

## CHAPTER 4

# Teachers' Opinions on the Use of Games in Mathematics Education: A Case Study

Ebru ERGÜL<sup>1</sup>

Zeynep Bahar ERŞEN<sup>2</sup>

### INTRODUCTION

Today, instructional approaches that lead students to success are designed according to the needs and characteristics of students and place students at the center of the educational process by making them active. This approach, expressed as an active learning approach, refers to a learning process in which the student carries the responsibility of the learning process; the student is allowed to make decisions about various aspects of the learning process to make self-regulation. The student must use his/her mental abilities by engaging in complex instructional tasks during learning (Açıkgöz, 2003). Some methods that can be used in the active learning approach are concept mapping, problem-solving, and project-based activities (Güllükaya, 2006, cited in Aksoy & Kaleli-Yılmaz, 2011). In addition, one of the active teaching methods is game-based teaching (Baki & Ersoy, 2021).

Game-based teaching can be defined as placing the subject, concept or acquisition desired to be taught in a discipline into a game that will support teaching. The games to be selected in

---

<sup>1</sup> Re. Assist., Selcuk University, ebruergul28@hotmail.com

<sup>2</sup> Assist. Prof. Dr., Selcuk University, zbahar.ozdogan@hotmail.com

this process can be educational, instructional, and computer games whose processes are planned and carried out for a specific purpose (Sezgin, 2016; Ke & Grabowski, 2007). Game-based teaching significantly contributes to mathematics education, where students generally have negative attitudes (Baran Kaya & Gökçek, 2021). Orim and Ekwueme (2011) evaluated the benefits of using mathematics games in mathematics teaching under the titles of application, motivation, anxiety, and comprehension and found positive results in each title. According to Foster et al. (2011), games are the best way to increase students' participation in mathematics courses and to ensure effective learning. Games in mathematics education increase students' motivation for learning and provide concrete experiences about abstract mathematics topics (Stupiansky et al., 1999).

With the assumption that effective learning is an active process in which the learner builds new ideas on top of his/her previous knowledge and experiences (Başaran, 2004), it can be said that the use of games in mathematics education will provide effective mathematics teaching (Baki & Ersoy, 2021). At this point, it is seen that some studies have been carried out at the level of teacher training undergraduate programs, and mathematics curriculum (Ministry of National Education [MoNE], 2018; Council of Higher Education [CoHE], 2018). Renewed in 2018, the mathematics curriculum for grades 1-8. This curriculum states that games can be used in mathematics courses: *"The effect of developing a positive attitude towards mathematics-on-mathematics achievement cannot be ignored. Attempts should be made to include mathematics games in the sections deemed appropriate in relation to the unit contents."* (MoNE, 2018, p.15). This statement shows that teachers can prefer games as a method in the mathematics teaching process. The association of mathematics courses with games in the content of the Primary Mathematics Teacher Education Undergraduate

Programme (Council of Higher Education [CoHE], 2018) is evidence that teachers are trained in the use of games in mathematics education before their profession.

Finding out how the regulations of the curriculum makers to ensure the use of games in mathematics education is reflected in practice should be noticed as an essential research area in terms of the development of mathematics teaching in our country. In order to make a real evaluation, it is necessary to conduct a process evaluation with the people who are the subjects, influencers, and influenced by the process (Çil & Sefer, 2021). When previous studies are examined, some studies are carried out by obtaining opinions from various groups. In some of these studies, the pre-service teachers' opinions were included (Baran Kaya & Gökçek, 2021; Obay & Çelik, 2021; Saygı & Alkaş-Ulusoy, 2019; Usta et al., 2017). Some studies evaluated teachers' and pre-service teachers' opinions (Ayvaz-Can, 2020; Uğurel & Moralı, 2010). In some studies, only teachers' opinions were examined (Ateş & Bozkurt, 2021; Callaghan et al., 2018; Özata & Coşkuntuncel, 2019; Çil & Sefer, 2021; Doğan & Sönmez, 2019; Güneş, 2010; Güneş & Yünkül, 2021; Hanus & Fox, 2015; Martinie, 2005; Nabie, 2009; Proctor & Marks, 2013; Russo et al., 2020). Previous studies' general results show that using games in mathematics teaching is necessary. However, the results of the research conducted by Proctor & Marks (2013) indicate that very few teachers at the primary and secondary levels have had experience with games, and accordingly, they are not sufficiently inclined to use games in their mathematics courses. According to the results of the studies, the participants frequently stated that problems such as the use of games, design, cost, lack of physical environment, loss of time, etc., may occur. However, it is possible to say that most of the previous studies were limited to a single teaching branch. However, primary school and mathematics teachers are two teaching fields in which the use of games in mathematics teaching is frequently associated with both

curricula and higher education programs. Therefore, in order to observe the extensive impact of the use of games, it should be considered necessary to conduct research in which both primary school and mathematics teachers participate together, and their opinions are taken. In this research, the opinions of primary school and mathematics teachers were included together. The possible research results are expected to bring significant contributions to the literature. Accordingly, the research aims to reveal the opinions and thoughts of primary school and mathematics teachers about the use of games in mathematics education. For this purpose, answers to the following research questions will be sought:

1. How do primary school and mathematics teachers evaluate the use of games in mathematics teaching?
2. Which types of games do primary school, and mathematics teachers prefer, and for which purposes?

## **METHOD**

### **Research Design**

This study was a qualitative research approach. It designed a case study. Qualitative studies are preferred because they provide a realistic and holistic investigation of the participants' understandings, feelings, and thoughts (Yıldırım & Şimşek, 2018). In this context, the focus is on understanding and discussing a particular situation and process in depth by taking it realistically and determining its holistic characteristics (Merriam, 2018). For this study, the research is suitable for a case study since the case of "teacher views on the use of games in mathematics education" is examined.

