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Research Article

The effect of designing educational digital games on pre-service teachers' some competencies

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Today, there is an increasing interest in digital games. However, using digital games in education has also come to the agenda. Supporting a problematic and tedious course such as mathematics, which is considered difficult and tedious, with games considered more fun, has been a subject of curiosity and practice for educators. In this study, pre-service mathematics teachers were asked to design digital games related to the objectives of secondary school mathematics courses. The study examines the effect of designing educational digital games on pre-service mathematics teachers' use of educational games, creativity and game development self-efficacy. The research lasted eight weeks. Single group pre- and post-test design, one of the quantitative research designs, was used in the study. The study sample consisted of 37 pre-service mathematics teachers enrolled in the second year at a state university. Data were collected with the help of three scales. SPSS was used to analyse the data. After the determination of normality, Wilcoxon signed rank test and paired sample t-tests were used. As a result of the research, it was seen that digital game designing did not significantly affect pre-service mathematics teachers' educational game use and creativity. However, it was determined that game designing significantly affected game development self-efficacy.

Keywords: Digital educational game, technology-supported mathematics education, digital game use, creativity, digital game development self-efficacy

1. Introduction

Teachers educate children after their parents, and the best performance of teachers in their profession has positive effects on society (Tuğluk & Kürtmen, 2018). For this, teachers are expected to have some competencies. Because teaching is a profession based on a broader approach rather than just teaching subject knowledge. Teacher competencies are the knowledge, skills and attitudes necessary for the effective and efficient realisation of the profession (Tosuntaş, 2020). A high-quality education process is required for teachers to have the expected competencies. For this reason, teachers' personal and professional development activities should be increased starting from the candidacy process (Ministry of National Education [MoNE], 2017). Developments in science and technology have brought innovations in learning and teaching approaches to changing needs. As a result, individuals are expected to produce knowledge, think critically and solve problems (MoNE, 2018). In line with the developments in the world, it has come to the agenda to review the competencies related to the teaching profession. In this context, 21st-century skills have come to the fore in teacher qualifications and competencies (Yavuz et al., 2015). Especially with the widespread use of technology, teachers are expected to integrate technology into the classroom environment and integrate it with their lessons (Aktürk & Delen, 2020). Because technology has the potential to motivate students (Chao et al., 2016; Lin et al., 2017; Scanlon et al., 2005). In addition, technology contributes to features such as creative thinking, efficient working, and designing (Göksoy & Yılmaz, 2018), and performance (Fabian et al., 2018).

Technological developments should be utilised, especially in feared and difficult lessons such as mathematics (Çubukluöz, 2019). Because there is a perception that mathematics is a difficult subject based on formulas and rules (Udjaja et al., 2018). It has been stated that technology is the primary approach in teaching and learning mathematics and improves students' learning (NCTM, 2000, as cited in Joung & Byun, 2021). With technology, mathematics teaching is enriched in terms of teaching methods and being fun (Turan, 2022). The knowledge of teaching mathematics is grounded in the undergraduate period. For this reason, the development of mathematics teaching knowledge should be examined in the process (Bütün & Baki, 2019). Gaining technological competencies in mathematics for pre-service teachers who will step into the teaching profession is one of the important agendas of educators. Although they can improve themselves through in-service training at the end of the education process, it is thought that recognising and using current technologies before starting the profession will provide convenience in their professional lives.

