Evaluation of prospective teachers' digital literacy levels and mobile learning attitudes

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Article Info	Abstract
  Research Article	This research aims to examine prospective teachers' digital literacy levels and mobile learning attitudes. A correlational survey method was used to design the research. In addition, whether the digital literacy levels and mobile learning attitudes of prospective teachers differed significantly according to the variables of gender, grade level, department and mobile application usage time was examined. The research was carried out with 443 prospective teachers studying at the education faculty of a state university. The prospective teachers in the research were studying at the 1st, 2nd, 3rd and 4th grade levels and in 10 different departments. The research data were collected in the digital environment and the participants were determined by the maximum variation sampling method. The research data were collected by using a digital literacy scale and mobile learning attitude scale. In addition, gender, grade level, department and mobile application usage time variables were used. According to the research results, prospective teachers' digital literacy levels and mobile learning attitudes are at a moderate level and there is a positive and significant relationship between them. In addition, the digital literacy levels of prospective teachers explains 35% of their mobile learning attitudes. The digital literacy levels of prospective teachers significantly differ according to the gender, grade level and department variables and mobile learning attitudes significantly differ according to the department variable.

1. Introduction

Technology provides convenience to people in many ways in every field. Individuals tend to use technology more intensively in order to take advantage of improvement. This improvement increases the tendency of individuals to be digitally literate. When the historical development process of digital literacy from past to present is examined, it is seen that it does not have a distant past, but it has shown a rapid development in the last 30 years and is more involved in people's lives. Since technology began to enter the lives of individuals, scientists have begun to investigate the importance of technology in different fields, the reasons for its effect on individuals, the convenience it offers, and its role in human life in the future.

In the process of technology-oriented research, the use of technology by scientists has revealed the concept of digital literacy. Gilster (1997) explained digital literacy as a cognitive skill based on dominating thoughts beyond pressing keys, and states that digital literacy includes technological hardware and software knowledge, understanding software applications, accessing and using information,

understanding and interpreting digital applications and the necessity to have creative thinking skills. In order to make the historical process of the concept of digital literacy more understandable, the importance of technology in the lives of individuals is better understood when the definitions so far are examined. Digital literacy is the transfer of communication and interaction needs of individuals in private and business life, and their cultural productions, to the world of technology (Manovich, 2001). Digital literacy is individual's ability to adapt to the digital world and stay in the digital world (Eshet-Alkalai, 2004). Digital literacy is the development of the awareness level and attitude of the individual's abilities, access to digital resources, evaluation, integration, analysis and synthesis of these resources, revealing new information, creating communication channels between individuals, and transferring digital literacy skills to social life with constructive and social actions (Martin, 2008). Digital literacy, which contributes to traditional literacy but goes far beyond, provides individuals with employment, learning and socialization in the modern world (Churchill, Ping, Oakley & Churchill, 2008). An individual's digital literacy is parallel with his adaptability and tendency towards new or emerging technologies. In other words, the tendency and skill of individuals towards existing or developing technologies also increase the level of digital literacy (Ng, 2012).

Technology, which has a permanent place in the lives of individuals in many aspects, has an indispensable importance in different institutions and organizations. One of these institutions is higher education. Excluding from technological transformation and for students to graduate without digital literacy skills will not be the right approach for higher education, which is the highest and most intensive level of education. For this reason, technology and digital literacy include all individuals who are directly or indirectly related with higher education. In order for higher education institutions to be successful in digital transformation and for students to be digitally literate, all departments should be included in the digital transformation process which covers integrating the digital transformation process with the vision and mission of the university, and accelerating digital transformation by investing in employees and students with digital literacy skills, and it is expected to make higher education institutions attractive by developing technology-based infrastructure (PWC, 2018). Higher education institutions are expected to implement digital transformation intensively. In this context, institutional and educational services are expected to be restructured in parallel with digital transformation. In order to achieve transformation, Higher education institutions are expected to provide a service-oriented transformation, updating management and education services in parallel with the digital transformation, and finally providing a holistic digital transformation that includes management and education services based on technology (Sandkuhl & Lehmann, 2017). Providing management and education competencies in order to integrate into the developing world and meeting the expectations of the society are imperative for leading educational institutions. The theory on which this research is based is the three-dimensional digital literacy model developed by Ng (2012). Accordingly, digital literacy consists of technical, cognitive and emotional-social dimensions. The technical dimension refers to the technical and operational skills of the individual in using technology, the cognitive dimension refers to the individual's ability to think critically and access information, and the emotional-social dimension refers to the ability of individuals to use the internet in communication, socialization and learning in accordance with the principles of ethical responsibility.

