship levels of teacher candidates are supported by other study findings in the body of literature. Kocadağ (2012), Sakallı (2015), Bakır (2016), and Arslan (2016), in their study conducted, found that the digital citizenship levels of teacher candidates studying in different teacher training programs are high. Besides, the high level of digital citizenship of prospective teachers can be evaluated as that Çubukçu and Bayzan (2013) included in the definition of digital citizenship and carried out by pre-service teachers of behaviors that can criticize while using information and communication tools, are aware of the ethical consequences of online behaviors, use technology in a way that does not harm others, use the right to communicate online, show the right attitude in their sharing and cooperation, and encourage others in this direction. A similar situation is supported by the statements of Karaduman and Öztürk (2014), who define digital citizens as people who have the power to understand, write, read and share the information on the internet and use the internet effectively.

The findings of the study conducted that digital literacy increases the level of digital citizenship is supported by other study findings in the literature. Zahrani (2015) was determined that digital literacy is an extremely important factor in the perception of digital citizenship. Kaya (2020) was reported in his study conducted that there is a moderate, positive relationship between digital citizenship level and digital literacy level. Besides, in the study of Kaya (2020), the effect of digital literacy on digital citizenship was found to be positive and significant. In the study conducted, findings were obtained indicating that teacher candidates' self-efficacy levels of digital material development are high. Digital textbooks, applications, and online complementary resources (Edson & Thomas, 2016; cited in Göçen Kabaran, 2020), animations, simulations, presentations, digital texts, and videos come to mind when it comes to digital teaching material (Taşlıbeyaz & Karaman, 2015). Today, teacher candidates studying in teacher training programs are called digital natives by age. These materials, which are suitable for the nature of digital native students, can contribute to the teaching-learning environments of the 21st century. However, digital materials offer many different educational opportunities that cannot be achieved in traditional teaching forms (Kalyuga & Liu, 2015). When the expressions about the importance of digital teaching material in conceptual terms are combined with the finding that the teacher candidates' digital material development with self-efficacies are high, it can be said that the study results are sufficient for the pre-service teachers in terms of digital material development efficacies. The high level of digital literacy, digital citizenship, and digital material development self-efficacy of teacher candidates and their interrelatedness is evidence that teacher candidates studying in teacher training programs in Turkey are sufficient in terms of the three variables expressed. Besides, the relationship of study subjects examined on a digital basis is also supported by data obtained from digital platforms in Turkey (see TUIK (TSI), 2020 data).

Limitations and Recommendations

The current results of the study should be read carefully. The results of the study conducted it is limited by the opinions of teacher candidates who study in different teacher training programs at universities in different regions of Turkey. In addition to these, the limitations of the study conducted: It can be shown that (1) it was carried out with a limited sample group with teacher candidates in higher education institutions and that generalization to larger samples is limited and (2) only the perceptions of teacher candidates in state universities are determined.

Although the above-mentioned limitations in the study provide a theoretical framework for the relationship between variables that are seen as important in increasing the level of digital literacy thus, this study can contribute to deepening the knowledge on the concept of digital literacy. It was determined that the findings of the study conducted that digital literacy increases the level of digital material development self-efficacy is supported by other study findings in the body literature. More comprehensive results can be obtained, especially in the sense of digital literacy and digital citizenship, by adding different variables to research processes other than the three variables expressed. In the study, it was determined that the digital material development self-efficacy tool plays a variable role in the relationship between perceived digital literacy and digital citizenship behavior. In the future study to be held, in the relationship between digital literacy and digital citizenship behavior, economic factors affecting students' access to digital platforms, their education towards using digital platforms, or their attitudes towards digital platforms can act as mediators. Besides, according to the study results, it was suggested, that the teacher candidates' work on increasing digital literacy levels would be beneficial to improve their digital citizenship and digital material development self-efficacies. In addition to this, the study to be held can be conducted in a qualitative study on the reasons for the relationships between the concepts studied.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the authors.

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