Various technologies are used in mathematics education. One of these is digital games. Educational digital games used in technology-supported mathematics education have recently become widespread. Digital games are essential, especially for today's children and adolescents. Therefore, there are developments every day in order to provide an educational benefit from this situation (Dele-Ajayi et al., 2016). Research shows that various aspects of cognition, such as visual short memory, multitasking and spatial skills, can be improved by playing games (Castellar et al., 2015). Digital games allow students to explore and participate in digital learning environments (Sun et al., 2021a). Digital game-based learning in mathematics teaching is a learning strategy that increases students' willingness and interest in many disciplines (Hussain et al., 2017). Digital educational games can be used alone or in other learning environments (Prensky, 2001). For example, Yong et al. (2016) stated that combining classroom teaching and computer games is one of the best mathematics pedagogies in parallel with this approach. Digital games provide students with a graphical interaction system that develops scientific concepts in a fun environment (Ishak et al., 2021). It also provides concrete learning experiences. This helps students connect abstract concepts and real-world situations (Panoutsopoulos & Sampson, 2012). Digital games contribute to mathematics and computational literacy (Bertram, 2020). In addition, they improve scientific creativity (Sarıçam, 2019) and increase academic achievement (Soydan et al., 2021; Hung et al., 2014; Kaynar, 2020). It has been determined that digital games contribute more to the development of low-achieving students (Denham, 2019). It also improves children's learning (Chen et al., 2014; Moyer-Packenham et al., 2019). Digital games effectively improve students' performance in mathematics education (Byun & Joung, 2018; Fokides, 2018). With these games' help, students can understand mathematics and improve their knowledge (İncekara & Taşdemir, 2019; Sun et al., 2021a). They improve conceptual understanding (Bağ, 2020) and problem-solving (Cömert, 2020; Dai et al., 2023; Dai et al., 2022). It contributes to students' positive attitudes towards mathematics (Soydan et al., 2021). Papastergiou (2009) stated that computer memory improves knowledge. Computer games increase students' interest (Deng et al., 2020; Huang et al., 2014; Öztürk & Gökkurt-Özdemir, 2021) and motivation (Fadda et al., 2022; Hung et al., 2014; O'Rourke et al., 2017; Öztürk & Gökkurt-Özdemir, 2021) in mathematics. It also positively contributes to cognitive and emotional skills (Hussein et al., 2022). Hwa (2018) stated that game-based learning is more effective than traditional learning. Because it increases students' participation in the lesson with games (Deng et al., 2020), improving their learning activities and mathematics perceptions (Sun et al., 2021b). Kiili and Ketamo (2017) stated that game-based assessments are influential in education. They also stated that these assessments reduce exam anxiety. For example, Ninaus et al. (2017) found that game-based assessments are effective in fraction teaching. Games also effectively automate mathematical calculation (Jensen & Skott, 2022), mathematical reasoning skills and self-efficacy development (Huang et al., 2014). It was found that children who played games performed better in number line estimation and reading skills (Vanbecelaere et al., 2020). Gök and İnan (2021) stated that digital game-supported learning environments contribute to students' self-directed learning. In addition, it encourages students to use mathematical process skills such as problem-solving, proving, reasoning and transferring.

Creativity is defined as the process of creating something new and valuable. Creativity enables the production of new ideas and products by supporting interaction and participation (Hagen et al., 2023). It has been observed that digital educational technologies can support creativity (Yalcinalp & Avci, 2019). Rahimi and Shute (2021) emphasised that creativity is important because it contributes to personal and social development. They also emphasised that some, but not all, types of digital games have significant potential in developing creativity. Similarly, Behnamnia et al. (2020) stated that digital game-based learning applications significantly affect children's creative thinking. Marin and Notargiacomo (2023) observed that digital game development through the Luovus game impacts the player's creativity. Earp et al. (2013) stated that students' designing and developing games instead of playing digital games develops creativity and many skills. The first step in designing games in education is to teach it. This task is closely related to teachers and preservice teachers. Akgül and Kılıç (2020) had pre-service teachers design games in their research and stated that pre-service teachers had positive views on designing games. Li et al. (2013) also stated that game-creation mathematics practices affect some pre-service teachers' competencies. These are perceptions of difficulties, problem-solving, and game and design. Aksoy & Küçük-Demir (2019) stated that digital game design contributed to the creativity of pre-service teachers. When the benefits of using digital games in mathematics are considered, it is also seen that educators should choose games in line with their needs (Joung & Byun, 2021). The development of computer games has progressed simultaneously with the development and popularisation of computers. As the features of computers have improved, the features of games have also improved. This situation has enabled the companies producing games in the market to produce more varieties and quality games. One of the games that can be used in many areas is Kahoot! With Kahoot!, a quiz can be organised on any subject or language. The game is then shared on a large screen. Through a PIN given to the host, contestants enter the game and answer questions (Kahoot, 2023). Kahoot! is a game-based learning platform that reviews and evaluates student knowledge (Wang & Tahir, 2020). Kahoot! allows students to answer the teacher's online questions via mobile devices and quickly check their and their classmates' results (Curto et al., 2019). Kahoot! used appropriately, has been found to improve learning outcomes (Umboh et al., 2021) and contribute to mathematics learning (Abdullah & Rochmadi, 2020). It also improves students' extracurricular cooperation (Zhang & Yu, 2021). In addition, Kahoot! increases motivation in mathematics lessons (Setiawan & Soeharto, 2020). Wahyuni et al. (2021) found that the application improved the conceptual understanding of pre-service mathematics teachers.