The concept of learning is experiencing change and transformation with the development of technology today. Distance education, digital learning environments, technological applications and mobile learning are some of them. One of the basic behaviors that digital literacy offers to individuals is mobile learning. With the development of technology, studies on mobile learning covering technological tools such as portable computers, tablets, iPads, smart phones, and mobile phones have also been reflected in the definitions. Accordingly, mobile learning is learning performed using mobile tools in mobile environments (Trifonova, 2003). Learning outside the mobile learning environment can be provided with technological support (Seppala & Alamaki, 2003). Mobile learning is the use of technology-based tools to support individuals' learning, increase their knowledge and skills, and improve their performance (Clark

& Mayer, 2008). Mobile learning is the realization of learning and teaching activities with technology-based devices such as smart phones, tablets and portable computers.

With the provision of digital transformation, mobile learning has gained importance in higher education institutions that enable students and employees to reach the level of digital literacy. Problems in transportation, physical facilities, crowded classrooms and health problems lead higher education institutions to offer mobile learning in many courses. The portability of mobile devices offers many opportunities such as individuals' use of social interaction, making data collection faster and more effective, joining other mobile networks and providing connectivity (Klopfer & Squire, 2008). From this point of view, the completion of digital transformation by higher education institutions, the digital literacy of students and the provision of mobile learning proficiency support the development of education and meeting the needs of today's education system.

This research aims to investigate the digital literacy levels and mobile learning attitudes of prospective teachers studying at different departments and grades. In this context, the research seeks answers to the following questions:

1. What is the digital literacy level of prospective teachers?

2. What is the mobile learning attitude level of prospective teachers?

3. Do the digital literacy level and mobile learning attitude level of prospective teachers change according to gender, grade level, department and mobile application usage time?

4. What is the relationship between prospective teachers' digital learning level and mobile learning attitude level?

2. Methodology

2.1. Research model

This research aims to examine the digital literacy levels and mobile learning attitudes of prospective teachers. A correlational survey method was used to design the research. With the correlational survey model, the relationship between variables can be revealed (Fraenkel, Wallen & Hyun, 2012). In this context, the relationship between prospective teachers' digital literacy levels and their mobile learning attitudes were examined. In addition, prospective teachers' mobile learning attitudes and digital literacy levels were examined according to the variables of gender, grade level, department and mobile application usage time.

2.2. Participants

The research was carried out with 443 prospective teachers studying at the faculty of education of a state university. The prospective teachers in the research were studying at the 1st, 2nd, 3rd and 4th grade levels in 10 different departments. The research data were collected in the digital environment and the participants were determined by the maximum variation sampling method. The maximum variation sampling method is used to determine the participants related to the research problem in such a way that they consist of similar, changing and different situations (Grix, 2010). By choosing maximum variation sampling method, the representativeness of the sample to represent the universe was strengthened. The participants' demographic information is given in Table 1 below.

Table 1

Demographic information of the participants

Variable	Group	f	%
Gender	Female	354	79.9
	Male	89	20.1
Grade level	1st grade	184	41.5
	2ndgrade	107	24.2
	3rd grade	143	32.3
	4th grade	9	2
Department	German Language Education	35	7.9
	Science Education	44	9.9
	Elementary Math Education	15	3.4
	English Language Education	75	16.9
	Preschool Education	49	11.1
	Special Needs Education	110	24.8
	School Psychologist Education	13	2.9
	Primary Education	39	8.8
	Social Science Education	31	7
	Turkish Language Education	32	7.2
Mobile application usage time	1-3 hours per day	128	28.9
	4-6 hours per day	221	49.9
	7 + hours per day	94	21.2

Table 1 demonstrates that this research was conducted with 443 participants. Among the participants, 354 (79.9%) participants are female and 89 (20.1%) participants are male. According to the grade level, 184 (41.5%) participants were in the 1st grade, 107 (24.2%) were in the 2nd grade, 143 (32.3%) were in the 3rd grade, and 9 (2%) were in the 4th grade. According to the department variable, 35 (7.9%) were in the German Language Education department, 44 (9.9%) were in the Science Education department, 15 (3.4%) were in the Elementary Mathematics Education department, 75 (16.9%) were in the English Language Education department, and 49 (11.1%) were in the Preschool Education department, while there were 110 (24.8%) participants in the Special Needs Education department, 13 (2.9%) in the School Psychologist Education department, 39 (8.8%) in the Primary Education Department, 31 (7%) in the Social Science Education department, and 32 (7.2%) in the Turkish Language Education department. According to mobile application usage times, 128 (28.9%) participants used mobile applications for 1-3 hours per day, 221 (49.9%) participants used mobile applications for 4-6 hours per day, and 94 (21.1%) participants used mobile applications for 7 or more hours per day.

