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Research Article

Games in mathematics education: systematic literature review

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Abstract

The article delves into the crucial relationship between "mathematics education" and "games" by systematically reviewing the existing literature in this area. The initial screening process involved evaluating 285 articles based on specific selection criteria tailored to focus exclusively on research that intertwined mathematics education with gaming elements. Following this rigorous filtration, 24 articles emerged as relevant, aligning with the defined criteria, and were subsequently included in the detailed analysis. To facilitate easier reference, each article was assigned a unique code prefixed with the letter 'M' (for instance, M1, M2, M3), which allowed for structured discussions throughout the study. The analysis employed a systematic literature review method, coupled with document analysis. This approach not only enabled a thorough examination of the written materials but also provided insightful information surrounding the educational phenomena in question. The goal of the research was to identify key trends, methodological approaches, and significant findings within the combined realms of mathematics education and gaming. The findings showcased a diverse range of methodological strategies present in the examined studies, highlighting how gaming can enhance mathematical skills and conceptual understanding among learners. The research further underlined the increasing integration of games into educational practices and illustrated the potential advantages of gamification in promoting engagement and motivation in learning environments. In conclusion, the article provides a comprehensive overview of the current state of research bridging mathematics education and games. It offers valuable insights that can guide future studies and instructional strategies, ultimately aiming to promote more effective educational practices.

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Introduction

Learning is one of life's important skills. In the learning journey, on the basis of educational sciences, different teaching methods, different strategies and different approaches are being researched to pave the way for children to learn better. Therefore, different teaching strategies have been developed to make the learning process more attractive and effective. One of the strategies developed to make the learning process more enjoyable is the use of games in education (Gee, 2003; 2007). Strategies such as gamification, game-based learning, and game use are among the approaches that have attracted attention in recent years and have found more and more application areas (Deterding et al., 2011; Kiili, 2005). Because

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the use of games in education increases motivation and makes the learning process more active by enabling students to learn while having fun (Gee, 2003; 2007)

When the existing literature is reviewed, there is a broad consensus that games contribute to student learning experiences and are more effective than traditional methods in education (Gee, 2003; Papastergiou, 2009). Game-based learning also has strong links with constructivist approaches in education. The work of constructivist theorists such as Piaget and Vygotsky emphasize that learning is an experiential and social process (Piaget, 1954,1962; Vygotsky, 1978). Games provide students with this experiential learning environment. Problem solving processes within the game allow students to construct knowledge by encouraging their active participation (Piaget, 1954,1962; Vygotsky, 1978). Games provide students with problem solving, logical thinking and strategy development skills in a fun environment (Hamari et al., 2016; Shaffer, 2006; Van Eck, 2006, Squire,2005). The interaction provided by games makes learning processes more dynamic and allows students to develop different strategies (Papastergiou, 2009). In this way, games encourage students to actively participate in learning processes.

Mathematics is often perceived as a challenging and abstract learning area for students. For many years, mathematics education has also been seen as an area where many students struggle because abstract concepts can often be a source of anxiety for students (Ashcraft & Krause, 2007; Maloney & Belilock, 2012, Mayer, 1998, Artz & Armour Thomas, 1992; Marchis, 2011). Mathematics is perceived as an abstract subject for most students and this can lead to learning anxiety and negative attitudes. In difficult subjects such as mathematics, learning anxiety is a major obstacle for many students (Ashcraft & Krause, 2007). Game-based learning methods have the potential to reduce this anxiety (Plass, Homer, & Kinzer, 2015; Wouters, van Nimwegen, van Oostendorp, & van der Spek, 2013). Games make the learning process less challenging and make students feel more confident. This increases students' engagement in lessons and positively affects their learning experience (Ke, 2008). The integration of games in education has the potential to increase student achievement as well as reduce learning anxiety and create a positive learning environment (Ke, 2008; Boaler, 2016). Moreover, game applications make learning processes more structured by providing opportunities to monitor and evaluate students' achievements and learning goals (Boaler, 2016). Game-based learning increases students' interest in mathematics lessons and makes learning processes more meaningful (Harikrishnan, et al,2019).

In the literature, there are many studies on games and mathematics education (e.g. Anderson et al., 2008; Ke, 2008). For example, a study by Kill et al., on 2015 found that game applications helped students better understand and apply mathematical concepts. These findings further strengthen the role of games in education. Games help students understand mathematical concepts in a more concrete way and make the knowledge permanent (Sung et al., 2017). Additionally, research shows that teaching through games enhances academic achievement (Liang, Zhang, Long, Deng & Liu, 2019; Rawansyah, Pramudhita & Pramitarini, 2021; Rondina & Roble, 2019). In this context, digital and traditional games deepen students' conceptual understanding by engaging them in experiential learning (Papert, 1980). In particular, digital games have become an important tool for making sense of abstract mathematical concepts and provide students with opportunities for mathematical modeling, problem solving, and strategy development (Ke, 2008; Shute & Ke, 2012). While students develop problem solving skills through games, they also facilitate learning (Gee, 2003). In this context, the use of games in the classroom enables students to take a more active and participatory role in mathematics lessons. In addition to helping students transform mathematical concepts from abstract to concrete, games improve their mathematical thinking processes by offering different ways of learning (Boaler, 2016).