Another tool used in mathematics learning is Wordwall. Wordwall is used for both interactive and printable activities. There are many ready-made templates in its content. The content created by selecting one of these ready-made templates is transferred. Interactive activities can be used on any Web-enabled device. Students can play the game individually. Alternatively, they can take turns under the supervision of the teacher. There are templates for individual and group play (Wordwall, 2023). It has been successfully used in mathematics learning assessment (Shafwa & Hikmat, 2023). Wordwall also allows students' learning activities in mathematics learning to be categorised as oral and written (Rahma et al., 2023). Basarahil (2022) stated in his research that Wordwall can be used to measure students' assessment in learning trigonometry and that the application is a valid tool for material and media experts. It was also found to be very attractive by teachers and students. It was also determined that Wordwall positively affected mathematics learning outcomes (Susanto & Sari, 2023).

Another tool is puzzles. Thomas et al. (2013) stated that puzzles improve students' problem-solving and independent learning skills and increase their motivation to learn mathematics. The purpose of using puzzles is to stimulate students' emotions, creativity and curiosity and develop their general thinking skills (Klymchuk, 2017). Ramlah et al. (2022) stated that puzzles in mathematics activate students and promote mathematical understanding and fun mathematics learning. It also shows that implementing the interactive puzzle environment increases students' confidence, encourages motivation to learn, develops confident learning, and provides a clearer understanding of recognising the concept of numbers and the concepts of numbers and geometric shapes. Huang et al. (2007) stated that puzzle-solving helps players develop logical thinking and facilitate problem-solving strategies. Lieban et al. (2018) reported that puzzles positively affect students' geometric vocabulary and understanding of transformations. Puzzles contribute to spatial reasoning skills (Nicolaidou et al., 2021) and critical thinking skills (Darmayanti, 2023). Fesakis et al. (2018) stated that students solve puzzles by applying mathematical knowledge, discussing and collaborating. He also stated that they are interesting for students. Puzzles are effective in developing students' logical thinking and increasing the quality and effectiveness of teaching. They also develop students' interest in mathematics and computer science (Rustamov, 2020).

Again, one of the sites that can be used is fenaktivite. This site offers ready-made content for teachers and students. It also allows users to prepare games by creating their templates. Games such as Millionaire Contest, Fate Kismet, and Significant Risk are up-to-date and can attract students' attention.

Instructional Technology and Material Design [ITMD] course is a course in which pre-service teachers have knowledge about materials and can design materials. In this course, pre-service teachers gain the ability to prepare concrete and digital materials, which impacts professional gains (Baş, 2020). The use of materials affects learning by doing and experiencing in many courses, especially in mathematics, and the retention of information (İnci-Kuzu & Uras, 2019). In this study, pre-service mathematics teachers were asked to create a digital game in line with the outcomes of the secondary school mathematics course within the scope of the ITMD course. The games are Kahoot!, Wordwall, fenaktivite and various puzzles. These platforms were chosen for not needing high technology knowledge to create games and easy use. It was aimed to examine the effects of this game creation process on pre-service teachers' creativity, game development self-efficacy and digital educational game use.

Accordingly, the research problems are as follows:

RQ 1) Is there a significant difference between pre-test and post-test digital educational games usage scores of pre-service teachers?

RQ 2). Is there a significant difference between pre-service teachers' pre-test and post-test creativity scores?

RQ 3). Is there a significant difference between pre-service teachers' pre-test and post-test digital educational game development self-efficacy scores?

2. Method

The study examines the effect of designing digital games on pre-service mathematics teachers' use of games, creativity, and self-efficacy in developing digital educational games. For this reason, a one-group pretest-posttest experimental design, one of the quantitative research methods, was used in the study. This design observes the difference between the pre-test and post-test before and after the research (Creswell, 2012). This design was preferred for the research due to conducting the research online and conducting the ITMD course with a single class within the faculty.

2.1. Sample

The research sample is 37 students enrolled in the ITMD course at a state university. 18 of the participants were male, and 19 were female. It was aimed to conduct the research with 66 students enrolled in the course. However, due to the limited participation in online education and the lack of sufficient responses from some students in the pre-test and post-tests, 37 students with precise data were subject to the research.

