
The Effect Of Teaching Mathematics With A Learning By Play Strategy In The Acquisition And Improvement Of Mathematical Skills For 6th-Grade Students In Israel

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Abstract: This study aimed to reveal teachers' opinions about the usage of educational games in mathematics teaching: it investigates the impact of teaching mathematics with a learning-by-play strategy on acquiring mathematical skills and improving social communication skills among 6th-grade students in Israel. The study sample consisted of two divisions for the 6th -grade from Arab Schools in North Israel. Each of the two groups is consisting of 20 male and female students. One is studying using the traditional method and the other studying mathematics with a learning strategy by playing. The researchers developed the mathematical skills test and the social communication scale. There were statistically significant differences ($\alpha \geq 05.0$) between the mean averages of the two groups' scores on the mathematical skills test and on the social communication dimension scale from the teacher's viewpoint and the experimental group. In conclusion, the teachers indicated that educational computer games would provide benefits such as making students' learning more permanent, visualizing concepts, making students love mathematics, learning by entertaining, reinforcing what has been discovered, and developing thinking skills. Nevertheless, the teachers stated the limitations of educational computer games, such as causing addiction and physical damages, being time-consuming, requiring special equipment and software, and making class management difficult. Besides, it was revealed that the teachers demonstrated positive attitudes towards the use of games in courses while they did not feel competent in terms of application. In this case study, one of the qualitative research methods was used. Data were collected by utilizing a semi-structured interview form with the teachers and analyzed using by content analysis method.

Keywords: Educational computer games, mathematics teaching, learning-by-play, math teachers.

Introduction:

Advances in technology significantly affect our life aspects including the field of education, in particular mathematics education. Especially developments in computer and internet technology create various application areas in mathematics teaching. One of these application areas is educational computer games (Kebritchi, Hirumi & Bai, 2010). With the increasing interest in education and the challenges it faces in the twenty-first century, interest has increased in choosing teaching strategies concerned with the learner and the teacher and are commensurate with their new roles in light of this cognitive and technological development. On the teacher alone and ending with modern strategies that are based on self-learning. The teacher performs many tasks and roles in the school, and it is no longer the same as it was in the traditional school. The learner is the one who builds his knowledge by himself by providing him with a solid and correct basis in the educational materials and experiences presented to him. The teaching strategy is of importance for the teacher to help him achieve the educational goals because the teaching process is described as complex, and its elements are interdependent and intertwined with each other, as each step is affected by what came before it and affects what comes after (Al-Samadi, 2010). Teaching strategies vary, and this diversity depends on the subject matter. Instructional nature and its nature and the teacher deems appropriate to the teacher's experience in teaching and the individual differences between learners and the classroom environment. Still, all aim to reach the educational process's desired goals (Hariri, 2010). Al-Smadi (2010) believes that teaching strategies based on learning by playing have a significant role in shaping the learner's personality effectively in its various dimensions, so educational games play a role in the child's learning when the games are well planned organized, and supervised. Through play, children can tell us what they think through free representational play (P.32-36). Play also contributes to shaping children's personalities and facilitating the delivery of information to them. Play is a therapeutic method used by educators to solve many students' behavioral problems (Badir, 2008). Plato was the first to indicate that play has practical value through his book, *Law*. He also called for providing children with physical materials to learn arithmetic and give realistic miniature building tools to children who should become builders in the future. Aristotle points out the importance of encouraging children to play, and that Aristotle also points out that play helps children learn about professions and helps shape children's professional tendencies (in Hariri, 2010).

In addition to the above, there is a close relationship between play and social communication, as play contributes to the growth and development of social relations. Enjoying play makes the child create a kind of contact between himself and others, to provide him with sensory and emotional stimuli so that what children show in terms of improvement and development in social behavior. This is the evidence for the above is the existence of a type of play called social play, as children at the beginning tend to play individually. Still, with time they tend to play with others through cooperation, and this process is gradual as there is difficulty in classifying the development of the child's play at a particular time (Al-Sayed, 2003.) Play is just a child's means to prepare experiences and helps him understand what surrounds him and learn by making the child feel happy because it contains many new experiences and allows him to reshape his previous experiences (McKinney, 2003).