### **SAMPLE GROUP**

Since the research aims to reveal the situation in two different teaching branches regarding the use of games in mathematics

teaching, the participants were selected from primary school and mathematics teachers. The chain and the criterion sampling techniques were used together in determining the participants. Chain sampling is one of the purposeful sampling techniques that allow reaching the first of the people who are interested in the research in cases where it is difficult to access the data, and then reaching the other participants by getting the information about who else can be reached from the first participant (Glesne, 2020). For this study, the study group was expanded to include other participants after reaching the first participants from both primary school and mathematics teachers. Criterion sampling is to study and review all situations that meet predetermined importance criteria (Patton, 2018). The researcher can create these criteria, or a pre-prepared list of criteria can be used (Yıldırım & Şimşek, 2018). For this study, 'using game(s) in mathematics courses' was determined as a criterion by the researchers. Although there is no definite number for the study group in qualitative research, the number of participants can be limited if data satisfaction is ensured (Creswell, 2017). For this research, after it was seen that data satisfaction was reached (the answers repeated to each other), the process of including participants was completed. At the end of the process, 76 teachers were reached. All participants were examined as a part of the research criteria, and it was seen that six participants did not match the criteria. A total of 25 participants could not be included in the study, because five did not declare voluntary participation and 15 had significant data losses in their responses (blank questions, irrelevant answers to questions, etc.). Accordingly, the final participants consisted of 50 people. Some demographic information about the participants are, 41 of the participants were female, and 9 were male. 28 of the participants are primary school teachers, and 22 of them are mathematics teachers. 4 of the teachers work in private schools and 46 of them work in public schools. 15 of the teachers teach at the secondary

school level and 7 of them teach at high school level. 28 teachers work at primary school level. 16 teachers have a seniority of 16 years or more. 15 teachers have 10-15 years of seniority. 5 teachers have 6-9 years of seniority. 13 teachers have a 2-5 years of seniority. 1 teacher has 1 year of seniority. 16 of the teachers have a master's degree in teaching. 34 teachers have a bachelor's degree in teaching.

## **DATA COLLECTION TOOL**

The data were collected through a semi-structured opinion form created by the researchers. The opinion form comprises five questions in which demographic information and teachers' opinions are determined. In the demographic information section, teachers were asked six questions about their gender, branches, professional seniority, the latest education level, the type of institution where they work, and the level of education they teach. There are two questions in the section aimed at revealing the teachers' views in the context of the research questions. These questions are as follows: "Can you explain the effect of using games in mathematics courses on your teaching processes?", "Which of the educational, instructional, or computer games do you prefer for teaching mathematics? Please explain which purpose is effective in this preference."

While creating the data collection tool, firstly, a literature review was conducted. As a result of this review, possible questions were created. The determined questions were presented to academicians working in mathematics teacher instruction and primary school teacher instruction for expert opinion. Two questions were selected from among the questions determined by the expert opinions and the common opinion of the researchers. First, the selected questions were transferred to a form created on "Google forms" to reach more participants. The form's link was sent to a group of 15 teachers, and the comprehensibility and functionality of the

questions were tested. As a result of the pilot implementation, it was determined that the questions in the data collection tool were understandable and suitable.

## **DATA COLLECTION PROCESS**

The data were collected over four months through a semi-structured opinion form created through “Google forms”, considering the cost and time factors. Obtaining data through internet-based platforms is shown by Creswell (2019) and Patton (2018) as a proper data collection method for qualitative research. In this direction, people who reach the open-ended questions in the form sent to them can express their opinions in writing within the given time (Creswell, 2019). For this research, a similar way was followed, and the form link was sent to the first participant who declared volunteer participation, and then the other participants were reached. The data collection process was completed at the point where the data in the form began to repeat itself.

## **DATA ANALYSIS**

Both researchers first read the data collected from 50 participants. During this reading, each participant was given a code name starting with the words “PST1” and “MT1”, and codes were created based on the participant’s responses. Sub-themes and themes were then reached through the codes determined. The themes and sub-themes determined by the researchers were compared and discussed regarding their similarities and differences. In these comparisons, it was seen that there were twenty-three sub-themes and five themes with similarities, four sub-themes, and one theme with differences. The opinions of a third colleague were taken for similar situations, especially those that create differences. As a result of the mutual exchange of views, the sub-themes were grouped under twenty-six headings and the themes under six

headings. The theme's information was presented based on the qualitative data analysis method. Accordingly, the main headings of the findings were expressed only with frequency values without quantifying the data with visual presentations. Direct quotations of the teachers supported the themes and sub-themes.

## **CREDIBILITY AND ETHICS**

Determining the validity and reliability of the data collection tools, research design, and data analysis used in the research affect the degree of acceptance of the research (Guba & Lincoln, 1994). For this reason, the data collection tool used in the research was created due to the literature review and expert opinions. In addition, a pilot study was conducted before its final use. The fact that another expert analyzed the research data, i.e., providing colleague or expert confirmation, contributes positively to validity (Denzin & Lincoln, 2011). In this study, data analysis processes were controlled by a colleague (academician). According to Patton (2018), determining the agreement coefficient between coders is necessary for reliability. In this study, the coefficient score was on par with Miles & Huberman's (1994) coefficient for the agreement.

The obtained data from participants who declared voluntary participation were included only in the study. The participants' identity information was kept confidential, and they were given code names as "PST1" (first participant, primary school teacher) and "MT1" (first participant, mathematics teacher), according to the branch of teaching. In addition to the code names, "P" instead of primary school, "S" instead of secondary school, and "H" instead of high school were added to indicate the level of education they worked. The obtained data were not shared with any person or institution, excluding the researchers and the colleague who conducted the analysis. In order to ensure the transparency of the research, the raw data were kept for a certain period of time.

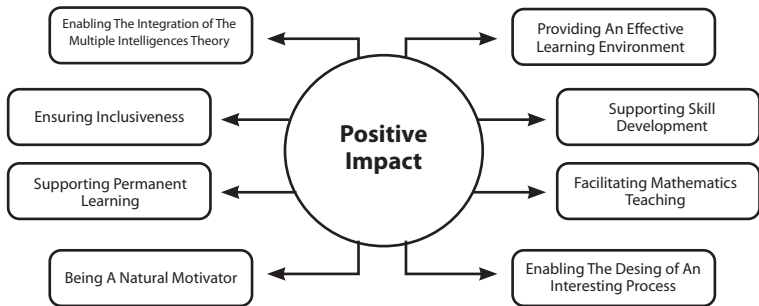


The ethics committee permission for the research was obtained following the decision of Selçuk University Ethics Committee dated 15.03.2022, and numbered E.254279.

