Teachers' Tendencies of Using Digital Games and Creative Thinking

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Abstract

In today's digitalized era, children's internet accessibility is increasing, impacting their habits, learning pace, and creativity. Recognizing creativity as a blend of skills, attitudes, and dispositions, it becomes pedagogical responsibility to guide children in utilizing digital games consciously, given their growing leisure activity status. Teachers play a pivotal role in this guidance, necessitating extensive knowledge of digital applications and games for effective integration into education. This study aims to explore the correlation between demographic variables and the utilization of digital games alongside creative thinking tendencies among mathematics teachers. Employing a quantitative research approach, the study adopts a descriptive survey design, focusing on the digital game usage and creative thinking inclinations of 70 mathematics teachers in Eastern Anatolia during the 2022-2023 academic year. Results indicate that younger and less experienced teachers demonstrate higher engagement with digital games, while older and more experienced counterparts exhibit superior creative thinking skills. This suggests younger generations' adeptness with digital tools for teaching. Study recommendations include enhancing the emphasis on digital games in teacher training, equipping candidates with 21st-century skills, and prioritizing metacognitive skills relevant to contemporary demands.

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Introduction

In a world that is becoming more digital day by day, people's opportunities to access the internet are also becoming easier. This situation greatly affects people's habits and learning speed. Digitalization in education is inevitable for the new generation who is introduced to the digital world and frequently uses technological tools in their daily lives. Therefore, the developments in technology and the use of educational digital games in the education process are parallel (Sardone & Devlin-Scherer, 2010), and the frequency of use of information technologies (Durak & Seferoğlu, 2018) facilitates the integration of educational games with the learning process (Furio et al., 2013). The fact that new generation students, called Generation Z, frequently use technology in their daily lives shows that the integration of educational games and education is necessary and that this process will be easy (Aldemir-Engin, 2022).

It seems that textbooks, encyclopedias, libraries and teacher notes used in the teaching process are among the necessary resources that can be used, but they are insufficient (Prensky, 2008). In this regard, especially in recent years, different and new teaching approaches have been developed to update and develop the knowledge, talents and skills of new generations and to prepare them for the current challenges of the industrial world (Hauge & Riedel, 2012; Perinia et al., 2018). Interactive learning environments, which have been used in different types in recent years to support the development of advanced production skills, raise students' awareness of the challenges of the modern world and enable them to explore, are quite different from traditional teaching methods (Dessouky et al., 1998). The new approaches developed can easily enable the use of technology and the design of complex learning experiences (Mavrikios et al., 2013; Perinia et al., 2018).

Among interactive learning environments, undoubtedly one of the first methods that comes to mind is teaching with games. Game can be defined as a means of learning, producing, gaining experience, communicating and being competent (Razon, 1993). In addition, games, which are both a part of and a reason for producing, make it easier for a person to express him/herself, relax him/her and encourage him/her to discover new things (Morgül, 1995). Street games have diversified over time related to developing technological tools and the internet network. It is played with modern game materials thanks to electronic toys, individual computers and game consoles. According to Aksoy & Küçük-Demir (2019), in recent years, contemporary play materials have attracted the attention of not only children but also researchers. In today's world, in addition to traditional games, new games that allow use on technological devices or the internet have been included in the education process. These games are called digital games (Prensky, 2001).

Through learning through digital games, students can be willing to participate in the process and learn through hidden learning through different teaching methods (Çatak, 2011). According to Dellos (2015), educational digital games are a modern form of game-based learning that educators use to involve students in meaningful and entertaining activities. It is also said that the process of processing the necessary information with the help of digital games shifts from verbal to visual. (Gros, 2007). Digital games include PC games, console games, huge online games, mobile games, and social games. Mobile games are among the games designed for portable mobile devices such as tablets or phones (Ilgaz-Büyükbaykal & Abay-Cansabuncu, 2020). It can be said that the mobile gaming industry has grown rapidly in recent years, in parallel with the rise in the use of smartphones and tablets. It is also known that game developers market games of different genres in virtual markets where mobile game downloads are made (Altuntaş & Karaarslan, 2017).