2.3. Data collection tools and data collection

The research data were collected by using a digital literacy scale and mobile learning attitude scale. In addition, gender, grade level, department and mobile application usage time variables were used.

Digital Literacy Scale: The digital literacy scale developed by Ng (2012) and adapted into Turkish by Hamutoğlu, Güngören, Uyanık and Erdoğan (2017) by conducting a validity and reliability study was used in the research. The scale consists of 17 items and 4 factors which are attitude, technical, cognitive and emotional-social. The scale was prepared as a 5-point Likert type and the rating ranges were determined as strongly disagree (1) to strongly agree (5). The KMO value of the adapted scale was .91, and the Bartlett sphericity test value was found to be 1549.40. In addition, Cronbach's alpha values were found to be .93 for the overall scale, .88 for the attitude sub-dimension, .89 for the technical sub-dimension, .70 for the cognitive sub-dimension, and .72 for the emotional-social sub-dimension.

Mobile Learning Attitude Scale: The mobile learning attitude scale developed by Knezek and Khaddage (2012) and adapted into Turkish by Çam, Uysal, Kıyıcı, and İşbulan (2019) was used in the research. The scale consists of 7 items and a single dimension. The scale was prepared as a 5-point Likert type and the rating ranges were determined as strongly disagree (1) to strongly agree (5). The KMO value of the

adapted scale was .82, and the Bartlett sphericity test value was 139.50. In addition, the Cronbach alpha value of the scale was found to be .81.

The research data were collected from the prospective teachers studying in different departments of the faculty of education within 20 days. The scale forms used in the research were collected in the digital environment in accordance with the research subject. The confidentiality, purpose and scope of the research were explained to the participants in detail. In addition, the volunteer status of the participants was taken as the basis.

2.4. Analysis of data

The data collected from 443 prospective teachers were analyzed to examine the prospective teachers' digital literacy levels and mobile learning attitudes. The data collected in the digital environment were first transferred to the analysis program. Normality distribution test, t-test and one-way ANOVA analysis were applied to the data. In addition, it was revealed whether the digital literacy levels of the prospective teachers and their mobile learning attitudes differed significantly according to the variables of gender, grade level, department and mobile application usage time.

3. Results

In the results section, the analyses made on the research data are explained in order in accordance with the purpose of the research. Table 2 below contains descriptive statistics for the digital literacy levels of prospective teachers.

Table 2

Descriptive statistics for prospective teachers' digital literacy levels and sub-dimensions

	Variables	N	$\overline{X}$	sd	Med	Mod	Ky	Bs
Digital Literacy Level	Digital Literacy Level		3.56	.59	3.58	3.41	.142	-.248
	Attitude	443	3.47	.71	3.57	4	.189	-.524
	Technical		3.70	.64	3.83	4	.168	-.360
	Cognitive		3.68	.79	4	4	.703	-.655
	Emotional-social		3.32	.89	3.50	4	-.002	-.376

Table 2 shows that according to the kurtosis and skewness analysis (±1), the prospective teachers' digital literacy levels are normally distributed for the scale and sub-dimensions. When the mean scores of prospective teachers' digital literacy levels were examined, it was revealed that the levels were $\overline{X}$= 3.56 in the overall scale, $\overline{X}$= 3.47 in the attitude sub-dimension, $\overline{X}$=3.70 in the technical sub-dimension, $\overline{X}$=3.68 in the cognitive sub-dimension, and $\overline{X}$=3.32 in the emotional-social sub-dimension. In addition, in this study, the Cronbach alpha values were found to be .89 in the overall scale, .82 in the attitude sub-dimension, .83 in the technical sub-dimension, .58 in the cognitive sub-dimension, and .70 in the emotional-social sub-dimension. Table 3 below shows the descriptive statistics for mobile learning attitudes of prospective teachers.

