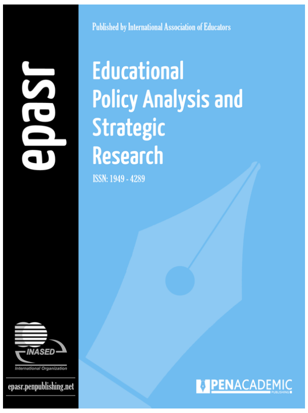

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Augmented Reality, Virtual Reality and Digital Games: A Research on Teacher Candidates

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Abstract

Virtual reality, although it is in the real world, is a three-dimensional simulation model that brings users to a different environment with computer-generated graphics, video and audio, and enables communication with the media. Virtual reality is the imitation of the physical structure from a real-world or an imaginary world in a computer-generated environment. Augmented reality is the combination of the real world with the virtual world, the creation of enriched environments using virtual objects, the combination of physical reality and digital holograms, or the creation of a virtual world suitable for the purpose by using digital products. The aim of this study is to determine the opinions of teacher candidates studying in the faculty of education in terms of augmented reality, virtual reality and digital games depending on some demographic variables. The working group of the study consisted of teacher candidates studying in different departments of the Faculty of Education of Mustafa Kemal University in 2018-2019 Academic Year. Mixed model and General survey model were used in the study. In order to determine the opinions of teacher candidates, Using Digital Educational Plays Scale was used as a data collection tool. As a result of the research, there was no statistically significant difference between the opinions of the teacher candidates about the use of digital educational games in terms of the affective component, perceived usefulness, perceived control and the scale generally in terms of the scale, however, however, it has been concluded that there is a difference in favor of women in sub-dimension of affective components. In addition, in the research, teacher candidates were not afraid to use computer, but they were afraid of playing computer games.

Keywords: Augmented Reality, Virtual Reality, Digital games, Hologram, Virtual world

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Introduction

Virtual reality and augmented reality are two technologies that are similar, but in some ways different from each other. Augmented reality is a term used to describe the direct environment of reality. Real or other virtual objects form a new real-time and complex reality and consist of several devices that add virtual information to existing physical information (Aveleyra, Racero & Toba, 2018). Augmented reality is a reality where physical reality and digital holograms are used together. In augmented reality, users see the holograms as much as the real world (Noor, 2016). Thus, objects of the real world and objects of the virtual world coexist in augmented reality.

Virtual reality is basically a set of technology and computer hardware used to create an immersive simulation of a three-dimensional environment (Neelakantam & Pant, 2017). Virtual reality is the imitation of the physical structure from the real-world or an imaginary world in a computer-generated environment. Virtual reality can be thought of as an environment that changes senses such as image and sound according to its users. Virtual reality is a simulation model that gives the participants a realistic feeling and provides mutual communication with a dynamic environment created by computers (Ozdinc, et al, 2016; Bayraktar & Kaleli, 2007). Although the users are in the real world, they are taken to a completely different environment with effects such as graphics, video and sound with computer-generated virtual reality environment (Jaros, 2018).

The idea of Virtual Reality dates to the 1930s, when different technologies and concepts first emerged. In 1929, Edward Link developed the Link Trainer, which was completely electromechanical, as the first example of a commercial flight simulator. Also, in the 1930s, science fiction writer Stanley G. Weinbaum wrote a story named Pygmalion's Spectacles, the first idea of a pair of glasses that made the wearer live a fictional world through holograms, smells, flavors and touches (Cruz-Neira, Fernandez & Portales, 2018: 1). In the 1950s, the idea of virtual reality re-emerged with Morton Heilig's Experience Theater. In this play, all the senses were tried to be revived and the audience was given the feeling of being inside the film. In 1962, Morton made a prototype like the virtual glasses called Sensorama, which has not lost its function (Aslan & Erdogan, 2017: 207). Later, Philco Corporation designed a head-mounted device, with a monitor and an eye tracker for each eye, called Headsight, but it was not released because of the high cost of the device (Hearn, 2018).

From the 1960s until today, more advanced and better equipped virtual reality glasses have been designed to be presented to users in research laboratories (Dey, Billinghurst, Lindeman & Swan, 2015). Ivan Sutherland, a software developer in the 1963, was the first to see the benefits of virtual reality and did some experimental work on this subject (Blascovich & Bailenson, 2005). The next big turning point for virtual reality was Jaron Lanier's first use of the term virtual reality in 1987. Until then, this technology had no name. In 1985, Lanier was working on a glove that would turn hand movements into virtual reality. This technology has evolved over time and paved the way for the creation of the current Oculus Rift (Hearn, 2018).

By the 1990s, the Nintendo Company developed a console called *Virtual Boy*, which provided users with experience in virtual reality games. Due to the technical limitation, this game console had a small screen. Thanks to its low-performance processors, it was able to run only simple graphics and boring games, so it wasn't favoured by users (Schmalstieg & Hollerer, 2016). Although virtual reality is used commercially, reasons such as security problems, high price, difficulty in use, freezing and health risks limit virtual reality applications. While the development of technology gets rid of some of these kinds of problems over time, the content of virtual reality will be enriched as time progresses. It still needs a long time, a lot of money and people's attention to be able to correct them all (Chin, et al, 2018).