The mathematics curriculum has general goals: it seeks to achieve through teaching mathematics at all stages from kindergarten to university education, which is represented in acquiring scientific and thinking skills, dealing with knowledge of a digital nature, in addition to appreciating the impact of mathematics and its importance in developing society, and forming tendencies and trends Positive and sound towards learning mathematics by the learner, and the acquisition of good social skills (Al- Nawashi, 2010). Badawi (2007) believes that learning mathematics helps achieve communication between students through oral or written communication a lot in individual or group rooms. The students communicate about their experiences, making the classroom a dynamic learning environment full of strength and activity. Communication between students may be difficult at first, but they will develop their ability to communicate if given opportunities to share on an ongoing basis. As a result of this importance of playing and the benefit that the teacher may gain from using this modern strategy in teaching, the current study aimed: to investigate the impact of using the learning-by-play strategy in acquiring mathematical skills and improving social communication skills in mathematics among first-grade students.

Literature Review

Educational computer games are softwares that help students learn lesson subjects or improve their problem-solving skills using a game format (Zirawaga et al., 2017). Educational computer games are used for problem-solving and strategic purposes in science, mathematics, medicine, engineering, language teaching. It is frequently used to improve thinking skills (Hussein et al., 2019). It also reveals the imagination, struggle, competition, pleasure, worry, uncertainty, goal, decision, discussion, and affective bonding (Lo et al., 2008). With these features, educational games facilitate students' readiness and active participation in learning by making even a boring learning environment exciting and fun (Chen et al., 2001 and 2012). There are many studies in the literature to reveal students' attitudes towards educational computer games. In these studies, most of the students enjoy the educational game environments (Hussein et al., 2019), they do enjoy these environments at a high level and that they are willing to learn in these environments (Papadakis, 2018). Besides, game-based learning environments reduce anxiety (Chen et al., 2012, Hung, CM., Huang, I. & Hwang, GJ. 2014, Wu, W.Y., Chang, C.K. & He, Y.Y. (2010), help individual learning (Noemí, 2014), and visually support learning is emphasized (Simkova, 2014).

Since mathematics is an abstract science by its nature, it can be difficult for school students. It is stated that this difficulty can be overcome by concretizing and presenting the concepts in mathematics teaching (Abramovich et al., 2019). Educational computer games are also frequently used in teaching mathematics for this purpose. Educational computer games in teaching mathematics are used to motivate students, change students' negative perceptions towards mathematics, help students overcome their fear of mathematics, and break students' prejudices against mathematics (Demirbilek & Tamer, 2010). Also, studies have shown that teachers use games to evaluate and support the lesson. However, educational computer games are preferred by teachers as they have the potential to create an educational environment outside of school (Demirbilek & Tamer, 2010).

Many studies have been conducted to investigate the effects (academic achievement, attitude, self-confidence, etc.). In many of these studies, the success of educational computer games and motivation (Corsi et al., 2006; Lopez-Morteo & Lopez, 2007; Owston et al., 2009; Pareto et al., 2012). On the other hand, some studies indicate that educational computer games do not affect students' achievement and motivation (Tuzun et al., 2009). In the integration of educational computer games into educational environments, besides the student dimension, pedagogical, technical infrastructure and teacher dimensions are also critical. Teachers have an essential role in the effective use of computer games in educational settings. Teachers have a vital place for facilitating computer games' integration into education. Studies in the literature reveal the opinions of teachers or teacher candidates in different fields about educational computer games. It is noteworthy that although the number of these studies is limited, teachers think that educational

computer games will provide significant gains for students in the education process. Demirbilek and Tamer (2010) stated that teachers' game-based learning environment motivates students to the lesson, enables students to gain some knowledge and abilities, and improves their vocabulary. They indicated that it increases the permanence. As a result of the research conducted by Can and Çagiltay (2006), the opinions of teachers about educational computer games were revealed, computer and instructional technologies related to educational computer games.

Educational Computer Games in Mathematics Teaching

The positive opinions of the teachers in this study reported that:

- Students could learn more valuable things in the game-based environment compared to the traditional setting.
- The learning will be more permanent.
- The students will be active.
- The student's creativity and critical thinking skills will develop.
- The lessons will be more understandable through games.