Table 3

Descriptive statistics for prospective teachers' mobile learning attitudes

Variables	N	$\overline{X}$	sd	Med	Mod	Ky	Bs
Mobile Learning	443	3.58	.53	3.57	3.57	.784	-.334

Table 3 shows that according to the kurtosis and skewness analysis (±1), the prospective teachers' mobile learning attitudes are normally distributed. In addition, the mean score of prospective teachers' mobile

learning attitudes is $\overline{X}$= 3.58. The Cronbach alpha value of the scale was found to be .72. In Table 4 below, the results of the analysis regarding the digital literacy and mobile learning attitudes of the prospective teachers according to the gender variable are given.

Table 4

Digital literacy levels and mobile learning attitudes by gender variable

Variable	Group	N	$\overline{X}$	sd	df	t	p
Digital Literacy	Female	443	3.52	.55	441	-2.677	.008
	Male		3.73	.68			
Mobile Learning	Female	443	3.59	.50	441	.514	.608
	Male		3.55	.65			

* p>.05

Table 4 reveals that the digital literacy levels of prospective teachers according to the gender variable [t$_{(441)}$=-2.677, p<.05] significantly differ, whereas prospective teachers' mobile learning attitudes do not significantly differ [t$_{(441)}$=.514, p>.05]. Table 5 below presents the analysis results of digital literacy levels of the prospective teachers' according to their grade level, department and mobile application usage time variables.

Table 5

Digital literacy levels of prospective teachers in terms of grade level, department and mobile application usage time variables

Variables	Source of variance	Sum of squares	Sd	Mean square	F	p
Grade level	General	154.738	442		4.627	
	Between groups	4.743	3	1.581		.003
	Within groups	149.995	439	.342		
Department	General	154.738	442		4.171	
	Between groups	12.344	9	1.372		.000
	Within groups	142.394	433	.329		
Mobile application usage times	General	154.738	442		2.526	
	Between groups	1.756	2	.878		.081
	Within groups	152.982	440	.348		

* p>.05

Table 5 reveals that prospective teachers' digital literacy levels significantly differ according to the grade level and department variable, but do not significantly differ according to the mobile application usage time. There is a significant difference between 2nd grade and 3rd grade and 2nd grade and 4th grade groups according to grade level. There is a significant difference between the Turkish Language Education, Science Education, English Language Education and Primary Education department dual groups according to the department variable. Table 6 below presents the analysis results of prospective teachers' learning attitudes according to grade level, department and mobile application usage time.

Table 6

Mobile learning attitudes of prospective teachers in terms of grade level, department and mobile application usage time variables

Variables	Source of variance	Sum of squares	Sd	Mean square	F	p
Grade level	General	127.968	442		.584	
	Between groups	.509	3	.170		.625
	Within groups	127.459	439	.290		
Department	General	127.968	442		2.969	
	Between groups	7.438	9	.826		.002
	Within groups	120.530	433	.278		
Mobile application usage times	General	127.968	442		1.771	
	Between groups	1.022	2	.511		.171
	Within groups	126.946	440	.289		

Table 6 explains that the mobile learning attitudes of prospective teachers significantly differ according to the department variable but do not significantly differ according to grade level and mobile application usage time variables. According to the department variable, there was a significant difference between the Turkish Language Education, Science Education, English Language Education, Preschool Education, Special Needs Education, Primary Education and Social Science Education dual groups. Table 7 below presents the Tolerance Values (Tolerance = 1 / VIF) and Variance Inflation Factors (VIF) of the digital literacy sub-dimensions.

Table 7

Tolerance and VIF values of digital literacy sub-dimensions

Predictive Variables	Tolerance	VIF
Attitude	.582	1.719
Technical	.398	2.510
Cognitive	.600	1.667
Emotional-Social	.463	2.162

Table 7 shows that the VIF values of the predictor variables are lower than 10 and that the tolerance values are higher than 0.20. In other words, the multicollinearity problem in terms of tolerance values and VIF values among the predictive variables is not observed (Hair, Anderson, Tatham & Black, 1998). The relationship between digital literacy levels and mobile learning attitudes of prospective teachers is given in Table 8 below.