The augmented reality was designed by Ivan Sutherland in 1968 to assist helicopter pilots as a head-mounted display system. This system consisted of three-dimensional skeletal models where only lines could be seen using computer-assisted graphics. The system was not completely virtual, projected onto a transparent glass, and the pilot could see the physical world. In fact, the main purpose of the system was to enable the pilots to make safe landings at night, and it could also monitor the eye and head movements of the users (Sundar, 2008).

In 1972, Myron Krueger discovered Video Place, a system that allows users to interact with virtual objects for the first time. In the 1990s, Rosenberg and Steven Feiner designed the first major prototype of an Augmented Reality system called KARMA. In 1994, Paul Milgram and Fumio Kishino announced that they would build a virtual reality device for constant use, and then in 1997 they designed the first mobile augmented reality system, the Touring Machine (Aveleyra, Racero & Toba, 2018). In 1997, Azuma announced to the whole world that he had separated the augmented reality from virtual reality. According to his definition, augmented reality was a technology that could combine the real world with the digital world, which allows real-time and spatial co-existence of reality and virtuality (Azuma, 1997; Azuma, Billinghurst & Klinker, 2011). Since the days when it was developed, augmented reality tools were both designed and used for entertainment purposes (Kruger, et al, 1995). In the 2000s, the AR-Quake game was launched for augmented reality technology users, and such games continued to increase in number over time (Thomas, et al, 2000).

In 2013, Google Glass designed virtual holograms in a lens over the user's eye. The designed device acts as a camera and can also display the current time, menus and web browsers (Sawyer, at al, 2014). The HoloLens device, developed in 2016, uses sensors to learn the shape of the physical environment, connect its virtual holograms to objects in the physical world, and detect the predefined hand gestures through sensors, and use the hand movements to select, move, exit, and navigate virtual holograms (Hearn, 2018).

Although some devices have been developed in the areas of virtual reality or augmented reality, virtual reality is an area in which users do not communicate with real life in any way. Users can wear virtual glassses to obtain a 360-degree view of the simulation world with special software and sensors designed in this field (Noor, 2016). Virtual reality is a multi-input output device that provides two-way information flow between the user and the virtual world (Burdea & Coiffet, 2003).

The virtual environment is usually a copy of a real environment, and it is performed with three-dimensional settings, sounds and various tools for users to interact with consoles. A user's movement is monitored using a head mounted device or using motion detection sensors (Neelakantam & Pant, 2017).

These environments are created entirely by the software developer's imagination and coding capability. Second life and openin Muve's are considered as the first international softwares to be organized according to the virtual world and capable of contributing to different areas of education (Penfold, 2009; Schott, 2012; Wang & Burton, 2013). Recently, new versions of software such as unity and unreal that can allow virtual reality games are released (Rogers, 2012). The development of softwares depends mostly on the development of the hardware with which the software will be used. The hand gestures of the users who will replace the keyboard or mouse in the real world will be created by integrating the software and hardware together (Wozniak, Vauderwange, Mandal, Javahiraly & Curticapean, 2016). Virtual reality is implemented using interactive devices such as gloves, headphones or helmets. The most famous virtual reality equipments used in the market are Oculus Rift and HTC VIVE (Dempsey, 2016; Desai, Desai, Ajmera & Mehta, 2014).

In general, augmented reality and virtual reality are not completely different topics. While virtual reality does not provide users with a visual connection to the physical world, augmented reality is created by adding virtual information to the physical world (Jaros, 2018). There are three principles of augmented reality. The first is to bring the real and the virtual together, the second is to interact in real time, and the third is the three-dimensionality (Azuma, 1997).

Recently, there has been an increasing interest in augmented reality. Especially wearable augmented reality devices, with Google glasses, have become very attractive to users. Google glasses using computer-assisted graphics by creating holograms in front of users' eyes (Tseng-Lung & Feng, 2014), give holograms the feeling as if they are flowing in front of the eye. Thanks to these Google glasses, messages can be sent to the users via smart wifi or bluetooth, and directions can be given to the users. In addition, video and photo shooting can be done with the camera (Muensterer, Lacher, Zoeller, Bronstein & Kubler, 2014). Another device is HoloLens developed by Microsoft. HoloLens means that it does not cover the user's entire field of view; instead it displays holograms around the user's physical environment based on where the user is looking.

There are many uses of virtual reality and augmented reality. Virtual and Augmented Reality technology can be used comfortably in areas such as education, engineering and entertainment (Dey, Billinghurst, Lindeman & Swan, 2018). Blascovich & Bailenson (2005) stated that virtual reality can be used in choreography, golf, health education and flight simulations, as well as by playwrights, filmmakers and educators, in physical exercises such as psychological therapy and exercise.