Effective teaching through digital games requires that both content design and earnings are properly transferred to educational digital games. Because effective content design is crucial to the success and effectiveness of digital game-based learning. (Hong et al., 2009). Digital games produced with educational content also support students' learning while they are having fun (Great & Annual-Ince, 2021). Various studies have shown that ignored student characteristics and learning-enhancing interfaces that are not properly integrated into

the digital game-based learning environment have negative consequences in terms of motivation and success. (Komalawardhana et al., 2021). Also, curricula and games may fail to be properly combined in many educational games. For this reason, a positive development in terms of motivation may not be seen (Wechselberger, 2009).

Researches show that the new generation has better visual literacy skills and that learning processes with digital games are more interesting and effective than traditional education (Chaudhary, 2008). In addition, digital-based activities that make learning fun can enhance the effectiveness, motivation, interest and incentives of teaching, and encourage learning everywhere and anytime. Digital games are said to boost the player's motivation in problem-solving and empathy, which enhances learning. (Aleksic, 2018; Perinia et al., 2018). Through digital games, individuals provide real-time feedback for self-assessment, enabling students to understand where they need to improve (Coller & Scott, 2009). These games allow for reflective practice, clarify the goals of the learning activity and the expected results (Avramenko, 2012). It also develops visual intelligence and acquires a variety of skills required in some professions (e.g. piloting). (McKinley et al., 2011; Prensky, 2001). It helps people with learning difficulties due to attention problems. It constantly promotes creativity and problem-solving by representing an ideal environment for discovering, developing and testing new ideas (Hung & Leon, 2005).

Creativity is one of the skills of the 21st century, and especially for R&D and innovation, which are currently the keywords of business. More than one definition of creativity can be found, including Rouqette's (1992) expression that the individual is the fusion of the concepts of pressure, process and product. Stewig (1985) pointed out that there should be a product that had never been met before. Educational institutions that prepare individuals for the future also emphasize the ability to evaluate and develop the creativity of individuals (Shahin, 2003). Learning leaves its place, along with other skills, to developing the creativity, the most important skill that will highlight the individual. To increase the level of creative thinking, qualities such as thinking, motivation, participation, imagination, relative freedom, and independent thinking are very important (Idris & Nor, 2010).

In the educational process, educational digital games are used primarily and effectively by teachers. So the awareness and ability to use technological tools is important for teachers. To prepare the Z generation for the new world order, teachers need to be equipped with digital educational games to increase their interest and motivation. (Ustabulut & Kana, 2021).

Importance of the Research

Turkey's primary education programs have begun to give more space to digital games due to changes made in the 2005-2006 educational year (Kaytanlı, 2011). The results of research with digital math games have shown that educational digital games have improved mathematics teaching and have great potential (Akcanca & Sömen, 2018; Alyaz & Akyıldız, 2018, Dönel-Akgül & Kisić, 2020; İnal & Korkmaz, 2019; Özer, 2020, Tuğrul et al., 2014; Yiğit-Akkikgöz & Yalman, 2018; Chen et al., 2012; Divjak & Tomić, 2011; Giannakos, 2013; Ku et al., 2014; Plass et al., 2013, Tsai et al., 2012). Considering the potential role of digital games in mathematics teaching, teachers are expected to acquire a positive attitude towards digital games, a pedagogical perspective and technical skills. Teachers should also be able to create and guide a different learning and teaching environment to support students' creativity and development. In this process, they should also be able to develop their own creativity, and their thinking skills, such as original, flexible, fluid, meaningful, multi-faceted thinking, integration, which are the elements of creativity (Senemoğlu, 1996).

In the results of the research conducted by Karamustafaoğlu and Kılıç (2020), it was seen that educational game research was mostly conducted with secondary school and primary school students. As a result of the literature review on the subject, the study is thought to be important because no similar study was found on mathematics teachers' use of digital games.

Purpose of the Research

The aim of this study is to examine the effects of different demographic variables on mathematics teachers' use of digital games and

creative thinking skills. In line with this purpose, the sub-problems of the research were determined as follows.

1. Does the gender factor make a statistically significant difference in the level of use of digital games or in the tendency to think creatively?
2. Does the age factor make a statistically significant difference in the level of use of digital games or in the tendency to think creatively?
3. Does the service year factor make a statistically significant difference in the level of use of digital games or in the tendency to think creatively?