## **FINDINGS**

### **Primary School and Mathematics Teachers' Evaluations on the Use of Games in Mathematics Teaching**

This section presents content analyses of teachers' answers to the first question of the study, "How do primary school and mathematics teachers evaluate the use of games in mathematics teaching?". In line with the answers the teachers gave to the first question, two main themes and 15 sub-themes were reached. The first central theme, "Positive Impact" and eight sub-themes related to it are presented in Figure 1.



**Figure 1.** Positive impact theme and sub-themes

According to Figure 1, most of the teachers ( $f=40$ ) stated that games positively affected mathematics education processes at primary, secondary and high school levels. Among the positive effects, the most frequently mentioned effect belongs to the sub-theme of "Providing Effective Learning Environment" ( $f=15$ ). Some of the teacher's written statements that were effective in the emergence of this theme are as follows:

*“First of all, games are important in terms of enabling students to access information by doing and experiencing. In addition, while playing games, children can learn both winning and losing, time management, and reacting positively to their opponents. The fact that it enables us to teach by having fun like children and makes the course active and enjoyable has a positive effect.” PST6\_P*

*“Because a child first learns by doing and playing games. Basically, they live with this. Therefore, it makes students happy. Games create a good learning environment and increase students’ sense of curiosity. Students manage to adapt mathematics to life through games.” PST18\_P*

*“It is easier to draw students’ attention to the course with games. You can teach many subjects with games. It helps the courses to pass more efficiently.” MT7\_H*

*“It is more fun, motivation is higher. They can learn all the subjects they want to learn within the curriculum. I can reach more students, I can make healthier evaluations, I can do more exercises.” MT8\_S*

The sub-theme of “Facilitating Mathematics Teaching” constituted the positive impact theme with the second highest impact ( $f=7$ ). Some teacher-written statements that were effective in the formation of this theme can be presented as follows:

*“The best way to teach children, especially at primary school age, is play. For this reason, I often use games in mathematics teaching... Games that benefit the development of students’ cognitive and physical intelligence both facilitate learning mathematics and remove prejudice against mathematics. Students establish a mathematical connection with the game. Thus, they learn mathematics more easily.” PST11\_P*

*“I think that games facilitate learning and minimize prejudices*

*against the course. Gamification enables my students to see that mathematics is used in daily life, in nature, in art, in fact everywhere. Thus, mathematics has become a more popular course for my students, I have many students who say that I could not do mathematics before, but thanks to you, I understand it very well.” PST24\_P*

*“While teaching mathematical subjects, gamification makes it easier to learn the subjects. Since it is easy for students to learn, gamification also supports us.” MT9\_S*

*“Children learn best by playing. Mathematics games will facilitate learning as they will concentrate on mathematical concepts. Since it will facilitate teaching, it creates a happy student happy teacher cycle.” MT20\_H*

The “Supporting Skill Development” sub-theme was seen as the third-highest effect under the positive effect theme ( $f=6$ ). Some of the teachers’ written statements that were effective in the formation of this sub-theme are as follows:

*“Although it is difficult to teach with games in crowded classes, children learn more permanently with games. In addition to reinforcing the subject, I think it develops respect for each other, cooperation, solidarity, self-expression, and many other skills. In the courses we play games, children’s facial expressions and energies tell everything.” PST3\_P*

*“...In addition to having a pleasant time, other gains are realized. They can gain skills such as stress management, anxiety and worry control, managing emotions and thoughts...” MT6\_H*

*“...Processing mathematics with games will help the acquisition of the acquisitions in the curriculum and contribute to the development of 21st century skills such as decision making, collaborative working, reasoning, analyzing, critical and*

*creative thinking. Teachers' skills such as developing different methods and ensuring the comprehension of mathematics subjects, observing the students' active participation in the process of reaching the learning objectives and creating auxiliary activities for learning deficiencies are also developed..." MT17\_S*

The sub-theme of "Supporting Permanent Learning" was the fourth highest number of positive impact statements (f=5). The written statements of some teachers that are effective in the formation of the sub-theme are as follows:

*"Games attract students' attention very much. Students learn mathematical rules in the game. It accelerates their processing ability and provides more permanent learning." PST15\_P*

*"For children, the information they learn is more permanent and interactive. It is also more possible to teach courses efficiently. It can be especially useful in teaching subjects such as mathematical operations and numbers." PST27\_P*

*"Although there is a high probability of control problems in crowded classes, this situation can be turned into an advantage through co-operation and interactive courses. In this way, I think it will help permanent learning and attract interest." MT16\_S*

The sub-theme "Enabling the Design of An Interesting Process" constitutes the fifth sub-theme (f=4). Some of the teacher-written expressions that are effective in the formation of this sub-theme are as follows:

*"It is easier to attract students' attention with games and they learn by having fun... Gamification can be done in every subject. They can learn everything with fun..." PST5\_P*

*"It can be used to increase interest in the course. They can learn three-dimensional and analytical thinking..." MT13\_S*

*The sub-theme of "Being a Natural Motivator" constituted the*

*sixth sub-theme mentioning the positive effect (f=2). Only the primary school teachers' statements were effective in forming this theme. These statements are as follows:*

*"It encourages students towards the course. It increases their motivation towards the course. This intrinsic motivation has a very good effect on maths learning." PST12\_P*

*"My observation is that it supports effective learning by increasing children's motivation. My students are more willing to participate in the course in game environments. They are eager to learn." PST20\_P*