Virtual reality is also used in many areas such as video games, engineering, education, psychological therapy, e-commerce, marketing and art. Virtual reality is used to create a realistic digital environment in digital games, especially in first-person games. With mechanical modeling using both computer-assisted design software in engineering and education, it allows engineers and students to manipulate and develop the models they design as if they were working with a physical object (Neelakantam & Pant, 2017). Virtual reality is also used in medicine. In addition to the development of medical care, virtual reality is used to improve training given to soldiers. Virtual reality helps scientists in defeating patients' fears and making explanatory therapy (Hearn, 2018).

Digital games were first produced for entertainment purposes and after the realization of its effect, it was started to be used in the field of military and education with the help of simulations, respectively (Celen, Celik & Seferoglu, 2011). Digital games used in medical education have been also used in primary, middle and high school and even in pre-school education. The first digital games were produced educationally in the 1990s. These games are not used much in schools as they support the development of operational knowledge instead of conceptual teaching. Microsoft, in the 2000s, produced educational digital games about health, engineering, disaster management, education, policy, etc. in many areas. However, these games are too expensive to be used at the desired level of educational institutions.

There are two reasons why digital games are not preferred at the desired level. The first of these is that the designed digital games are usually designed by computer engineers or software developers, not by the help of experts in the field of education (Connolly, et al, 2012), and these games are usually designed to give simple skills such as addition and multiplication. The second reason is that teachers and parents have negative perceptions about digital games. In addition, teachers who have worked in the profession for many years have low perceptions about educational digital games (Valkcke, et al, 2011). The reason for this is that the educational digital games are used together with the concept of addiction and this situation is exposed to the negative point of view of parents and teachers (Aktas-Arnas, 2005).

Despite all these negative perspectives, digital games have many benefits to students in terms of education in particular, students can gain new concepts and skills (Li, et al, 2014), it can can increase students' motivation and perceptions of the course and students can follow their lessons fondly (Castellar, All, Marez & Looy, 2015). The best examples are in the interest and participation of the students. Normally, the attention and motivation of the students is reduced after 15-20 minutes (Bonwell & Eison, 1991). However, it has been proved in the researches that digital games increased the interest and motivation of the students over 30 minutes (Ravenscroft, 2007).

The concept of digital games in education programs facilitates the teaching of many lessons and subjects such as history, geography, language education, physics, chemistry, biology and mathematics (Beak, 2013). In addition to these contributions, they have a positive effect on the desired skills development such as creativity, problem solving, cooperative learning and critical thinking of students (Hwang & Wu, 2012). Especially for critical thinking, structuring knowledge and problem-solving skills (Kapp, 2007), its contribution to the creation of the most appropriate teaching environments to facilitate learning is quite high (Ebner & Holzinger, 2007). Because of these features, digital games can be used easily in student-centered education.

There are many studies on how digital games weaken social communication. However, a well-designed digital game can become an important tool that positively affects social learning (Kauchak & Eggen, 2003). Digital games can develop learning through cooperative learning, self-regulated learning and learning by doing, which are elements of social learning (Vos, et al, 2011).

When digital technologies are evaluated cumulatively, virtual reality, augmented reality and digital games are becoming increasingly important in educational terms. Developments in these technologies, which are ever increasing in variety, provide increasingly greater opportunities for students and educators especially in the field of education and provide numerous learning opportunities to learners with virtual learning (Huang, et al, 2016). In fact, according to some researchers, virtual reality and augmented reality technologies will soon replace the standard materials (computers, classrooms, schools, etc.) and change the educational system from the ground up (Rozinaj, et al, 2018). For this reason, the number of studies on virtual reality is increasing in almost all areas of education (Bacca, et al, 2014). Already since the 2000s, virtual reality technology has also been used as a means of supporting the education process.

Every learner has his/her own style of learning. For many users, virtual reality can be a very effective learning tool. Especially when visual, real world and verbal information are brought together, virtual reality can create the most effective learning environments (Brazley, 2018). Educators especially think that virtual reality tools will be one of the most effective tools that will provide learning through experience in the future (Niju, et al, 2018). In addition, devices designed based on virtual reality and augmented reality support the principle of learning by experiencing the constructivism approach. Moreover, the virtual reality environment also creates authentic content that allows users to format, share, and enhance the scope of learning (Häfner, et al, 2013).

Virtual reality and augmented reality technologies will increase student-student and student-teacher interaction and communication as opposed to what is believed (Brazley, 2014). Global videos can capture and record images from all directions. Interactive global video-based virtual reality applications can provide new pedagogical advantages to teachers. In this way, teachers can see every movement of the students and obtain more information about the student's personality, temperament and learning situation. In addition, students can examine themselves in more detail by watching the virtual records of how they worked or learned. In general, virtual reality can create educational environments that enable students to interact with each other and with other students during activities.