Method

Research Design

Quantitative research method and survey model were used in this research. In the quantitative research method, researchers try to prove the relationship between variables and look for the reasons for such relationships. The pattern to be applied is determined in advance and widely agreed upon process steps are followed (Büyüköztürk et al., 2011). The survey model is a research approach that aims to describe a past or present situation as it exists. The event, individual or object that is the subject of the research is tried to be defined in its own conditions and as it is. No effort is made to change or influence them in any way (Karasar, 2014).

Study Group

The study group consists of 70 primary school mathematics teachers working in a province in the Eastern Anatolia Region. 40 of these teachers are female and 30 are male. The demographic information of teachers is given in Table 1.

Table 1

Information about Participants

Gender		Age		Service Period	
Female	Male	Age Range 20-40	Age Range 41-60	0-20 Range Service Years	21-40 Range Service Years
40	30	47	23	53	17

Data Collection Tools

Data collection tools; The personal information form prepared by the researcher is the Digital Games Utilization Scale (DOYÖ) developed by Görmez (2020) and, Özgenel and Çetin (2017) Creative Thinking Tendencies Scale (YDEÖ).

DOYÖ was developed to determine teachers' attitudes towards using digital games and consists of 4 factors and a total of 17 items. YDEÖ has 25 items and 6 factors to determine teachers' creative thinking tendencies and the factors are named as innovation seeking, courage, self-discipline, curiosity, doubting and flexibility.

Data Analysis

The data obtained was analyzed with the SPSS (Statistical Package for the Social Sciences) package program. To decide which statistical tests to perform, Skewness-Kurtosis values were checked to see whether the data showed a normal distribution. These values are given in the table below.

Table 2

Normality Analysis of Data

Math teachers	Gender	Age	Service YeaR	Scale of use of Digital Games	Creative Thinking Tendencies Scale
Skewness	.295	.746	1.226	-.443	-2,547

Kurtosis	-1.970	-1.487	-.513	-.393	12,054

When Kurtosis and Skewness values are -1.5 to +1.5, it is considered to be a normal distribution (Tabachnick & Fidell, 2013). In this case, except for gender and creative thinking tendencies scale, other data appear to be normally distributed. Parametric and nonparametric test techniques were used in the analysis.

Findings

This section includes the findings obtained in line with the purpose of the research.

Findings Regarding Sub-Problem 1

"Does the gender factor create a statistically significant difference on the level of benefit from digital games or the tendency to think creatively?" Mann Whitney U Test, one of the nonparametric testing techniques, was used for the first sub-problem. It was analyzed whether the gender factor had a statistically significant effect on teachers' level of use of digital games or their creative thinking tendency. The findings obtained are listed in Table 3 and Table 4.

Table 3

Gender Factor- Level Of Benefiting From Digital Games Mann-Whitney U Test Analysis

Gender	N	Rank Average	Rank Total	U	p
Female	40	39.34	1573.5	446.5	.068
Male	30	30.38	911.5		
Total	70				

In the Mann Whitney U test analysis, it is seen that gender does not create a statistically significant difference on the level of mathematics teachers' use of digital games. Mann Whitney U test score is p = .068 > .05. According to the results of this analysis, gender does not change whether teachers benefit from digital games.

Table 4

Gender Factor -Creative Thinking Tendencies Mann-Whitney U Test Analysis

Gender	N	Rank Average	Rank Total	U	p
Female	40	31.78	1271.0	451.0	.077
Male	30	40.47	1214.0		
Total	70				

The Mann Whitney U test shows that gender does not create a statistically significant difference on the creative thinking tendencies of mathematics teachers. Mann Whitney U test test score is p = .077 > .05. According to the results of this analysis, gender does not change teachers' creative thinking tendencies.

When Table 3 and Table 4 are evaluated together, it can be said that the gender factor does not affect the level of use of digital games and creative thinking tendencies.

Findings Regarding Sub-Problem 2

"Does the age factor create a statistically significant difference on the level of benefit from digital games or on the tendency to think creatively?" Independent Groups T Test, one of the parametric testing techniques, was used for the second sub-problem. It was analyzed whether the age factor had a statistically significant effect on teachers' level of use of digital games or their creative thinking tendency. The findings obtained are listed in Table 5 and Table 6.