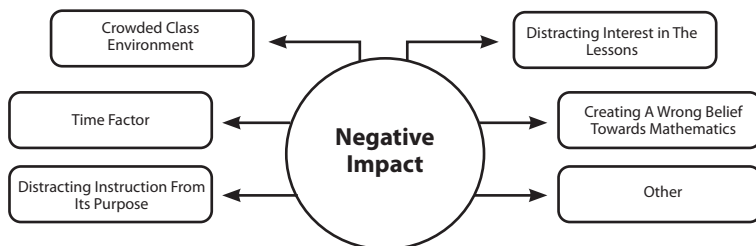
*The "Ensuring Inclusiveness" sub-theme is the seventh sub-theme expressing the positive effect. Only one primary school teacher's statement was effective in the formation of this theme. This statement can be presented as follows:*

*"...In some subjects, we may not be suitable for the learning and perception speed of students with individual differences. However, since the game appeals to all of them, everyone leaves the course having learnt something in gamified processes..." PST21\_P*

The sub-theme "Enabling the Integration of the Multiple Intelligences Theory" is the eighth sub-theme expressing the positive effect. Only one mathematics teacher's statement was effective in the formation of this theme. This statement is as follows:

*"I think that games appeal to more than one type of intelligence. While playing a game, it is possible to touch, hear, see, verbalize, write, draw, make calculations, jump, jump, and use songs at the same time. It is possible to turn any course you want into a game for all types of intelligence, of which maths is the most important one..." MT3\_S*

The second main theme of the findings, "Negative Impact" and six sub-themes are given in Figure 2.



**Figure 2.** Negative impact theme and sub-themes

According to Figure 2, some of the teachers ( $f=10$ ) were concerned that games may negatively affect mathematics education processes at primary, secondary, and high school levels. It was observed that there was more than one negative situation in the teachers' statements. Therefore, each concern expression of the teachers was included in the analysis phase. Accordingly, the situations that caused concern the primary school teachers expressed as negativity were most prominently gathered in the "Time Factor" sub-theme ( $f=5$ ). Some of the teacher's written expressions that were effective in the formation of this theme are as follows:

*"...Sometimes the fact that the games take too long can slightly prolong the learning process of the information to be given."*  
 PST18\_P

*"...There may be a problem in raising the subjects in the time allocated to the curriculum. In other words, every learning outcome in the programme may not reach the end of the year."*  
 PST26\_P

*"...However, it is very difficult to allocate time for games due to a busy curriculum. If we allocate time, it takes a lot of time. It becomes difficult to keep up with the curriculum. In order to keep up with the curriculum, it is necessary not to include too many games. A few games do not take much time."* MT5\_H

The “Crowded Classroom Environment” sub-theme is the second sub-theme (f=4) that includes statements that may cause negative effects. Some of the teacher written statements that are effective in the formation of this sub-theme are as follows:

*“Teaching with games is more fun and a process in which the child is active both in the introduction of the course and in the learning and reinforcement stages of the subject. But it is difficult to play some games in crowded classes. Since each student is not at the same level, it also affects the continuity of the game. When the game becomes boring, we cannot reach the goal...”* PST1\_P

*“... There may be difficulties in teaching games in crowded classes and in the Southeast where Turkish vocabulary knowledge is weak. Even in crowded classes, there may be difficulties in keeping the classroom dominance at the same level.”* MT4\_H

The sub-theme of “Distracting Instruction from its Purpose” includes the statements of the situation in which the third negative effect may occur (f=3). Only the primary school teacher’s statements were effective in the formation of this theme. Some of these statements are as follows:

*“...However, sometimes the games go beyond the achievement that the children should reach and become distracting for the students. Therefore, I think that even the game should be enough. Any excessive way and method that goes beyond its purpose will make mathematics teaching ineffective for students.”* PST16\_P

*“I think that educational games attract children’s attention more and provide a focus on the work done for a much longer period of time. However, the use of the same game for a long time can lead to distraction and the student may be distracted from the subject.”* PST28\_P

The sub-theme of “Distracting Interest in The Lessons” constitutes the fifth sub-theme of the negative impact theme. This sub-theme was determined by the statement of only one mathematics teacher. This statement is as follows:

*“I think that the concept of games is misunderstood by teachers. Therefore, I do not agree with the use of too many games in courses. The teacher creates an unnecessary freedom area for the child with the game and the interest in the course starts to be distracted.” MT1\_S*

*The sub-theme “Creating A Wrong Belief of Mathematics” constitutes the sixth sub-theme of the negative impact theme. This theme emerged with the statement of a mathematics teacher. This statement is as follows:*

*“...If students get used to only the easy and game aspects of mathematics, they may think that mathematics consists only of these and may lose motivation for the future.” MT19\_S*

*“Other” sub-theme constitutes the last sub-theme of the negative impact theme. This sub-theme was formed with the statement of a mathematics teacher. The teacher’s statement stated some problems related to physical conditions. This statement is as follows:*

*“Problems may arise depending on the school physical structure and material support. It is not always possible to buy or prepare games financially. Playing online games requires internet infrastructure. This is not sufficient in every school.” MT22\_S*

### **Types of Games Selected by Primary School and Mathematics Teachers and Reasons for Preference of Games**

Under this heading, content analysis of the answers to the question “What kind of types of games do primary school and mathematics teachers prefer and for which purposes?” are



presented. Four main themes and 12 sub-themes were reached in line with the answers given by the teachers. The relationship between the themes and sub-themes is shown in Figure 3.



**Figure 3.** Game types and purposes of preference of games

According to Figure 3, the statements of the teachers participating in the study about the types of games used in mathematics education were grouped under the theme titles of all games (instructional-computer-educational) ( $f=16$ ), computer games ( $f=11$ ), educational-computer games ( $f=6$ ) and instructional games ( $f=17$ ). When the sub-themes of the reasons for preferring these game types are analyzed, it is understood that some choices are specific to the game type, and some are common to all game types. To put it briefly, the purposes of the teachers who prefer instructional games intersect with those who prefer all game types to ensure active participation, skill development, and ensuring

permanence. At another point, the aims of teachers who prefer instructional games intersect with the aim of subject-concept reinforcement of teachers who use educational and computer games together. Among the independent purposes of teachers who prefer to use all games, the purposes of attracting attention and providing interest and motivation are seen. While ensuring permanence refers to the intersecting purposes of teachers who prefer computer games and teachers who prefer all game types, the purpose of skill development indicates the common purpose of teachers who prefer computers, all games, and instructional games. Teachers who prefer computer games use computer games for subject-concept visualization and creating a fun environment. It is understood that teachers who prefer to use educational and computer games together use these games to realize measurement and evaluation purposes. Multiple instructional purposes and subject-concept teaching constitute the common purposes of selecting various game types. When the teachers' statements about the purposes of choosing game types are analyzed, it is understood that they predominantly stated that they could achieve more than one instructional purpose with games ( $f=17$ ). Some of the teacher statements exemplifying this situation are as follows:

*"It is used in theme introductions, for subject repetition, as homework. Digital games such as Wordwall and learning apps serve every purpose." PST2\_P*

*"It is used in drawing attention, teaching process and evaluation. I play the rhythmic counting game I prepared myself and games such as matching and wheel on the websites." PST5\_P*

*"It can be used in teaching acquisitions, visualization, increasing retention and reinforcement. I taught the rhythmic number with HOPSCOTCH." PST8\_P*

*"All game environments can be used to attract, evaluate and deepen attention." PST14\_P*

*“It can be used for the purposes of concretising abstract concepts, increasing students’ processing skills, problem solving competencies, increasing thinking speed, increasing self-confidence and motivation. I use games such as Sudoku, Operation Square, and Kendoku apartments.” MT17\_S*

*“Considering the intensity of the maths curriculum, it would be preferred to have games for the subjects. If web 2 tools are accepted as games, yes. Web 2 tools (especially GeoGebra) visualization of graphics in a computer environment (on smart board), seeing how the graphics change in response to each value will increase the student’s interest in the subject and will be fun and effective as it answers questions.” MT20\_H*

*“It can be used to support learning and teaching. Maths games can be used for repetition during the teaching of the subject or after learning has taken place. Maths games increase retention and facilitate learning. I use the games in textbooks, the games in the computer environment or the games I produce myself. I think all of them are important.” MT21\_S*

The teachers who used different types of games in mathematics teaching processes stated that they prefer games for developing mathematical skills ( $f=7$ ). Some written statements showing this situation are as follows:

*“Speed is very important especially in four operation skills, I care about timed maths games, and I use them in my courses. I prefer online and timed games a lot. I give importance to them in terms of collecting their attention and being practical.” PST11\_P*

*“For the development of maths skills. I use it all the time. I usually play games made with materials such as balloons and glasses that I come up with at that moment.” PST23\_P*

*“I use games to develop my students’ ability to think fast, different and wide-angle, multi-dimensional mathematical thinking, analysis and synthesis.” MT15\_S*

The third reason for teachers' preference for games is that games are a method that can be used in subject and concept teaching (f=7). Some teacher-written statements showing this situation are as follows:

*"I used the four operations and rhythmic counting games in computer environments; the mathematics topics I created in the classroom and received from my friends (decimal-unity, digit name, digit value, cup-paper matching game related to each of the four operations). It is very useful for me in terms of comprehending and teaching the subject." PST1\_P*

*"It can be used for effective learning of achievements specific to each grade level. I used the ready-made application games of Okulistik and Morpa Campus in mathematics teaching." PST6\_P*

*"It can be used as a break for students who are overwhelmed by courses. In the meantime, rest is provided, and education continues at the same time. Because games can sometimes be more instructive than lectures. I used games many times in my maths courses. I mostly chose games that require attention and productive ideas outside the branch." MT6\_H*

The fourth reason for the teachers' preference is that they use various types of games in mathematics teaching to ensure permanence in subject-concept teaching (f=5). Some of the teacher's written statements are as follows:

*"It is very effective for permanent learning, especially in numbers, fractions, problem solving skills, all environments can be preferred according to the situation. For example, digital environments can provide a better infrastructure for problem solving. It is the same for fractions. Educational or instructional games can be effective for numbers (hopscotch, boom game, etc.)." PST13\_P*

*“It can be used to provide more permanent learning. My choice of game type varies according to the subject. I use counting, group competitions, etc.” MT8\_S*

*“More permanent learning is provided with 3 dimensions in a computer environment. I see this while teaching 3D geometric objects.” MT12\_S*

The fifth preference of teachers for using various games in mathematics courses was to reinforce mathematical topics or concepts (f=4). Some written statements showing this situation are as follows:

*“It can be used more for reinforcement. After comprehending the subject, I prefer games that reinforce the course, usually educational games played in groups or one-to-one.” PST3\_P*

*“To reinforce the subject. I used the taboo game for a better understanding of the terms.” MT14\_S*

The sixth reason why teachers preferred different types of games in mathematics courses was to draw attention to the course (f=3). The written statements of some teachers showing the situation are as follows:

*“An educational game can be used to attract attention and arouse curiosity at the beginning of the subject in a way that does not take too much time.” PST19\_P*

*“It can be used to attract attention when students have difficulty in being motivated for the course.” MT19\_S*

The seventh reason for the teachers to choose various types of games in mathematics education processes was that games provided active participation in the course (f=2). Some teacher statements showing this situation are as follows:

*“I used almost all games because they encourage student participation.” MT16\_S*

*“It can be used to increase the dominance of classroom management and to make the course active. I prepared various games with concrete activities and acted to actively involve students in the course.” PST22\_P*

The eighth preference reason of the teachers who expressed the necessity of using various types of games in mathematics education processes was gathered under the title of providing interest and motivation (f=2). This situation was stated only by mathematics teachers. The written statements of the teachers are as follows:

*“It helps to increase interest and motivation in the course. It is important to play a multiplication table game in order to memorize the multiplication table.” MT1\_S*

*“Gathering more attention can be useful in delaying the attention span. Games in which children will be active and concretize abstract phenomena can be preferred.” MT3\_S*

Finally, there is one primary school teacher who prefers to use games in mathematics courses to create a fun lesson environment and one mathematics teacher who prefers to use games in the assessment and evaluation phase and for visualizing the subject or concept. The direct statements of the teachers are as follows:

*“I use gamified activities (in the form of quiz) that I designed in environments such as Quiziz, Kahott to make the course fun.” PST12\_P*