It is believed that virtual reality will visualize the abstract concepts of students and observe the events in atomic and planetary scales (Youngblut, 1998). Through virtual reality tools, history students can walk through the streets of ancient Greece, biology teachers can learn about human physiology by navigating through human organs and vessels, exploring people in the past, present, and future events (Rickel, 2001). Virtual reality brings the environments where people cannot go, see and feel to their feet, and thus enriches the teaching and learning styles in education (Pan, et al, 2006). In some studies from the literature, the benefits of this technology and its contribution to education are highly mentioned. It has also been stated that it benefits students in understanding abstract concepts in science and in understanding mixed learning activities (Ragan, et al, 2012). Abbasi, et al, (2017) compared augmented reality and traditional education method for critical thinking in chemistry education, and at the end of the study, it was concluded that the students who received augmented reality education were more successful than the students who received traditional education.

In addition to mathematical courses, virtual reality also contributes to linguistics courses. In a study conducted by Vázquez, et al, (2018), it was determined that the language education performed in virtual reality environment or with virtual reality tools was more successful than the traditional language education made with paper, pencil and notebook only. It is also known that spatial presentations in virtual reality have a positive effect on students. Due to the nature of this spatial visualization, students need to see and interact with the 3D scenes as soon as possible to make sense of this 3D model. Virtual reality tools can also display 3D objects, and virtual spatial presentations are more instructive for students (Brazley, 2018). In the studies, it was found that spatial presentations and 3D vision improved the memory of the individual. In a study by Ragan, et al, (2012), virtual reality has been shown to strengthen memory through spatial presentations.

Virtual reality tools do not only affect learning but also affect student attitudes. In some researches, it has been determined that this technology has a positive effect on attitudes such as motivation, interaction and cooperation. Virtual reality is an important factor to improve cooperation among students (Huang, et al, 2016). In addition, augmented virtual reality increases the participation of students in the classroom and enables students to develop positive attitudes towards the course (Bacca, et al, 2014). Studies have shown that augmented reality in the classroom can be used as an advanced learning tool and that students can increase their motivation to learn positively (Vate-U-lan, 2012).

One of the most important features of virtual reality is its security feature. Security is also important in schools as in workplaces. Particularly, science laboratories are the places where most fatal or injured accidents occur in schools (Chin, et al, 2018). Therefore, thanks to the laboratories arranged in a virtual reality environment, misconceptions resulting from education will be prevented and the risks of accidents will be eliminated.

The virtual learning environment not only provides rich teaching patterns and teaching content, but also helps students develop their ability to analyze problems and explore concepts. Virtual reality constitutes a shareable virtual learning area accessible to all students living in virtual societies integrated with interactive, integrated and imaginary advantages (Pan, et al, 2006).

In general, virtual reality content is collected under four main features. According to Rickel (2001), these features;

1. It provides an integrated learning resource, including tools to help access learning resources, assessment and guidance.

2. It enables the communication through community's communication e-mail, group discussion, internet connectivity and social media.

3. Being active. Students actively participate in the education with the action function. With virtual reality, students are not just accepting information. They are the ones who are asking questions, answering questions, providing information and analyzing concepts.

4. Facilitating tools help map the program elements. By evaluating and recording these elements, students can evaluate the success of these elements.

Potentially, this technology can both inspire students' motivations and increase their learning performance. However, teachers' willingness to learn or use this technology remains unclear. Therefore, teachers are the biggest obstacle to using this technology in the classroom. In fact, there are cases where teachers are right. Even though augmented reality and virtual reality tools are on the market, security problems, high price, difficulty in use, errors due to software, health risks, etc., limit the application of augmented reality and virtual reality technology. The development of technology can solve some of the problems. As time goes by, the content of augmented reality and virtual reality will increase and prosper. But it still needs a lot of money, time and people's attention (Chin, et al, 2018).

Despite all the studies, many software related to virtual reality and augmented reality being designed, the use of this technology in educational environments is still in its infancy (Bacca, et al, 2014). Virtual reality and augmented reality can be used in many different areas but can also lead to very large changes and problems, especially in the field of education. Because our educational institutions are designed in accordance with the industrial age instead of digital age. Therefore, teachers still have difficulty in adjusting new courses according to current cultural and social values (Bates, 2015). This will inevitably affect teacher training and will require teachers to re-organize their lessons according to the new system (Niju, et al, 2018). According to Regan (2012), although there is considerable consensus that these technologies will make a great contribution to education, there is still little research on how learning can be done or how it should be done.

Method

Research Problem

What is the level of teacher candidates' views on Augmented Reality, Virtual Reality and Digital Games? Do teacher candidates' views about Augmented Reality, Virtual Reality and Digital Games differ in terms of gender, type of program, and class level demographic variables?

Research Model

For this purpose, the Use of Digital Educational Games Scale, which was developed by Bonanno & Kommers, (2008) and was adapted to Turkish and by Sarigoz, Bolat & Alkan, (2018) with a high correlation (r=092; p<.01) was used as a data collection tool.

Affective Component: The affective component expresses the feelings of fear, hesitation and uneasiness experienced by the individual before and during game.

Perceived Usefulness: Perceived usefulness includes behaviors that arise from an individual's beliefs about the advantages of using educational games.