2.2. Data Collection Tools

In the study, data were collected with the help of three different scales. The first one is the Digital Educational Games Usage Scale [DEGUS], developed by Bonanno and Kommers (2008) and adapted into Turkish by Sarıgöz et al. (2018). The scale consists of 21 items. For each item, there are expressions of strongly disagree (0), disagree (1), undecided (2), agree (3) and strongly agree (4). Students were asked to tick the option that best reflects themselves for each question. The scale's reliability is .78 (Sarıgöz et al., 2018). Another scale used is the Digital Educational Game Development Self-Efficacy Scale [DEGDS]. The scale was developed by Kelleci and Kulaksız (2020). This scale also consists of 21 items. There are statements of disagree entirely (1), disagree (2), undecided (3), agree (4) and completely agree (5). In this scale, pre-service teachers were asked to choose the most appropriate option for each question. Cronbach alpha reliability coefficient of the scale is .972. The last scale used was the How Creative Are You [HCAY], adapted by Aksoy (2004) and presented in a different version by Bakaç (2015). The scale consists of 39 items. It is a Likert-type scale with agree, neutral and disagree options. The scoring of the scale has a different structure compared to other scales. For example, for the first question, agree 0, undecided 1, and disagree 2 points. However, agree 4, undecided 1 and disagree 0 points for the third question. The Cronbach Alpha reliability coefficient of the scale was calculated as 0.84 (Bakaç, 2015). All three scales were applied as pre-tests at the beginning and post-tests at the end of the study.

2.3. Data Collection Process

The research lasted eight weeks. What was done is presented in Table 1.

Table 1
Weekly activities during the research process

Week	*Activities*
1	Giving information about the research, applying the scales as a pre-test
2	Distributing the gains and analysing the Wordwall
3	Examination of fenaktivite
4	Analysing Kahoot!
5	Giving information about various puzzle preparation sites
6 and 7	Working on draft games
8	Collection of products and implementation of post-tests

The whole research was conducted online via Teams since online education was started due to the earthquake disaster in our country. Firstly, pre-service teachers were informed about the study. In addition, pre-tests (DEGUS, DEGDS and HCAY) were applied and collected electronically. In the second week, the 5th, 6th, 7th and 8th-grade gains (MoNE, 2018) related to the secondary school mathematics course were distributed to the students. Firstly, the Wordwall application was introduced in the study. Sample applications were made with the students. Next week, Kahoot! application was introduced, and information about its use was given. The following week, the fenaktivite website was introduced, and its games were emphasised. The following week, free online sites that can be used to prepare puzzles were shown. Wordwall and fenaktivite websites also included puzzle games. The pre-service teachers were asked not to choose to design the puzzle games but to prepare them from the puzzle sites shown. In the 6th and 7th weeks, the game drafts prepared by the pre-service teachers were discussed. Since some objectives were unsuitable for game formats, alternative plans were made. For example, while preparing puzzles, pre-service teachers stated that they usually had to use definitions, but there were no definitions in the given outcome. In this case, the objective was changed or stated so that the previous objectives' definitions related to the objective could be used. Finally, the products were collected digitally, and post-tests were applied.

2.4. Data analyses

SPSS package programme was used to analyse the data. It was examined whether the pre-test and post-tests showed normal distribution for each scale, and appropriate tests were selected accordingly.

3. Results

The findings are presented under three subheadings in line with the research problems. Findings of pre-test post-test digital educational games usage scores of pre-service teachers Firstly, descriptive analysis was performed for the data obtained from the DEGUS scale. The results of the analysis are presented in Table 2.

Table 2
Descriptive analysis findings of the DEGUS scale

						Skewness		*Kurtosis*	
	N	*Mean*	*SD*	*Minimum*	*Maximum*	*Skewness*	*SE*	*Kurtosis*	*SE*
Pre-test DEGUS	37	43.6	7.79	33.0	80.0	2.836	0.388	12.94613	0.759
Post-test DEGUS	37	43.7	3.39	36.0	51.0	−0.211	0.388	0.00570	0.759

Table 2 shows the descriptive values of the data related to the DEGUS scale. If the kurtosis and skewness values are between -1 and +1, the data set is said to have a normal distribution (Büyüköztürk, 2014). The distribution is not normal since this data set is not in the relevant ranges. For this reason, the Wilcoxon test, one of the nonparametric tests, was applied to the research problem, and the results are presented in Table 3.