Table 5

Age Factor - Levels of Benefiting from Digital Games Independent Groups T-Test Analysis

Age	N	X	S	df	t	p
20-40	47	59.27	9.90	68	2.743	0.008
41-60	23	51.65	12.79			

The Independent Groups T test shows that age creates a statistically significant difference on mathematics teachers' Levels of Use of Digital Games. In the Independent Groups T test, p = .008 < .05 was found. According to the results of this analysis, the age factor creates a statistically significant difference on teachers' use of digital games. This difference is in favor of teachers between the ages of 20-40 (X = 59.27). Therefore, it can be said that young teachers can benefit more from digital games.

Table 6

Age *Factor -Creative Thinking Tendencies Mann-Whitney U Test Analysis*

Age	N	Rank Average	Rank Total	U	p
20-40	47	32.26	1516.0	388.0	.056
41-60	23	42.13	969.0		
Total	70				

In the Mann Whitney U test, it is seen that age does not create a statistically significant difference on the creative thinking tendencies of mathematics teachers (p=.056>.05). According to the results of this analysis, it can be said that age range does not affect teachers' creative thinking tendencies.

When Table 5 and Table 6 are evaluated together, it can be said that young teachers between the ages of 20-40 can benefit more from digital games, but the age factor does not change their creative thinking tendencies.

Findings Regarding Sub-Problem 3

"Does the year of service factor create a statistically significant difference on the level of benefit from digital games or the tendency to think creatively?" Nonparametric and parametric test techniques were used for the third sub-problem. It was analyzed whether the year of service factor had a statistically significant effect on teachers' level of use of digital games or their creative thinking tendency. The findings obtained are shown in Table 7 and Table 8.

Table 7

Service Year-Levels of Benefiting from Digital Games Independent Groups T-Test Analysis

Service Year	N	X	S	df	t	p
0-20	53	59.33	10.17	68	3.596	.001
21-40	17	48.76	11.68			

The Independent Groups T test examines the statistically significant difference in the level of mathematics teachers' use of digital games in terms of years of service. Independent Groups T test found p = .001 < .05. According to the results of this analysis, the year of service changes teachers' ability to benefit from digital games. It is seen that there are cases of using digital games in favor of teachers with 0-20 years of service (59.33). As a result of this

analysis, it can be said that teachers who have been working for a long time are less likely to benefit from digital games than teachers with fewer years of service.

Table 8

Years of Service -Creative Thinking Tendencies Mann-Whitney U Test Analysis

Service Year	N	Rank Average	Rank Total	U	p
0-20	53	32.25	1709.5	278.5	.018
21-40	17	45.62	775.5		
Total	70				

The Mann Whitney U test examines the statistically significant difference in the level of mathematics teachers' use of digital games in terms of years of service. Mann Whitney U test found $p = .018 < .05$. According to the results of this analysis, years of service change teachers' Creative Thinking Tendencies. When Table 6 is examined, a significant difference was found in creative thinking tendencies in favor of teachers with 21-40 years of service (45.62). It can be said that this year of experience increases the tendency to think creatively.

When Table 7 and Table 8 are evaluated together, it is seen that teachers with 0-20 years of service have higher levels of benefiting from digital games, whereas teachers with 21-40 years of service have more creative thinking tendencies. It follows that young teachers, whose years of service are generally parallel to each other, benefit more from digital games; However, it can be said that teachers with more experience have a tendency to think more creatively.

Conclusion and Discussion

The research was conducted in a province in Eastern Anatolia and included 30 male and 40 female primary school mathematics teachers. The effects of demographic variables such as gender, years of service and age on teachers' ability to think creatively and benefit from digital games were examined. In the light of the findings, it was seen that gender did not create a statistically significant difference on creative thinking or benefiting from digital games. It has been observed that young teachers and teachers with fewer years of service can benefit more from digital games. It is thought that this situation occurs because the younger generation is exposed to more digital applications or is more exposed to technology. It has been determined that teachers who are older and have more years of service have more creative thinking skills. This means that teachers with more experience are more competent in skills such as creative thinking and being able to evaluate events differently.