Table 8

The relationship between prospective teachers' digital literacy levels and mobile learning attitudes

	1.Mobile learning	2.Digital literacy	3. Attitude	4. Technical	5. Cognitive	6. Emotional-Social
1. Mobile learning						
2. Digital literacy	.542**					
3. Attitude	.584**	.862**				
4. Technical	.346**	.846**	.506**			
5. Cognitive	.397**	.712**	.596**	.482**		
6. Emotional-Social	.296**	.722**	.401**	.732**	.387**	
Mean score	3.58	3.56	3.47	3.70	3.68	3.32
Standard deviation	.538	.591	.719	.649	.794	.890

**p<.01

Table 8 reveals that prospective teachers' digital literacy mean scores and attitude, technical, cognitive and emotional-social sub-dimensions are positively and highly correlated with their mobile learning attitudes. A positive and significant relationship (.542) was found between prospective teachers' mobile learning attitudes and digital literacy levels. A positive relationship was found between mobile learning and the attitude sub-dimension (.584), between mobile learning and the technical sub-dimension (.346), between mobile learning and the cognitive sub-dimension (.397) and between mobile learning and the emotional-social sub-dimension (.296). In Table 9 below, the predictive level of digital literacy levels of prospective teachers for their mobile learning attitudes is given.

Table 9

Predictive analysis of prospective teachers' digital literacy levels on mobile learning attitudes

Variables	B	Standard Error B	β	t	p
Constant	1.936	.133		14.587	.000
Attitude	.389	.038	.520	10.280	.000
Technical	.011	.051	.014	.233	.824
Cognitive	.040	.034	.059	1.184	.237
Emotional-Social	.033	.034	.055	.976	.330

**p<.01

R=.590 R^2=.348 $F_{(4,439)}$=58.507 p=.000

Table 9 explains that prospective teachers' digital literacy levels and the attitude, technical, cognitive and emotional-social sub-dimensions explain their mobile learning attitudes at a rate of 35% (R^2=.348). The significance test of the coefficient of the predictor variable based on the regression equation also explains that the level of attitude (β=.520) is a significant predictor (p<.01). According to the simple linear regression analysis carried out to reveal the extent to which prospective teachers' attitude sub-dimension explains mobile learning, there is a positive and significant relationship between prospective teachers' attitude sub-dimension and mobile learning attitudes at a rate of 35% (R=.590; R^2=.348).

4. Conclusion and Suggestions

Societies have determined their needs over time and have shown progress to meet these needs. When ancient societies are examined, it is seen that they progressed in their period in order to survive, shelter and hunt. Societies that settled down sought and found the necessary knowledge for cultivating the land. With the industrial revolution, societies turned to mechanization and production. Today, technology has taken priority in societies. In addition to technology, individuals who can follow and use these

technological developments are also needed in all areas. For this reason, it is among the needs that come with people today to use technology and to be technology-literate. One of the areas where technology is particularly effective is education. It is aimed to establish a structure that meets the needs of societies and will take societies forward with technology. The use of technology in education is in parallel with the digital literacy levels of students and teachers. Learning can be mobile, in other words, students can access lessons and information via remote technology-based access tools. Therefore, technological tools are sufficient to access information. In this study, prospective teachers' digital literacy levels and mobile learning attitudes were investigated and the effects of gender, grade level, department and mobile application usage time were revealed.

The first research question of the research aims to reveal prospective teachers' digital literacy levels. In this study, the digital literacy level mean score of prospective teachers was found $\overline{X}$= 3.56. This result shows that prospective teachers' digital literacy mean score is at a good level. In addition, when the sub-dimensions are examined, it is concluded that the prospective teachers are digitally literate at a good level in the attitude, technique, cognitive and emotional-social sub-dimensions. According to the research, it has been concluded that prospective teachers' digital literacy levels are moderate in the fields of information, communication, content creation, security and problem solving, and that learning activities can be improved by usage of information technologies (Rizal, Setiawan & Rusdiana, 2019). Although there is not enough time in the education program, prospective teachers can integrate their skills into the lesson after a short digital literacy training (Botturi, 2019). Conducting teacher education in a digital environment and making use of technology opportunities will both increase the quality of teacher education and prospective teachers will have the ability to do their job in a digital environment (Olsson & Edman-Stålbrant, 2008). The quality of digital literacy, which is an educational tool in teacher education, should be increased and considered as a basic factor (Campbell, 2016). With the perception by prospective teachers that information and communication technologies support their development, their adoption and integration is also ensured (Khalid, Parveen, Slaettalio, & Hossain, 2015). When the findings were examined, it was concluded that digital literacy is in the developmental stage and should be included more in teacher education programs, and that teacher education should be transformed into a technology-based environment. In this context, the results of this research are in parallel with previous research studies.