Table 3
Wilcoxon W test findings for the DEGUS scale

Paired samples t-test				
			Statistic	*p*
Pre-test DEGUS	Post-test DEGUS	Wilcoxon W	205[a]	.176

Note. [a]4 pair(s) of values were tied

In the present study, a Wilcoxon signed-rank test was utilised to assess potential differences in the paired data sets of "Pre-test DEGUS" and "Post-test DEGUS". The results revealed a Wilcoxon W statistic of 205 ([a] 4 pair(s) of values were tied), with an associated p-value of 0.176.

Since p >.05, it was determined that there was no significant difference between the pre-test and post-test digital educational games usage scores of pre-service teachers.

3.1. Findings of Pre- and Post-test Creativity Scores of Pre-service Teachers

Descriptive analyses were performed for the data obtained from the HCAY scale. The results of the analysis are presented in Table 4.

Table 4
Descriptive analysis findings of the HCAY scale

						Skewness		*Kurtosis*	
	N	*Mean*	*SD*	*Minimum*	*Maximum*	*Skewness*	*SE*	*Kurtosis*	*SE*
Pre-test HCAY	37	37.9	7.13	25.0	55.0	0.2931	0.388	−0.334	0.759
Post-test HCAY	37	40.1	7.36	23.0	52.0	−0.0871	0.388	−0.539	0.759

For "Pre-test HCAY", the mean score was 37.9 (SD = 7.13), ranging from 25.0 to 55.0. The skewness value was positive (0.2931), indicating a slight right-skewed distribution. The kurtosis value was negative (−0.334), suggesting a distribution with slightly fewer peaked tails than a normal distribution. For "Post-test HCAY," the mean score was 40.1 (SD = 7.36), ranging from 23.0 to 52.0. The skewness value was close to zero (−0.0871), suggesting a relatively symmetrical distribution. The kurtosis value was also negative (−0.539), indicating a slightly less peaked tails distribution. It is therefore seen that the distribution is normal. For this reason, a paired samples t-test was used to analyse the data. The results are presented in Table 5.

Table 5
Paired sample t-test results for the HCAY scale

Paired samples t-test					
			Statistic	*df*	*p*
Pre-test HCAY	Post-test HCAY	Student's *t*	−1.62	36.0	.113

In the current study, a paired samples t-test was conducted to investigate potential differences between the paired data sets of "Pre-test HCAY" and "Post-test HCAY". The results yielded a *t*-statistic of −1.62 with 36 degrees of freedom, and the associated p-value was 0.113. The paired samples t-test did not reveal a statistically significant difference between the two paired data sets. The p-value of 0.113, when compared to the conventional alpha level of .05, suggests no strong evidence exists to conclude a significant difference in the measurements.

3.2. Pre- and Post-test Digital Educational Game Development Self-efficacy Scores of Pre-service Teachers

For the research problem, descriptive analysis was made for the data obtained from the DEGDS scale. The results of the analysis are presented in Table 6.

Table 6
Descriptive analysis findings of the DEGDS scale

						Skewness		*Kurtosis*	
	N	*Mean*	*SD*	*Minimum*	*Maximum*	*Skewness*	*SE*	*Kurtosis*	*SE*
Pre-test DEGDS	37	72.0	10.4	54.0	94.0	0.0637	0.388	−0.732	0.759
Post-test DEGDS	37	78.2	12.5	30.0	101.0	−1.4874	0.388	5.592	0.759

To further understand the characteristics of the data, descriptive statistics were calculated. For "Pre-test DEGDS," the mean score was 72.0 (SD = 10.4), ranging from 54.0 to 94.0. The skewness value was positive but close to zero (0.0637). Suggesting a relatively symmetrical distribution, while the kurtosis value was negative (-0.732), indicating a distribution that is slightly less peaked compared to a normal distribution.

Since the data did not show normal distribution, the Wilcoxon W test was performed and presented in Table 7.

Table 7
Wilcoxon W test results for DEGDS scale

Paired samples t-test				
			Statistic	*p*
Pre-test DEGDS	Post-test DEGDS	Wilcoxon W	164	.005

In the current study, a Wilcoxon signed-rank test was employed to assess potential differences between the paired data sets of "Pre-test DEGDS" and "Post-test DEGDS". The results revealed a Wilcoxon W statistic of 164, and the associated p-value was highly significant (p =.005). The Wilcoxon signed-rank test provided strong evidence of a significant difference between the two paired data sets. The p-value of 0.005, less than the conventional alpha level of .05, indicates a statistically significant difference in the measurements.