Çankaya and Karamete (2008) stated that educational digital games did not create a statistically significant difference in terms of attitudes towards mathematics lessons and educational computer games. On the other hand, it has been observed that digital mathematics games contribute to affective and cognitive development and make lessons fun (Berns et al., 2013; Rosas et al., 2003). It has also been stated that it will increase class participation, make students interested in the lesson, make students love mathematics, and reduce students' math anxiety-prejudices (Avcu, 2023; Huang et al., 2014). Educational digital games increase academic success (Cömert, 2020; Hwang et al., 2014; Kaynar, 2020; Korkmaz, 2023), improve problem-solving skills and provide creativity (Aldemir-Engin, 2023; Aksoy & Küçük-Demir, 2019; Gocheva et al., 2020; Yıldız-Durak & Karaoğlan-Yılmaz, 2019) have been seen to develop competencies in using technology in the field of mathematics. It is possible to say that parallel results were obtained with the study on creativity. In addition, it has been observed that it provides a suitable environment for teacher candidates to develop problem-solving skills and provides them with the proficiency in using technology (Yıldız-Durak & Karaoğlan-Yılmaz 2019). According to Prensky (2001), digital games provide ego satisfaction through winning situations, support creativity, and support learning with results and feedback. In addition, digital games help to enjoy mathematics (Griffiths, 2003) and focus on the

lesson (Chen et al., 2012). It is stated by researchers that educational digital games are effective to help students develop positive attitudes towards mathematics (Alabi & Aniah, 2014; Divjak & Tomić, 2011; González-González & Blanco-Izquierdo, 2012; Korkmaz, 2023), gain self-confidence (Ku et al., 2014), increase motivation to learn mathematics (Aşıksoy2018; Divjak & Tomić, 2011; Lu et al., 2011; Durgut, 2016) and increase in class participation (Dede et al., 2004; Gros, 2007; Rosas et al., 2003; Tsai et al., 2012). Memorability (Chaudhary, 2008; Çatak, 2009; Karamustafaoğlu & Aksoy, 2020), concretizing abstract subjects (Dönel-Akgül & Kılıç, 2020; Worker & Yeşiltaş, 2020; Saban & Çelik, 2018) and developing creativity (Ustabulut & Kana, 2021) also offers its advantages. It is possible to say that parallel results were obtained with this study regarding creativity.

Aktaş et al., (2018) stated that the mobile game developed for four operations in natural numbers has an effect on the skills of guessing and performing mental operations. Baş and Ulum (2019) stated that a fourth grade inclusive student was able to improve his basic mathematics skills with the help of a mobile game. In this regard, it can be said that it increases academic success (İncekara & Taşdemir 2019; Turan, 2019; Yavuzkan, 2019). In addition, it has been stated in some studies that it can be easily used to introduce an abstract concept on the subject (Altınışık, 2021; Gök, 2020). According to Ni and Yu (2015), educational mobile games support language development, critical thinking, emotional development, intelligence and imagination. It also increases students' desire to learn (Kuo & Hsu, 2020). With mobile game support, students can internalize information without memorizing it (Chu et al., 2019). Educational games increase critical thinking (Ming, 2020), creative thinking, decision making and evaluation (Aksoy & Küçük-Demir, 2019; Gök, 2020; Clements & Gullo, 1984; Clements, 1986; Clements, 1991; Liu, 1998; Rıza, 1999; Karadağ, 2015; Kwache, 2007; Nasiri & Rahmani, 2006; Michael, 2000; Michael, 2001; Kozielska, 2004, İdris & Nor, 2010; Moradnezhad et al., 2014; Ladan et al., 2016) skills by including game-based learning scenarios. Educational games also support students' social and technical skills (Berns et al., 2013; González-González & Blanco-Izquierdo, 2012). It is thought to develop 21st century learning skills (Day et al., 2001; DeLisi & Wolford, 2002; Gee, 2013; Hwang & Chen, 2017) due to critical thinking, problem solving and scientific creativity (Aksoy & Küçük-Demir, 2019; Sarıçam, 2019). In short, all these studies show that digital games can be a powerful and effective tool in learning and teaching (Koparan, 2021).

In the study, primary school mathematics teachers' skills in using digital games and creative thinking were examined in terms of different demographic variables such as gender, age and years of service. In order to conduct a more in-depth analysis of this study, further studies can be conducted with teachers on how often digital games are used or the main difficulties encountered in this process. Additionally, a semi-structured opinion form suitable for this category can be used to examine creative thinking tendencies in more detail. It can be investigated whether teachers have attended in-service courses or what they understand about digitisation. Additionally, research at NUTS1 and NUTS 2 levels can be conducted by expanding the working group.

Ethical Statement

Ethics committee approval for this study was obtained with the decision of Fırat University Social and Human Sciences Researchs Ethics Committee, dated 13.07.2023, meeting number 2023/13.

Conflict of interest

None

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