However, teachers said that: there is a possibility that students do not understand anything from games, and therefore games may prevent students from learning their lessons. They also stated that instead of games, more efficient lesson activities could be prepared, some games could restrict creativity and negative thoughts. In the studies, it is also stated that teachers generally have the self-confidence of problems coming from the integration of computer games into education. They resist new technologies, do not have enough time for game-based applications, and cannot provide classroom control during game use (Demirbilek and Tamer, 2010). Considering the adoption of game-based teaching by mathematics teachers, very few teachers at primary and secondary education levels have experience with games. They tend to use games in their lessons. (Bourgonjon et al., 2013; Proctor & Marks, 2013). For educational computer games to be used effectively in the education process, each pedagogical, technical infrastructure, student, and teacher dimensions should be considered separately. Although there are many studies on the current topic, it is seen that there are a limited number of studies that reveal teachers' experiences and opinions on the use of computer games in mathematics teaching. Besides, educational games' integration process into education differs according to academic fields (Can & Çagiltay, 2006). For this reason, studies on the use of educational computer games in different educational areas are essential. The prospective teachers will be the agents of change in schools in the future. Thus, it is necessary to determine the teacher's awareness levels for educational games and their intention to use them and work in this direction. Especially in Israel, it is seen that the studies in this direction are not at a sufficient level. Although this study reveals the potential use of educational computer games in education mathematics, it may also guide education curriculum development studies. In this direction, the study aims to examine the use of educational math games in education to reveal teacher candidates' opinions. For this purpose, the following research questions were sought in the study:

- What are the awareness and self-efficacy perceptions of the classroom teacher participating in the study about educational games within the scope of mathematics teaching?
- What are the opinions of the classroom teacher participating in the study about the benefits and limitations of using educational games in elementary mathematics teaching?
- What are the educational game selection criteria in mathematics teaching of the classroom teacher participating in the study?

Method

In this study, one of the qualitative research methods, a case study, was used. In the case study, the factors (environment, individuals, events, processes, etc.) of a situation are investigated in a holistic approach and how they affect the relevant situation and how it is the focus is on those involved. A limited number of participants were selected from classroom teacher at Arab community schools, and their views were investigated with a holistic approach.