Perceived Control: Perceived control expresses emotions and reactive behaviors of an individual while manipulating technological tools (using educational games). These skills include the ability to self-learn skills related to the task, control skills when using gaming tools and software, and the degree to which they can help others in carrying out the desired tasks.

Behavioural Components: It includes the positive behaviors that demonstrate the willingness to play educational games and the negative behavior of avoiding playing games.

The Turkish adaptation of the scale to use in studies from Turkey is done by Sarigoz, Bolat & Alkan (2018). The adaptation studies of the scale were carried out with 150 undergraduate students (65.7% female; 34.3% male) studying at Mustafa Kemal University Faculty of Education. The scale's Kaiser Meyer Olkin test result was 0.782 and Barlett's Sphericity Test result was (X_2 = 1223.40; p = 0.00). In the results of the analysis, the self-value of the scale is 4 factors greater than 1.0 and the variance explained by these four factors is 45,934% of the total variance. When Cronbach Alpha reliability coefficients of 4 factors are examined, it was found that the reliability coefficient of the ‘Affective Component’ sub-dimension was 0.79, the reliability coefficient of the ‘Perceived Usability’ sub-dimension was 0.77, the reliability coefficient of the ‘Perceived Control’ sub-dimension was 0.79 and the reliability coefficient of the ‘Behavioral Components’ sub-dimension was 0.80. The internal consistency of the scale was 0.88. In order to determine the reliability by test-retest method, the scale was applied to 30 participants at two weeks intervals and the test-retest reliability of the scale was found to be 0.78.

The responses of the participants to the scale based on the demographic variables were calculated by using T-test and one-way ANOVA test with SPSS 20 statistical package program. The items which are negative from the scale items were calculated by reversing. The scale used in the study consists of 21 items in five-point likert type (0) Strongly disagree, (1) Disagree, (2) Undecided, (3) Agree, (4) Strongly agree. The general evaluation of the scale used in the research is as follows (Uzunboylu & Sarigoz, 2015):

$$SA = \frac{EYD - EDD}{SS} = \frac{5-1}{5} = 0.8$$

SI: Scale Interval

MV: Maximum Value

LV: Lowest Value

NO: Number of Options

0.00 - 0.80: Strongly Disagree

0.81 - 1.60: Disagree

1.61 - 2.40: Undecided

2.41 - 3.20: Agree

3.21 - 4.00: Strongly Agree

General surveying model, which is one of the mixed method and descriptive surveying methods, was used in the study. Mixed-method research is defined as the combination of qualitative and quantitative methods, approaches and concepts in a study or consecutive studies (Creswell, 2003; Johnson & Onwuegbuzie, 2004). The general survey model is the surveying arrangements carried out overall or a sample taken from the whole or a group of the universe in order to make a judgment about the universe of many elements (Karasar, 2010: 79).

Findings

In this section, depending on the gender, program type and class level demographic variables, the opinions of teacher candidates on Augmented Reality, Virtual Reality and Digital Games were tried to be determined. In addition, the responses of the teacher candidates to the scale items were tabulated and interpreted.

Table 1. The t-test analysis results of teacher candidates' answers to The Use of Digital Educational Games Scale in terms of the gender variable.

Sub-dimensions	Gender	N	$\overline{X}$	Sd	Df	-t	p
Affective Component	*1. Female*	451	24.45	2.82	740	1.00	.316
	2. Male	291	24.24	2.77			
	Total	742					p>0.05
Perceived Usefulness	*1. Female*	451	19.99	2.69	740	.70	.486
	2. Male	291	20.12	2.36			
	Total	742					p>0.05
Perceived Control	*1. Female*	451	24.70	2.69	740	1.70	.091
	2. Male	291	25.06	2.91			
	Total	742					p>0.05
Behavioral Components	*1. Female*	451	16.66	2.01	740	1.99	.047
	2. Male	291	16.35	2.13			
	Total	742					p<0.05
General	*1. Female*	451	85.80	6.97	740	.06	.953
	2. Male	291	85.77	7.00			
	Total	742					p>0.05

From the analysis of the data in Table 1, depending on the gender variable, from the answers of the teacher candidates who participated in the research to the Use of Digital Educational Games Scale; in terms of affective component, perceived usefulness, perceived control and overall scale, there was no statistically significant difference between the views (p> .05) of using digital educational games. This shows that the views of teacher candidate participated in the research on using digital educational games are the same or similar. However, it was concluded that there was a significant difference in opinion among the teacher candidates in the research, in favor of females, from the responses to the behavioral components sub-dimension. Behavioral components refer to positive behaviors that demonstrate willingness to play and reluctant behavior to avoid the game. Therefore, from the research data and interviews with female teacher candidates, it is concluded that female teacher candidates are more reluctant to play educational digital games than male teacher candidates.

Table. 2. Anova test analysis results of teacher candidates' answers to the Use of Digital Educational Games Scale in terms of the program type variable.