4. Discussion, Conclusion, and Recommendations

Digital gaming experiences that started in arcades in the seventies continue today through mobile devices (Samur, 2022). Today, digital games are one of the channels where daily consumption on the internet is intense (Ilgaz & Abay, 2020). It can be observed that children, young people and adults spend serious time on games in daily life. It is known that well-designed games have a motivational effect (Bozkurt & Genç-Kumtepe, 2014). However, the use of digital games in education is still a controversial issue. The use of games is vital in terms of development and learning psychology. It should also be determined at which educational levels they should be used (Ülker & Bülbül, 2018).

In the study, pre-service mathematics teachers were enabled to create digital games within the secondary school mathematics course gains framework. The study aimed to examine the effects of the game creation process on the creativity, game development self-efficacy and digital educational game use of pre-service mathematics teachers. In the study, firstly, it was observed that the game creation process did not affect pre-service teachers' use of digital educational games. Ramazanoğlu (2019) stated in his study that pre-service teachers' skill level in using digital educational games is at a medium level. He stated that this situation is due to not using games sufficiently and not being sufficiently knowledgeable about game development. A similar situation is valid in this study. It is thought that the fact that pre-service teachers are in the process of creating games for the first time may be effective in not using the games sufficiently. It is thought that the pre-service teachers are still in the second year and at the beginning of developing themselves in the field; pedagogy and technology may be effective.

Another result of the research is that creating games does not significantly affect pre-service teachers' creativity. A study conducted with the same scale on creativity was conducted by Hacıoğlu and Türk (2018). This study conducted with gifted students stated that students expressed themselves creatively and were aware of their creativity. Gülel (2006) worked with pre-service classroom teachers. As a result, he found that female students were more creative than male students. In addition, a significant difference was found between the perception of university academic success and creativity. Hamlen (2009) found no significant relationship between the time spent playing video games and creativity. He also found no significant relationship between creativity and the skills used in video games. Özkaya et al. (2022) stated that STEM activities improve teachers' creativity. Topoğlu (2019) worked with pre-service teachers on the same scale. At the end of the research, it was determined that the creativity of pre-service teachers was below average. Tang et al. (2022) reviewed 61 articles in the literature and stated that digital technology has a complex effect on creativity. They stated that this differs depending on teaching strategies and learning behaviours.

Finally, it was found that pre-service teachers' game creation had a significant effect on their self-efficacy in digital educational game development. In their research, Ustabulut and Kana (2021) stated that pre-service teachers reported positive opinions due to their experiences designing digital games. They added that pre-service teachers said these games would facilitate students' learning and enrich their learning experiences. It has been said that the current teacher training programmes effectively increase pre-service teachers' affective skills about technology, especially their self-confidence (Sancar-Tokmak et al., 2013). Alkan and Mertol (2019) found that pre-service teachers were anxious but willing to use digital games in their research. The fact that the pre-service teachers create the game themselves contributes to the learning process and is fun (Usta & Güntepe, 2019). Ağıç and Korkmaz (2022) stated that a significant positive relationship exists between technological formation and mathematics teachers' digital teaching material development levels. It was stated that seniority did not have an effect. In the literature, there are studies examining pre-service teachers' educational digital game designs and their views on the process (Yıldız- Durak & Karaoğlan-Yılmaz, 2019).

The study was conducted on a single group. It is thought that working with more than one group may give different results regarding the validity and diversity of the research. In addition, the research was conducted with second-year pre-service teachers. One of the limitations of the research is that the pre-service teachers are at the beginning of the education process and do not have sufficient knowledge. In addition, the fact that pre-service teachers do not have sufficient technological knowledge and have not yet taken the necessary courses on this subject also affected the results. It is predicted that different research results may be conducted in higher grades. As a result of this situation, the researcher brought up the issue of creating more superficial games. Choosing games that require more technological knowledge and equipment and more information about designing can also be presented as a suggestion to researchers. Conducting the research in an online environment is another limitation. Because here, both the low participation in the lessons and the inability to obtain complete and complete information from the data collection tools were experienced. In addition, the fact that a significant portion of the students were in the earthquake zone also affected the motivation for the study.

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