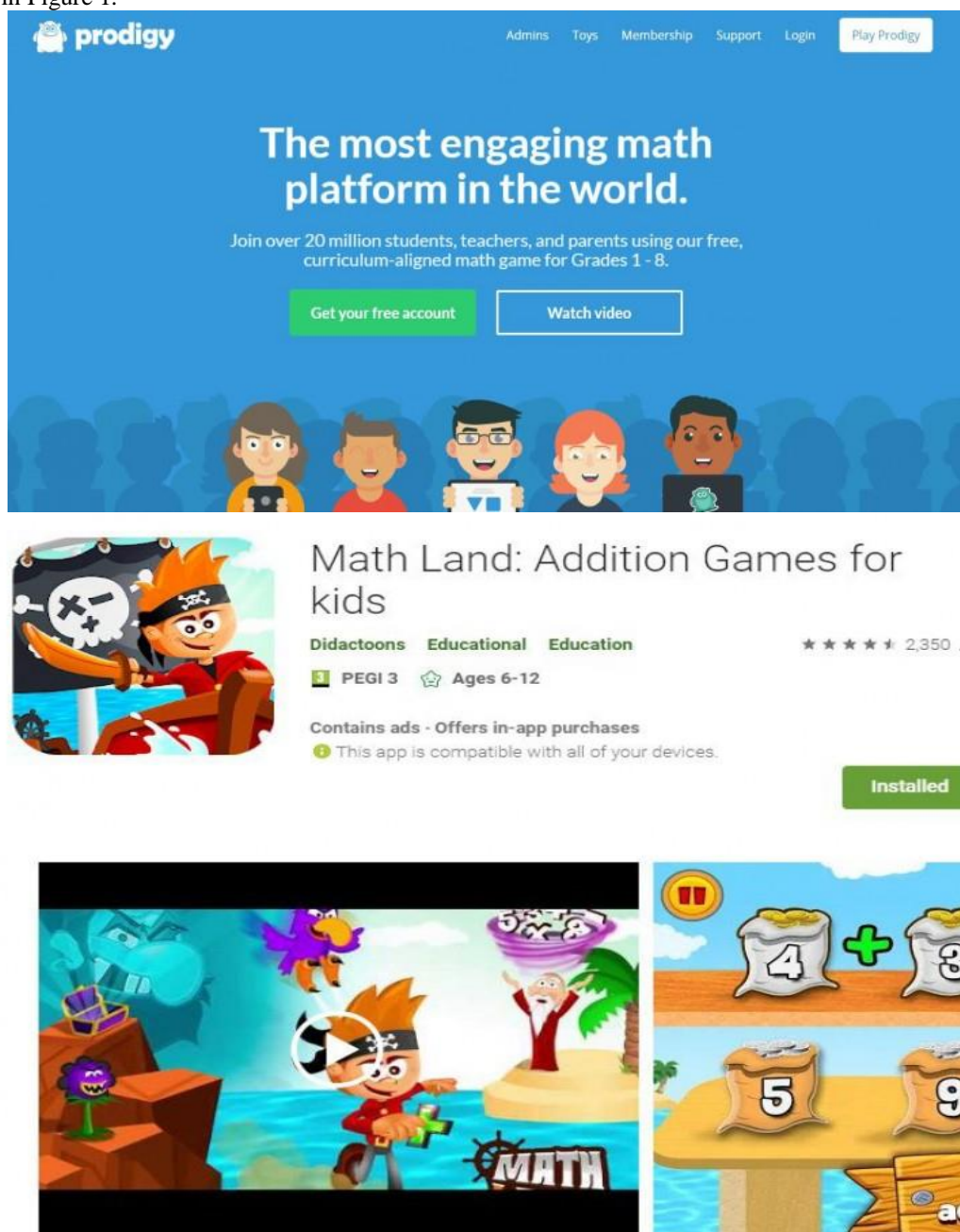
Participants

The participants of the study consisted 40 Pre-service-teachers. To become teachers, they have to take courses on techno pedagogical skills, mathematics field knowledge and techniques that will enable them to have competence and knowledge on variables such as educational computer games, technology, computers, and the internet. Besides, they gained a certain level of teaching experience, as they took the school experience course and did their internship in schools. For this reason, it was deemed appropriate to choose the participants of the study from the 6th -grade level.

Application Process

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The research process tried to determine an educational game suitable for education level to ensure that teacher candidates have information about educational games. At this stage, the conformity of educational computer games in the internet environment to academic game criteria (rules, goals and objectives, feedback, struggle, interaction, and story) was examined by the researchers. As a result of the examinations, the games named in the field of Mathematics containing the educational game features was determined. The studies understood that these games are an educational game prepared by the teachers for class settings. In this study, the first teacher was asked to play the game. Then, other teachers were asked to play the same game to have the experience. In this way, it was tried to ensure that the teacher participated in the study from common knowledge about the educational computer game to come out with opinions and results. The screenshots of the teacher' educational computer two different games within the scope of the study are given in Figure 1.



Data Collection

A semi-structured interview form consisting of 10 questions prepared in line with research questions was used as the study's data collection tool. In the interview form, there were questions about the attitudes, perceptions of self-efficacy,

and intentions of the participants towards the use of educational computer games in mathematics lessons and questions about the effects of the use of educational computer games on students. After the interview form was prepared, a field expert and one language expert were asked to check outcomes, and necessary arrangements were made. Individual interviews lasting approximately 15-20 minutes were conducted with the participants using the interview form. After the interviews were completed, the audio recordings were transcribed by the researchers and made ready for analysis. Some of the Pre-service-teachers did not have responses to all questions, and their participation was limited to what they could answer.

Data Analysis

The data obtained in the study were analyzed by using the descriptive analysis method and presented in the findings section by including direct quotations. The data obtained in the descriptive analysis method are summarized and interpreted according to previously determined themes. At the same time, direct quotes are frequently used to reflect the opinions of the participants in a striking way. In this study, the interviews' data were organized according to the three themes revealed by the research questions and presented in the findings section.

Findings

In this section, the findings obtained as a result of the analysis of the data obtained within the scope of the study are presented under the titles of teachers' awareness of educational games, the benefits and limitations of using educational games in education, and teachers' educational game selection criteria. While giving the participant expressions, the participated pre-service-teachers were coded as "PST."

Awareness of Educational Games and Perceptions of Self-Efficacy

According to the obtained findings, it was revealed that the majority of the participants did not have information about educational mathematics games. At the end of the academic game shown within the study's scope, they had an idea about this issue. The statement of a teacher on this subject is as follows:

I did not have the chance to see much of a game since I did not have such research until today. I can even say that for the first time, I can say that I saw such games (PST).