	Program Type	**N**	**$\bar{X}$**	**Sd**	**Source of Variance**	**Sum of Squares**	**Sd**	**Squares Avg.**	**F**	**p (Tukey)**
Affective Component	*1. ST*	128	24.53	3.08	Betw. gr.	9.21	3	3.07	.39	.761
	2. TLT	211	24.46	2.74	With. gr.	5817.61	738	7.88		
	3. ELT	140	24.30	2.88	*Total*	5826.82	741			
	4. CT	263	24.26	2.68				p>0.05		
Perceived Usefulness	*1. ST*	128	20.31	2.34	Betw. gr.	38.74	3	12.91	1.97	.118
	2. TLT	211	19.71	2.60	With. gr.	4848.97	738	6.57		
	3. ELT	140	20.01	2.46	*Total*	4887.71	741			
	4. CT	263	20.19	2.69				p>0.05		
Perceived Control	*1. ST*	128	25.32	2.47	Betw. gr.	140.93	3	46.98	6.19	.000
	2. TLT	211	25.29	2.83	With. gr.	5600.99	738	7.59		*1-4; 3-4*
	3. ELT	140	24.62	2.36	*Total*	5741.92	741			
	4. CT	263	24.36	3.01				p<0.05		
Behavioral Components	*1. ST*	128	16.54	2.05	Betw. gr.	238.15	3	79.38	20.09	.000
	2. TLT	211	16.78	1.80	With. gr.	2916.29	738	3.95		*2-1;4-1*
	3. ELT	140	15.40	2.34	*Total*	3154.44	741			
	4. SÖ.	263	16.95	1.90				p<0.05		
General	*1. ST*	128	86.70	7.05	Betw. gr.	449.08	3	149.69	3.10	.026
	2. TLT	211	86.24	7.25	With. gr.	35632.70	738	48.28		*1-2*
	3. ELT	140	84.33	6.64	*Total*	36081.78	741			
	4. CT	263	85.76	6.82						
	Total	742	85.79	6.98						p<0.05

From the analysis of the data in Table 2, as a result of the Anova test conducted based on the answers of the teacher candidates to the Use of Digital Educational Games Scale, it was determined that there was no statistically significant difference between the cognitive component and the perceived usefulness subscales from the subdimensions of the scale. (p> .05). However, it was determined that there was a statistically significant difference (p <.05) between Perceived control, Behavioral components and Overall scale with respect to teacher candidates from different departments. From the results of the Tukey's test to learn the source of this difference;

Regarding the perceived control sub-dimension of the scale; there was a statistically significant difference (p <.05) between the students in the Department of Turkish Language Teaching (TLT) and the students in the Department of Classroom Teaching (CT) in favor of the students from Department of Turkish Language Teaching; there was a statistically significant difference between the students from the Department of English Language Teaching (ELT) and the students from the Department of Classroom Teaching in favor of the students from the Department of Classroom teaching (p<.05).

Regarding the Behavioral components sub-dimension of the scale; there was a statistically significant difference in opinion (p<.05) between the students from Turkish Language Teaching, Classroom Teaching and Science Teaching (ST) in favor of the students from Turkish Language teaching and Classroom teaching; there was a statistically significant difference (p<.05) between the students of Science teaching and English language teaching in favor of students from Science teaching.

In terms of Overall scale; It was found out that there was a statistically significant difference (p<.05) between the teacher candidates studying in the departments of Turkish Language Teaching and Science Teaching in favor of teacher candidates from Science teaching.

Table. 3. Anova test analysis results of the answers of the teacher candidates to the Use of Digital Educational Games Scale according to the grade level

Sub-dimension	Program Type	N	$\bar{X}$	Sd	Source of Variance	Sum of Squares	Sd	Squares Avg.	F	p (Tukey)
Affective Component	*1. Grade*	197	24.61	2.62	Betw. gr.	45.74	3	15.25	1.95	.121
	2. Grade	185	24.52	2.73	With. gr.	5781.08	738	7.83		
	3. Grade	178	24.37	2.92	*Total*	5826.82	741			
	4. Grade	182	23.96	2.94				p>0.05		
Perceived Usefulness	*1. Grade*	197	20.19	2.50	Betw. gr.	200.60	3	66.87	10.53	.000 *1-4; 2-4;3-4*
	2. Grade	185	20.54	2.36	With. gr.	4687.11	738	6.35		
	3. Grade	178	20.26	2.55	*Total*	4887.71	741			
	4. Grade	182	19.16	2.67				p<0.05		
Perceived Control	*1. Grade*	197	24.43	2.90	Betw. gr.	150.44	3	50.15	6.62	.000 *3-1;3-4*
	2. Grade	185	24.90	2.62	With. gr.	5591.48	738	7.58		
	3. Grade	178	25.57	2.79	*Total*	5741.92	741			
	4. Grade	182	24.51	2.68				p<0.05		
Behavioral Components	*1. Grade*	197	16.44	2.22	Betw. gr.	29.75	3	9.92	2.34	.072
	2. Grade	185	16.82	1.91	With. gr.	3124.70	738	4.23		
	3. Grade	178	16.62	1.88	*Total*	3154.45	741			
	4. Grade	182	16.28	2.18				p>0.05		
General	*1. Grade*	197	85.67	6.63	Betw. gr.	1018.32	3	339.44	7.14	.000 *2-4;3-4*
	2. Grade	185	86.78	7.01	With. gr.	35063.46	738	47.51		
	3. Grade	178	86.82	6.88	*Total*	36081.78	741			
	4. Grade	182	83.91	7.07						
	Total	742	85.79	6.98						p<0.05