The second research question of the research aims to reveal prospective teachers' attitudes towards mobile learning. In this study, the mobile learning attitude mean score of prospective teachers was found to be $\overline{X}$=3.58. This result explains that prospective teachers are willing to learn using mobile devices and that mobile learning will be beneficial in education. According to the studies, mobile learning makes an important difference to the permanence of learning and academic success (Martin & Ertzberger, 2013). Prospective teachers who have high perceptions of ability and confidence also have high attitudes and readiness levels towards mobile learning. According to this result, prospective teachers' digital competencies and self-confidence should be increased (Yeap, Ramayah & Soto-Acosta, 2016). A high self-efficacy level is parallel to individuals' knowledge of the functions of mobile learning technologies and in this context, individual learning skills (Lin, Lin, Yeh & Wang, 2016). Mobile learning tools provide students with ease of communication and increase students' cooperation and academic effectiveness (Anderson, Franklin, Yinger, Sun & Geist, 2013). Mobile learning creates an independent learning environment for students (Furio, Juan, Seguí & Vivo, 2015). When the results of the research are examined, it is concluded that mobile learning will support education and contribute to the academic success of prospective teachers with mobile learning.

The third research question of the research aims to reveal the effects of gender, grade level, department and mobile application usage time on prospective teachers' digital literacy levels and mobile learning attitudes. In this study, the digital literacy level of prospective teachers creates a significant difference according to gender, grade level and department, while mobile learning attitudes create a significant difference according to the department. When the previous research studies are examined, there is a

significant difference in the competence sub-dimension of prospective teachers in terms of gender, and this difference is in favor of male participants (Yontar, 2019). In terms of the grade level of the prospective teachers, the digital literacy level of the 2nd grade students creates a significant difference compared to the other grade levels (Yazıcıoğlu, Yaylak & Genç, 2020). The digital literacy self-efficacy levels of prospective teachers also present a significant difference according to the department, and it was concluded that this difference was in favor of the computer and instructional technologies education department (Karakuş & Ocak, 2019). According to the department variable, the digital literacy levels of prospective teachers do not make a significant difference according to the evaluation results (Öztürk & Budak, 2019). When the mobile application usage time of the prospective teachers was examined, it was concluded that the duration of internet usage, the status of having internet accounts and the level of technology usage positively affected their digital literacy levels (Sarıkaya, 2019). The last problem situation of the research aims to reveal whether there is a relationship between digital literacy and mobile learning of prospective teachers and to what extent this level of digital literacy predicts mobile learning. According to the research results, there is a positive and advanced relationship between prospective teachers' digital literacy levels and mobile learning attitudes, and digital literacy explains 35% of mobile learning.

The results of this research reveal that technology is an integral part of the education system. It is concluded that prospective teachers will contribute to their education and development of technology, and that being technology-literate provides great benefits in accessing and usage information. In other words, prospective teachers care about being technologically literate and about mobile learning both in the prospective education and in-service process. In order to increase the digital literacy levels and mobile learning attitudes of prospective teachers, learning environments and course contents can be arranged according to technology, digital literacy and mobile learning skills can be included among the professional competence conditions of prospective teachers, and course activities can be integrated with technology and a technology-based education system.

References

Anderson, J., Franklin, T., Yinger, N., Sun, Y., & Geist, E. (2013). Going mobile: Lessons learned from introducing tablet PCs into the business classroom. The Clute Institute International Academic Conference. Las Vegas: ABD.

Botturi, L. (2019). Digital and media literacy in pre-service teacher education. *Nordic Journal of Digital Literacy*, *14*(03-04), 147-163.

Campbell, E. (2016). Pre-service teachers' perceptions and practices: integrating digital literacy into English education (Unpublished Doctoral dissertation). University of Cape Town, South Africa.

Churchill, N., Ping, L.Ç., Oakley, G., & Churchill, D. (2008). Digital storytelling and digital literacy learning. International Conference on Information Communication Technologies in Education, Readings in Education and Technology: Proceedings of ICICTE. Island.