Participants stated that they did not feel sufficient in using game-based teaching in the current situation and that they did not have enough knowledge and practice about game-based learning. However, they stated that they will involve games in the teaching profession in the future, they would develop themselves in this direction and conduct research. Some of the participant expressions in this direction are given below:

I understood that I have to do a lot of research to use it in the lessons. Because I don't have much to do with games, but I would love to research and use them. It will be beneficial, especially in my lessons. I will start learning it right now (PST).

I mean, I cannot feel very adequate for now because I haven't gotten into this business yet. But I believe that I can do something in the future (PST).

I cannot use enough at the moment. But I would love use it in the class (PST).

Benefits and Limitations of Educational Mathematics Games

As a result of the interviews, the participants stated that educational math games could make the lesson more enjoyable, especially by making the math lesson popular. Besides, the participants said that educational games could provide advantages such as making the information permanent, visualizing the concepts, and providing the students with a fun learning environment. The opinions of the teacher participating in the study regarding the benefits of using educational computer games in primary education are presented in Table 1.

Table 1. Benefits of Educational Computer Games

Benefits	Frequency
Making students love mathematics and making the lesson enjoyable	14
Permanent learning	12
Visualizing concepts	11
Attracting attention and increasing motivation	10
Learning by having fun	8

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It is easier to instruct information	8
Relieving the teacher's burden	8
Embodimenting abstract concepts	6
Secret learning	4
Eliminate the fear of math	4
Distancing teaching from tradition	2
Developing thinking skills	1
Taking education home	1

Some of the preservice teachers' statements on this issue are presented below:

The contribution could be as follows: If we make children love mathematics with these games, other teachers' jobs will be easier (PST).

First of all, I think it makes the teacher's job easier. As I said before, it will make it easier for the student to understand. I think so. There will be a difference for students and a difference for teachers. We get rid of mediocrity (PST).

... this facilitate the teaching of the teacher and encourages the student's learning. So games help both students and teachers. It creates a more enjoyable lecture or lecture listening environment. Eliminates students' negative thoughts about the lesson. Because children in the first or second grade are usually better for them because they think about the game, it would be enjoyable. So generally, because students are afraid of mathematics... it can eliminate fear. As I said, it facilitates learning (PST).

It becomes more permanent. You know, it becomes enjoyable (mathematics). Mathematics is an abstract lesson; after all, it becomes difficult to learn. We know from ourselves that it was one of the most challenging lessons we had. So I use it for persistence and more embodying. It improves the thinking skills of the child (PST).

In the interviews conducted within the scope of the research, the participants stated that educational games have some limitations besides their benefits. Participants' educational computer emphasized that their games may have restrictions such as creating addiction, causing physical damage (radiation, etc.), and requiring a long time. The teacher' opinions on the limitations of the use of educational computer games in primary education are also presented in Table 2.

Table 2. Limitations of Educational Mathematics Games

Limitations	Frequency
Be addictive	12
Physical damage (eye disorder, radiation, etc.)	6
Takes too much time	6
Requires special hardware and software (computer, appropriate game, etc.)	4
Classroom management becomes difficult	4
Social weakening of students	2

Some teacher' statements on this issue are given below:

Maybe discipline may not be provided in the game. It won't be accessible if the classroom environment is crowded (PST).

Once the child is negatively affected in terms of sociality. It becomes addicted. Since he constantly looks at the screen, his brain cells are damaged (PST).

Educational Game Selection Criteria

Participants stated that specific criteria should be considered in the selection of educational computer games to be used in mathematics lessons. Compliance with the student level comes first among the criteria they will consider in selecting educational games. Besides, visualization, teaching by entertaining, absence of distractions, are among the features that prospective teachers seek in educational games. Table 3 presents their views in this direction.

Table 3. Educational Game Selection Criteria

Criterion	Frequency
Suitable for the target audience	12
Inability to instill any thoughts or opinions	4

Visualizing concepts	4
Teaching while entertaining	4
No distractions	4
Compliance with MEB principles	2
Compliance with the goal and purpose of the lesson	2
Compliance with the duration of the lesson	2

 Some of the prospective teachers' views on this issue are given below:

As we said once, it should be educational. It is also essential that it is related to the subject because something irrelevant would be ridiculous, in my opinion (PST).