*“It can be used for end-of-course assessment and evaluation. I used it in one of my courses as follows: I took the children out to the garden, determined an area for the students, and 5 meters away from this area, I placed the cards on which many numbers were written on the ground so that they did not overlap. Then I asked them to separate into pairs and take turns to find the prime numbers and bring them to me. It was a nice and fun game for me to reveal how much they learned*

*about prime numbers. I also think that games can be prepared and used with Web 2 tools such as Wordwall and GeoGebra to evaluate other subjects.” MT18\_S*

*“In order to concretize the concepts in the subject, I provided visualization support by playing the games related to the subject on the Wordwall site.” PST11\_H*

## **CONCLUSION, DISCUSSION, AND RECOMMENDATIONS**

According to the results obtained from the research, primary school and mathematics teachers think that using games in the mathematics teaching process has a positive effect. A significant majority of the teachers state that the use of games in mathematics courses provides an effective learning environment. In addition, there are several statements from teachers that game-based learning facilitate learning, improves cognitive, affective, and psychomotor skills, provides permanent learning, increases interest in the course, makes all students active, appeals to individuals with different types of intelligence, and helps concept teaching. In similar studies conducted with teachers in the literature, it is seen that teachers have similarly expressed positive opinions about the use of mathematical games (Ateş & Bozkurt, 2021; Callaghan et al., 2017; Çil & Sefer, 2021; Doğan & Sönmez, 2019; Güneş, 2010; Güneş & Yüncül, 2021; Nabie, 2009; Özata & Coşkuntuncel, 2019; Proctor & Marks, 2013; Russo, Bragg & Russo, 2020; Uğurel & Morali, 2010; Usta et al., 2017). In the studies on the effectiveness of teaching mathematics with games, it was found that game-based learning increased academic achievement (Divjak & Tomić, 2011; Pehlivan, 2020; Türkmen, 2017), provided a rich learning experience (Heshmati et al., 2018), and contributed to the development of positive attitudes towards mathematics (Aksoy & Kaleli-Yılmaz, 2011; Katmada et al., 2014), improves thinking and problem-solving skills (Bottino et al., 2013; Kebritchi et al., 2010; Sanders, 2016).

When primary school and mathematics teachers' opinions on the use of games in mathematics teaching are analyzed, teachers express that games have negative effects and limitations in some aspects. Teachers stated that using games in crowded classrooms makes classroom management and course processes difficult. However, contrary to this view, researchers argue this is a prejudice (Van de Walle et al., 2016). In addition, the teachers stated that teaching with games creates disruptions in the process when the time allocated to the subject in the curriculum is taken into consideration, that the skills for the determined outcomes sometimes do not emerge in the process of teaching with games, that it may reduce the interest in the course after a while, that the gamification of mathematics may be misperceived, and that the lack of physical environment/material may prevent the effective implementation of game-based learning. The results obtained here are similar to the results of studies examining teacher opinions on teaching with games (Güneş, 2010; Hanus & Fox, 2015; Martinie, 2005; Özata & Coşkunel, 2019; Obay & Çelik, 2021). However, as stated by a secondary school mathematics teacher in this study, teachers have difficulties finding or preparing games (Çil & Sefer, 2021; Doğan & Sönmez, 2019) is a significant limitation for the effective use of this method. In this context, written or digital resources containing games for the objectives at each grade level in mathematics teaching should be provided, and the material support provided by MoNE in physical or digital environments should be increased.

In the study, it can be said that teachers included educational, instructional, and computer games in their mathematics courses for various purposes. To emphasize in particular, it is seen that instructional games, which are developed and planned for a specific purpose, are preferred more ( $f=17$ ). When the teachers' statements are analyzed, it is seen that primary school teachers



mainly express this opinion. It can be thought that the students, who are the education level they work at, are more prone to playing games, and the widespread views on the importance of the education the students receive at the primary school level in raising students with a correct mathematical infrastructure affect the preference of primary school teachers for instructional games. In other respects, it is also seen that only computer games ( $f=11$ ) and the combination of educational-computer games ( $f=6$ ) are included in mathematics courses. The fact that there are teachers who include all instructional-computer and educational games in their mathematics courses shows that different types of games are included.

Moreover, it is vital in terms of enriching the content of teaching. In addition, the fact that most teachers included digital games is a remarkable result considering the necessity and importance of using technology today. As a matter of fact, when the studies on teaching mathematics with games in recent years are examined, it is seen that almost half of the studies include computer games (Erşen & Ergül, 2022). Noteworthy, it is thought that teachers' inclusion of some cultural games under educational games will ensure the transfer of cultural heritage and increase the value students attach to mathematics. In his study, Hacısalihoglu-Karadeniz (2017) indicated that using culture-based traditional games in mathematics teaching will yield positive results.

Teachers expressed their reasons for preferring games as; achieving multiple instructional goals with games, developing mathematical skills, games being effective in subject-concept teaching, ensuring retention, reinforcing concepts, increasing attention to the course, ensuring active participation, making the course fun, concretizing concepts, and conducting alternative measurement and assessment. These opinions of the teachers also support their positive opinion on the use of games in mathematics

teaching. Moreover, it is also an indication that games that can be used in mathematics courses can be sufficient in achieving many of the goals aimed to be achieved in education-teaching processes. Rosas et al. (2003) stated that teachers see games as an entertainment tool rather than an educational tool. In contrast, it is noteworthy that the teachers in this study had positive views on the use of games in mathematics teaching and included games in their courses. This may be since most of the teachers participating in the study ( $f=34$ ) had a professional seniority of 15 years or less. In other words, considering the years of education that the teachers graduated, it can be said that they graduated from the university by completing a curriculum in which constructivist approach practices are at the forefront at the undergraduate level. This situation can also be important evidence of how the pre-service education shapes teachers' practices and views in the teaching process. In this regard, it is necessary to carry out studies in which the views of pre-service teachers who took "Game-based mathematics instruction" courses at the undergraduate level and those who did not take the course on "Game-based mathematics instruction" are examined comparatively after they start to work.