Clark, R. C., & Mayer, R. E. (2008). E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning. USA: Wiley

Çam, E., Uysal, M., Kıyıcı, M., & İşbulan, O. (2019). Turkish culture adaptation of mobile learning attitude scale. *International Journal of Turkish Educational Studies*, *7*(13), 114-125.

Eshet-Alkalai, Y. (2004). Digital literacy: A conceptual framework for survival skills in the digital era. *Journal of Educational Multimedia and Hypermedia, 13*(1), 93-106.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). How to design and evaluate research in education. New York: McGraw-Hill.

Furio, D., Juan, M. C., Seguí, I., & Vivo, R. (2015). Mobile learning vs. Traditional classroom lessons: a comparative study. *Journal of Computer Assisted Learning, 31*(3), 189-201.

Gilster, P. (1997). Digital literacy. New York: John Wiley.

Grix, J. (2010). The foundations of research. London: Palgrave Macmillan.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. (1998). *Multivariate data analysis*. Prentice Hall, Upper Saddle River: NJ.

Hamutoğlu, N. B., Güngören, Ö. C., Uyanık, G. K., & Erdoğan, D. G. (2017). Adapting digital literacy scale into Turkish. *Ege Journal of Education, 18*(1), 408-429.

Karakuş, G., & Ocak, G. (2019). An investigation of digital literacy self-efficacy skills of pre-service teachers in terms of different variables. *Afyon Kocatepe University Journal of Social Sciences 21*(1), 129-147.

Khalid, S., Slaettalío, T., Parveen, M., & Hossain, M.S. (2015). A systematic review and metaanalysis of teachers' development of digital literacy. Learning International Conference on Innovations in Digital Learning for Inclusion. Aalborg University, Denmark.

Klopfer, E., & Squire, K. (2008). Environmental Detectives-the development of an augmented reality platform for environmental simulations. *Educational Technology Research and Development*, *56*(2), 203-228.

Knezek, G. & Khaddage, F. (2012). Bridging formal and informal learning: A mobile learning attitude scale for higher education. *British Journal of Social Sciences*, *1*(2), 101-116.

Lin, H. H., Lin, S., Yeh, C. H., & Wang, Y. S. (2016). Measuring mobile learning readiness: scale development and validation. *Internet Research, 26*(1), 265-287.

Manovich, L. (2001). The language of new media. MIT Press: Cambridge, Mass.

Martin, A. (2008). Digital literacy and the "digital society". *Digital literacies: Concepts, Policies and Practices*, *30*(2008), 151-176.

Martin, F., & Ertzberger, J. (2013). Here and now mobile learning: An experimental study on the use of mobile technology. *Computers & Education, 68*, 76-85.

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education, 59*(3), 1065-1078.

Olsson, L., & Edman-Stålbrant, E. (2008). Digital literacy as a challenge for Teacher Education. In IFIP World Computer Congress. Boston, MA: Springer.

Öztürk, Y., & Budak, Y. (2019). Research on preservice teachers' own perception of digital literacy. *The Journal of Kesit Academy* 5 (21), 156-172.

Seppala, P., & Alamaki, H. (2003). Mobile Learning in teacher training. *Journal of Computer Assisted Learning, 19*, 330-335.

PWC (2018). The 2018 Digital University. Retrieved from https://goo.gl/znyzi1

Rizal, R., Setiawan, W., & Rusdiana, D. (2019, February). Digital literacy of preservice science teacher. Journal of Physics: Conference Series. IOP Publishing.

Sandkuhl, K., & Lehmann, H. (2017). Digital transformation in higher education–The role of enterprise architectures and portals. Digital Enterprise Computing.

Sarıkaya, B. (2019). Evaluation of digital literacy status of prospective Turkish teachers in terms of various variables *Journal of International Social Research*, *12*(62), 1098-1100.

Trifonova, A. (2003). Mobile learning: Review of the literature. Technical Report, Department of Informatıon and Communication Technology, University of Trento.

Yazıcıoğlu, A., Yaylak, E., & Genç, G. (2020). Digital literacy levels of prospective preschool and primary school teachers. *The Journal of Social Sciences Research*, *10*(2), 274-286.

Yeap, J. A., Ramayah, T., & Soto-Acosta, P. (2016). Factors propelling the adoption of m-learning among students in higher education. *Electronic Markets, 26*(4), 323-338.

Yontar, A. (2019). Digital literacy levels of teacher candidates. *Journal of Mother Tongue Education*, *7*(4), 815-824.