Either I will look at the questions in the game. So if it is suitable for children, I make it play. Other than that, if there are issues that I have not been told about, I will make them move (PST).

It should be at a level that students can understand. It should be parallel with the achievements. According to the age level, it should be no religious discrimination, gender discrimination, racial discrimination, and language discrimination, such as beautiful responsibility, justice, and respect. It needs to mix and give (PST).

Discussion and Conclusion

This study revealed the opinions of classroom teacher on educational computer games in mathematics teaching. For this purpose, it was determined from the beginning, within the research scope, teachers' awareness and self-efficacy perceptions of educational games, the benefits and limitations of using educational games in primary education, and prospective teachers' opinions about educational game selection criteria. In the examinations made within the scope of the study, it was seen that the classroom teacher who participated in the study did not have information about educational computer games. At the end of the academic game shown within the study's scope, it was understood that they had an opinion on this subject. This result may indicate that teachers do not sufficiently include educational technology applications in the courses they take for technology use. This is because the teachers' lack of knowledge and skills in technology integration creates an obstacle to integrating technologies such as educational games. In the study, it was determined that the classroom teacher displayed a positive attitude towards using the games in the lessons. Still, they did not feel having sufficient knowledge about the applications. The literature states that very few mathematics teachers have experience with games (Bourgonjon et al., 2013). However, in this study, contrary to the literature, it was determined that teachers were willing to use game-based teaching. This may be because the teacher participating in the study were included in the indigenous digital group, who can quickly access information and frequently use technological tools in their daily lives. Classroom teacher' willingness to use educational computer games is essential for the effective use of technology in classrooms in the future.

To achieve this, it is necessary to provide an educational environment for teacher candidates in this direction by providing appropriate technical and pedagogical infrastructure in education faculties. Classroom teachers stated that educational computer games would provide benefits such as making students' learning more permanent, visualizing concepts, promoting mathematics, learning with fun, reinforcing what was discovered, and improving thinking skills. Similar results were obtained in different studies. Students generally have a negative perception towards mathematics lessons since primary education. This situation can be prevented by popularizing mathematics lessons with educational games starting from primary education. Besides, in this study, teachers' game-based educational environments; also stated that they can provide benefits such as visualizing what is learned and bringing education home. In this way, it can be thought that students' time to engage in mathematics lesson actively will increase. Primary school teacher stated that educational computer games have limitations such as creating addiction, causing physical damage, taking too much time, requiring special hardware and software, and making classroom management difficult. Studies have generally focused on the student dimension and mentioned its negative effects on students. Compliance with the student level comes first among the criteria that prospective teachers will consider in selecting educational games. Besides, visualization, teaching by entertaining, and the absence of distractions are among the features they seek in educational games. Similarly, it has been specified by the teacher candidates as the criteria to be considered as the criteria to be following the goals, purpose, duration, and principles of National Education, they emphasized the choice of games and the use of games for instructional purposes and stated that educational games would not have the expected effect unless they were selected appropriately.

In this study, it was determined that classroom teacher candidates have positive opinions about educational computer games in primary school mathematics lessons. They are aware of the benefits and limitations of educational games. They will pay attention to specific criteria in their choice of educational games. They want to use this technology in their future lessons. This study can be seen as limited in terms of being a case study and based on a limited number of

participants' opinions. Still, the results obtained are essential in terms of getting in-depth information from classroom teacher candidates. In the light of the results obtained from the study, the following recommendations can be made:

- Practical seminars on the integration of educational computer games with educational environments can be given to prospective teachers.
- While developing educational computer games at the primary education level, benefits, limitations, and preferences stated by pre-service teachers can be considered.
- To popularize educational computer games in lessons, educational game development activities can be encouraged by state institutions.
- Instructors' use of educational games in their studies can enable teacher candidates to gain experience in educational games.
- Educational computer games for elementary school mathematics lessons can be designed and shared in online environments that classroom teachers can easily access.
- Comprehensive research can be conducted by reaching more prospective classroom teachers and lecturers by performing survey development work.
- By carrying out similar studies in different educational fields and levels, comparative studies can be conducted on which areas and educational computer games can be more effective.

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