From the analysis of the data in Table 3, As a result of the Anova test done with the answers of teacher candidates to the Use of Digital Educational Games Scale, it was determined that there was no statistically significant difference between the Affective components and Behavioral components sub-dimensions (p> .05). However, it was found that there was a statistically significant difference in opinion (p <.05) among the teacher candidates who were studying in different grades for Perceived Usefulness, Perceived Control and Overall Scale. From the results of the Tukey's test to learn the source of this difference;

Regarding the perceived usefulness sub-dimension of the scale; between the 1st, 2nd, 3rd and 4th grades, there was a statistically significant difference (p<.05) among teacher candidates in favor of 1st, 2nd and 3rd grades. Regarding the perceived control sub-dimension of the scale; there was a statistically significant difference in opinion (p<.05) among teacher candidates in the 1st, 3rd and 4th grades in favor of teacher candidates studying in the 3rd grade. Regarding the Overall scale; between the 2nd, 3rd and 4th grade teacher candidates, there was a statistically significant difference (p<.05) in favor of teacher candidates studying in the 2nd and 3rd grades.

Table. 4. Arithmetic averages and skill levels of teacher candidates' responses to the Use of Digital Educational Games Scale

The Use of Digital Educational Games Scale	$\bar{X}$	Skill Level
AFFECTİVE COMPONENT		
5. I hesitate to use an educational digital game with the concern that I might look stupid.	3.26	Strongly Agree
20. Educational digital games bother me.	3.24	Strongly Agree
8. I'm not nervous when I use an educational digital game.	3.13	Agree
12. Playing educational digital games doesn't scare me in any way.	3.06	Agree
When I'm given the opportunity to play a popular digital game, I get scared that I'll have trouble navigating through the game.	2.90	Agree
16. I hesitate to use the computer to play games because I'm afraid to make mistakes that I can't fix.	2.83	Agree
PERCEIVED USEFULNESS		Agree
21. Educational digital games provide opportunities for more efficient learning.	3.14	Agree
13. We can also obtain many other achievements, which we can obtain from an educational digital game, in other ways.	3.03	Agree
6. Educational digital games that requires extra effort enrich our learning experience to a degree.	3.01	Agree
2. I'm working better because educational digital games make me feel better.	2.95	Agree
17. Educational digital games offer more interesting and creative ways to learn.	2.91	Agree
PERCEIVED CONTROL		
3. I can learn a lot of information I need to know about a digital game on my own.	3.29	Strongly Agree
7. When I play games on the computer, I have difficulty controlling the game completely.	3.24	Strongly Agree
9. When playing an educational digital game, I can do what I want on the computer.	3.17	Agree
19. I need someone to tell me the best ways to use an educational digital game.	3.10	Agree
11. I need an experienced person with me when using an educational digital game.	3.06	Agree
15. When I encounter a problem using an educational digital game, I can usually solve that problem in one or more ways.	2.94	Agree
BEHAVIORAL COMPONENTS		
18. I will regularly use educational digital games throughout the school years.	3.33	Strongly Agree
10. I only play educational digital games when told to do so.	3.22	Strongly Agree
4. I find it hard to learn if a subject is taught with digital games.	3.18	Agree
14. I avoid playing educational digital games.	2.82	Agree

**General Arithmetic Average of the Scale: 3.09 (Agree)*

Table 4 shows the arithmetical averages and skill levels of the answers of teacher candidates studying at the Faculty of Education to the Use of Educational Digital Games Scale. Examining responses to scale items, the *highest* arithmetic means of the responses given to the sub-dimensions of the scale are as following; teacher candidates avoiding playing digital games, being hesitant, playing only when they are told and having enough knowledge about digital games. In addition, in interviews with teacher candidates on educational digital games;

Related to the topic, they said '*It is necessary that students play such educational games rather than teachers. This way, students' motivation and attention will be increased. As they learn by having fun, their morale and their academic success will increase… (SAB25)'*.

In parallel with the responses of the teacher candidates to the scale, the teacher candidates emphasize that they can learn about the digital games themselves. Regarding this, a teacher candidate said *'Learning the content of educational games is not difficult. When I examine a game, I can also learn about what needs to be learned on this subject…(SAE8)'.*

Although some teachers' fears of digital educational games have been determined with the help of a scale, teacher candidtaes think that they can use digital educational games to obtain fruitful results for learning. Regarding this finding, a teacher candidate said, '*Digital educational games may have dangerous and problematic points. However, when used correctly, it can provide positive environments for learning to take place. Students can learn more easily and quickly…(SAB33)'*.