## **REFERENCES**

- Açıkgöz, K. Ü. (2003). *Aktif öğrenme*. İzmir: Eğitim Dünyası.
- Aksoy, N. C., & Kaleli-Yılmaz, G. (2011). The influence on the attitudes towards mathematics of the 6th students of game supported instruction in fractions unit. *Bayburt University Journal of Faculty of Education*, 6(1-2), 105-117. <https://dergipark.org.tr/en/pub/befdergi/issue/23152/247325>
- Ateş, B. K., & Bozkurt, E. (2021). Classroom teachers' views on teaching mathematics through games. *Journal of Muallim Rifat Faculty of Education*, 3(2), 1-17. <https://dergipark.org.tr/en/pub/mrefdergi/issue/64326/836322>
- Ayvaz-Can, A. (2020). Primary school teacher candidates' metaphoric perceptions about "mathematics game". *Marmara University Atatürk Education Faculty Journal of Educational Sciences*, 52, 482-504. <https://doi.org/10.15285/maruaeabd.683137>
- Baki, Ü., & Ersoy, E. (2021). Reflections from a game-based mathematics teaching lesson. *Turkish Journal of Mathematics Education*, 2(3), 97-118. <https://tujme.org/index.php/tujme/article/view/45>

- Baran-Kaya, T., & Gökçek, T. (2021). Analysis of games designed by the secondary school pre-service mathematics teachers, *The Journal of Buca Faculty of Education*, 52, 600–621. <https://doi.org/10.53444/deubefd.962734>
- Başaran, B. I. (2004). Active learning and multiple intelligence: A review. *Aegean Journal of Education*, 5(1), 7-15. <https://dergipark.org.tr/en/pub/egedf/issue/4920/67308>
- Bottino, R. M., Ott, M., Tavella, M. (2013). Children's performance with digital mind games and evidence for learning behaviour. In *Information Systems, E-learning, and Knowledge Management Research: 4th World Summit on the Knowledge Society*, 21-23 September 2011, Mykonos, Greece, (pp. 235-243).
- Callaghan, M. N., Long, J. J., van Es, E. A., Reich, S. M., & Rutherford, T. (2018). How teachers integrate a math computer game: Professional development use, teaching practices, and student achievement. *Journal of Computer Assisted Learning*, 34(1), 10–19. <https://doi.org/10.1111/jcal.12209>
- Creswell, J. W. (2017). *Nitel araştırma yöntemleri* (Mesut Bütün & Selçuk Beşir Demir, Çev. Ed.). Ankara: Siyasal Kitapevi.
- Creswell, J. W. (2019). Bir görüşme tutanağı hazırlamak ve uygulamak Hasan Özcan (Ed.), *Nitel araştırmacılar için 30 temel beceri* içinde (pp. 126-137). Ankara: Anı Yayıncılık.
- Çil, O., & Sefer, F. (2021). The investigation of elementary school teachers' opinions on game- based mathematics activities, *Trakya Journal of Education*, 11(3), 1366–1385. <https://doi.org/10.24315/tred.814024>
- Denzin, N. K., & Lincoln, Y. S. (Eds.) (2011). *The sage handbook of qualitative research*. London: Sage Publ.
- Divjak, B., & Tomić, D. (2011). The impact of game-based learning on the achievement of learning goals and motivation for learning mathematics-literature review. *Journal of information and organizational sciences*, 35(1), 15-30. <https://hrcak.srce.hr/69672>
- Doğan, Z., & Sönmez, D. (2019). Opinions of primary school teachers about the process of using mathematical games in mathematic lessons. *Marmara University Atatürk Education Faculty Journal of Educational Sciences*, 50(50), 96–108. <https://doi.org/10.15285/maruaeabd.545417>
- Erşen, Z. B., & Ergül, E. (2022). Trends of game-based learning in mathematics education: A systematic review. *International Journal of Contemporary Educational Research*, 9(3), 603-623. DOI: <https://doi.org/10.33200/ijcer.1109501>
- Foster, A., Katz-Buonincontro, J., & Shah, M. (2011). Designing a game-based learning course: K-12 integration and pedagogical model. In *Society for Information Technology & Teacher Education International Conference*, March 2011, (pp. 1477-1483).
- Glesne, C. (2020). *Nitel araştırmaya giriş* (Ali Ersoy & Pelin Yalçinoğlu, Çev. Ed.). Ankara: Anı Yayıncılık.
- Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of Qualitative Research*, 2(163-194), 105-117.

- Güneş, D., & Yünkül, E. (2021). Assessments of classroom teachers on the use of mind and intelligence games in primary school, *International Journal of Social Sciences Academy*, 5(5), 784-803. <https://doi.org/10.47994/usbad.893591>
- Güneş, G. (2010). *Teachers' views on the use of games and activities in teaching mathematics at second level of primary education (Kars province example)*. (Master thesis), Kafkas University, Kars.
- Hacısalihoglu-Karadeniz M. (2017). A general review of acquisitions and problems in the process of adapting and applying traditional children's games into maths, *Kastamonu Education Journal*, 25(6), 2245-2262.
- Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education*, 80, 152-161. <https://doi.org/10.1016/j.compedu.2014.08.019>
- Haylock, D., & Cockburn, A. D. (2003). *Understanding mathematics in the lower primary years: A guide for teachers of children 3-8*. London: Sage Publ.
- Heshmati, S., Kersting, N., & Sutton, T. (2018). Opportunities and challenges of implementing instructional games in mathematics classrooms: Examining the quality of teacher-student interactions during the cover-up and un-cover games. *International Journal of Science and Mathematics Education*, 16(4), 777-796. <https://doi.org/10.1007/s10763-016-9789-8>
- Katmada, A., Mavridis, A., & Tsiatsos, T. (2014). Implementing a game for supporting learning in mathematics. *The Electronic Journal of e-Learning*, 12(3), 230-242.
- Ke, F., & Grabowski, B. (2007). Gameplaying for maths learning: Cooperative or not?. *British journal of educational technology*, 38(2), 249-259. <https://doi.org/10.1111/j.1467-8535.2006.00593.x>
- Kebritchi, M., Hiruni, A., & Bai, H. (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. *Developmental Science*, 55(2), 427-443. <https://doi.org/10.1016/j.compedu.2010.02.007>
- Martinie, S. (2005). Families ask: Games in the middle school. *Mathematics Teaching in the Middle School*, 11(2), 94-95. DOI: <https://doi.org/10.5951/MTMS.11.2.0094>
- Merriam, S. B. (2018). *Nitel araştırma: Desen ve uygulama için bir rehber* (Selahattin Turan, Çev. Ed.). Ankara: Nobel Yayıncılık.
- Miles, M. B., & Huberman, A. M. (1994). *An expanded sourcebook: Qualitative data analysis* (2. Ed.). Thousand Oaks, CA: Sage Publ.
- Millî Eğitim Bakanlığı [Ministry of National Education-MoNE]. (2018). *Matematik dersi öğretim programı (ilkokul ve ortaokul 1, 2, 3, 4, 5, 6, 7 ve 8. sınıflar)* (26.01.2023 tarihinde <http://mufredat.meb.gov.tr/Dosyalar/201813017165445MATEMATIK% C 4 % B 0 K % 2 % C 3 % 9 6 % C 4 % 9 E R E T % C 4 % B 0 M % 2 0 P R O G R A M I % 2 0 2 0 1 8 v> adresinden ulaşılmıştır.)
- Nabie, M. J. (2009). *Cultural games in Ghana: Exploring mathematics pedagogy with primary school teachers*. (Doctoral thesis). University of Alberta, Canada.