In this research, it has been found that these games increase the motivation of the learner and provide a comfortable learning environment for the learner. Regarding this, a teacher candidate said '*Having lots of fun playing digital educational games. This situation makes me very comfortable. A comfortable learning environment increases my desire for learning. For this reason, I find educational games quite successful in terms of teaching…(SAB5)'*.

When the responses to the scale items are examined, the item with the lowest arithmetic mean is as following; teacher candidates avoiding playing digital games. *Regarding this, a teacher candidate said 'I don't know. Educational digital games make me uncomfortable. I need help while playing these games…(SAE17)'. Another teacher candidate said 'I believe educational games will be useful. I do not believe that it will create a negative situation for the student when used consciously…(SAE1)'*.

When faced with a problem using digital games, it was found out that teacher candidate's fear that they would not be able to solve the problem. Regarding this, a teacher candidate said *'Digital games don't give me confidence. I don't know what to do if I run into a problem playing games. These problems can also make educational games a problem. I think educational games are quite difficult to control…(SAE19)'*. In addition, prospective teachers are afraid to make hard-to-fix mistakes while playing digital games, and that they avoid playing digital educational games. From the interviews with teacher candidates to find out why, among the reasons for the low scores of these items, these should be thought as reasons: when sitting in front of the computer to play digital educational games, such games will become addictive over time, they will spend a lot of time to solve the problem when they encounter one, and they do not have much knowledge about the computer to solve the problem when they encounter one.

Conclusion and Recommendations

In this study, basic information about virtual reality, augmented reality and digital games are given and the opinions of teacher candidates on using digital educational games are tried to be identified. At the end of the study, the opinions of teacher candidates about the digital games were examined in terms of gender, grade level and department type variables and the relations between these variables were tried to be identified.

In the research, a significant difference was found in the behavioral components sub-dimension of the scale in favor of female teacher candidates in terms of the gender variable. Behavioral components refer to positive behaviors that demonstrate willingness to play and reluctant behavior to avoid the games. Therefore, from both research data and interviews with male and female teacher candidates, it is concluded that male teacher candidates are more reluctant to play educational digital games than female teacher candidates. This is due to the fact that male teacher candidates are more interested in other digital games than educational games. Therefore, male teacher candidates should be informed more about educational games.

Significant differences were found in the perceived control and behavioral components dimensions of the scale in terms of type of the program. Perceived usefulness is the beliefs about the advantages of using educational games while the behavioral components are the positive and negative behaviors of the individual to play the educational games. Therefore, all pupils should be provided with sufficient basic knowledge and training about educational games, so that the students' behaviors towards educational games and using educational games should be positively changed.

When the research data were examined in terms of the overall scale, it was determined that teacher candidates avoided playing digital games, hesitated, played only when told, feared that they would not be able to solve the problem when faced with one when using digital games or feared to make mistakes that is hard to fixed. In order to learn the reasons of these negative thoughts, interviews were made with teacher candidates. Based on the interviews, the basis of the negative thoughts of teacher candidates are as follows; when they sit in front of the computer to play digital educational games, such games will become addictive over time, they will spend a lot of time to solve the problem when they encounter one, and they do not have much knowledge about the computer to solve a problem when they experience one. To save the students from these thoughts, help should be taken from the necessary disciplines such as psychological counseling and guidance and the students should be freed from these thoughts.

In recent years, the research and development processes of virtual retina viewers, bionic contact lenses, holograms, mobile applications and smart glasses have been continuing at a great pace and are gradually being used in various fields. At this point, it is aimed to integrate augmented reality, especially human computer interaction, and to develop more advanced applications and devices, and in the near future it is expected that augmented reality technology will be used as a normal part of daily life (Altinpulluk & Kesim, 2015). For this reason, virtual technologies and augmented reality environments should be created very quickly in education.

As the learning is carried out in a virtual reality, as the students are driven to a more active learning process, as the attention and motivation increases, as the opportunity to work freely is provided, the learning is realized faster, and the students' upper thinking skills will increase, thus the success in education increases. Therefore, educational digital technology should be used effectively in education.

There are two important factors limiting the use of this technology in education. The first of these; to use digital technology in education, a serious economy is needed for the creation of infrastructure, equipment needs, software and hardware. The second is dizziness, nausea, headache or physical problems that can occur in students who are too much in technology. The first of these situations can be solved with time, and the second can only be solved by various measures to be taken by the individual and the family.

In order to be able to apply this technology in education, in-service trainings bout this technology should be given to teachers in schools and to instructors in universities so that individuals who know and are prone to technology should be trained, and the benefits and harms of this technology should be taught to all educators thoroughly.

Educational environments with virtual reality and augmented reality should be provided for students with difficulties in learning or with distractions. Thus, an effective and efficient learning environment to be provided to students with poor perception, their success in education should be raised.

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