- Obay, M., & Çelik, H. C. (2021). Examining middle school mathematics teachers' views on games used in education in terms of culture, education, and association. *Electronic Journal of Social Sciences*, 20(80), 1915-1932.
- Orim, R. E., & Ekwueme, C. O. (2011). The role of games in teaching and learning of mathematics in junior secondary schools. *Global Journal of Educational Research*, 10(2), 121-124.
- Özata, M., & Coşkuntuncel, O. (2019). Opinions of secondary school mathematics teachers on the use of educational math games in mathematics teaching, *Mersin University Journal of the Faculty of Education*, 15(3), 662-683. <https://doi.org/10.17860/mersinefd.619983>
- Patton, M. Q. (2018). *Nitel araştırma ve değerlendirme yöntemleri* (2. Ed) (M. Bütün & S. B., Demir, Eds. & Trans.). Ankara: Pegem Akademi Yayıncılık.
- Pehlivan, F. (2020). *The impact of gamification on mathematics success, motivation and learning strategies in the flipped classrooms* (Master's Thesis). Aydın Adnan Menderes University, Aydın.
- Pehlivan, H. (2014). *Oyun ve öğrenme*. Ankara: Anı Yayıncılık.
- Proctor, M. D., & Marks, Y. (2013). A survey of exemplary teachers' perceptions, use, and access of computer-based games and technology for classroom instruction. *Computers & Education*, 62, 171-180. <https://doi.org/10.1016/j.compedu.2012.10.022>
- Rosas, R., Nussbaum, M., Cumsille, P., Marianov, V., Correa, M., & Flores, P. (2003). Beyond nintendo: Design and assessment of educational video games for first and second grade students. *Computers & Education*, 40(1), 71-49. [https://doi.org/10.1016/S0360-1315\(02\)00099-4](https://doi.org/10.1016/S0360-1315(02)00099-4)
- Russo, J., Bragg, L. A., & Russo, T. (2020). How primary teachers use games to support their teaching of mathematics. *International Electronic Journal of Elementary Education*, 13(4), 407-419. <https://doi.org/10.26822/iejee.2021.200>
- Sanders, S. (2016). Critical and creative thinkers in mathematics classrooms. *Journal of Student Engagement: Education Matters*, 6(1), 19-27. <https://ro.uow.edu.au/jseem/vol6/iss1/4>
- Saygı, E., & Ulusoy-Alkaş, Ç. (2019). Views of the pre-service elementary mathematics teachers about memory games and contribution of memory games to mathematics teaching. *Bolu Abant İzzet Baysal University Journal of Faculty of Education*, 19(1), 331-345. <https://doi.org/10.17240/aibuefd.2019.19.43815-446550>
- Sezgin, S. (2016). Gamification of learning and teaching: game-based methods and strategies for study and education, *Journal of Open Education Practices and Research*, 2(1), 187-197.
- Stupiansky, W., Stupiansky, S., & Nicholas, G. (1999). Games that teach. *Instructor-Primary*, 108(5).
- Türkmen, G. P. (2017). *The effect of gamification methodology on students' achievements and attitudes towards mathematics*. (Master's Thesis). Erciyes University, Kayseri.

- Uğurel, İ., & Moralı, S. (2010). Usability of games in high school mathematics lessons, *Journal of National Education*, 40(185), 328-352.
- Usta, N., Işık, A. D., Şahan, G., Genç, S., Taş, F., Gülay, G., Diril, F., Demir, Ö., & Küçük, K. (2017). The opinions of pre-service teachers on the usage of games in mathematics teaching. *International Journal of Social Sciences and Education Research*, 3(1), 328–328. <https://doi.org/10.24289/ijsser.270771>
- Van De Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2016). *Elementary and middle school mathematics: Teaching developmentally*. Boston: Pearson Publ.
- Yıldırım, A. & Şimşek, H. (2008). *Sosyal bilimlerde nitel araştırma yöntemleri* (7. Ed.). Ankara: Seçkin Yayıncılık.
- Yüksek Öğretim Kurulu [Council of Higher Education-CoHE]. (2018). *Matematik öğretmenliği lisans program* (23.12.2022 tarihinde [https://www.yok.gov.tr/Documents/Kurumsal/egitim\\_ogretim\\_dairesi/Yeni-Ogretmen-Yetistirme-Lisans-Programlari/Matematik\\_Ogretmenligi\\_Lisans\\_Programi.pdf](https://www.yok.gov.tr/Documents/Kurumsal/egitim_ogretim_dairesi/Yeni-Ogretmen-Yetistirme-Lisans-Programlari/Matematik_Ogretmenligi_Lisans_Programi.pdf) adresinden ulaşılmıştır.)