Based on the above research, we can conclude that the existence of studies on the integration of mathematics education through games has an important place in the literature. However, it is also curious which games are used in mathematics education and whether these games are effective or not. However, at this stage, we encounter concepts such as games, gamification, and teaching with games. When the related literature was examined, there was no research on the concepts and contexts of "games" in mathematics education. It is thought that making this distinction will contribute to the literature. In addition, which games are used in the use of games in mathematics education and how these conceptualizations are shaped are also considered as the subject of this study. It is thought that answering this question

will directly contribute to researchers and teachers. In conclusion, game-based learning emerges as an important tool in the context of mathematics education and can positively affect students' learning processes. This review will strengthen the place of game-based learning in education and provide information on how teachers and educational administrators can use these approaches more effectively. It will provide important clues on how game-based learning strategies can be implemented to make learning processes more effective and reduce students' anxiety about mathematics. The aim of this study is to examine how and in what ways games are used in mathematics education through a systematic review method. Answers to the following research questions will be sought.

Problem of Study

In this study, the articles about 'mathematics education' and 'games' in the Web of Science database were examined by using the systematic literature review method. In this way, it is aimed to provide a perspective to those working on this subject by looking at all researches holistically. It is foreseen that examining international studies on this subject will contribute to the national and international literature. It also has an important place in terms of guiding a future study by showing which areas the researches focus on and which areas are lacking. Presenting the resources obtained in the literature review collectively to someone who will conduct a study on this subject in the future will make it easier for the person to conduct research. In line with the purpose determined in this study, it is aimed to answer the following research questions:

- What are the methodological characteristics of education and educational research articles about "mathematics education" and "games" in Web of Science?
- What is the distribution of education and educational research articles about "mathematics education" and "games" in Web of Science according to the years of publication?
- What are the methods used in education and educational research articles about "mathematics education" and "games" in Web of Science?
- What are the sample groups in education and educational research articles about "mathematics education" and "games" in Web of Science?
- What are the sample sizes in education and educational research articles about "mathematics education" and "games" in Web of Science?
- What is the content analysis of education and educational research articles about "mathematics education" and "games" in Web of Science?
- What are the subfields (mathematics, health, technology, etc.) of education and educational research articles about "mathematics education" and "games" in Web of Science?
- How are the underlying terms (game, gamification, etc.) conceptualized in the content of educational and educational research articles about "mathematics education" and "game" in Web of Science?
- What are the names of games used in education and educational research articles about "mathematics education" and "games" in Web of Science?
- What are types of games used in education and educational research articles about "mathematics education" and "games" in Web of Science?

Method

Research Model

In this section, information about the research method, data collection and analysis is given. In this study, data were collected through a systematic literature review. In this study, a systematic review method was used to examine the studies on games used in math education. A systematic literature review is an approach to identifying, evaluating, and understanding all research related to a specific research question, topic, or phenomenon of interest (Kitchenham, 2004). In the systematic review process, Daniel and Harland's (2017) triple model approach was adapted and used in accordance with the specific aims of the review. The tripartite model consists of three main components: descriptive systematic review (provides a summary of the literature), synthesis systematic review (categorizes the research logically according to

relevant ideas, connections and rationales) and critical systematic review (provides evidence to support, infer or present new ideas about the literature).

This review focuses primarily on the synthesis and descriptive systematic review steps of the model. As part of the descriptive systematic review, a literature summary was created, presenting the distribution of included studies by year. During the synthesis systematic review, studies were examined within the categories outlined in the Publication Classification Forum (see Appendix). In addition, following the systematic review approach, the steps recommended by Newman and Gough (2020) for the systematic review process were followed:

In line with the guidelines proposed by Newman and Gough (2020), these steps are: (1)Formulating a research question, (2)To create a conceptual framework, (3)Identify inclusion and exclusion criteria, (4)Design a search strategy, (5)Conduct a comprehensive search for relevant studies, (6) Screening and selecting studies, (7)Evaluate the quality of work, (8)extract data, (9)Synthesize information and (10) It includes reporting findings.

Documents

Within the scope of the systematic literature review, as a result of examining the researches conducted in Web of Science until 2024; 285 articles were reached when the words "mathematics education" AND "game" were searched in the 'Topic' section. The inclusion criteria for these results are as follows: a. Being written in the field of education, b. Being open access and full text, c. Being in article format, d. The concepts of 'mathematics education' and 'game' in the topic, e. The language should be Turkish or English

When the 285 articles were filtered according to the above criteria 49 articles were identified as related to 'mathematics education' or 'games'. When these 49 articles were examined, it was seen that some studies were not directly related to "mathematics education" or "games", but these terms were only mentioned a few times in the study. Upon a detailed content analysis of these 49 articles, and the ones that were not related to 'mathematics education' or 'games' were removed, 24 articles remained. These 24 articles were found to meet all these criteria and were included in the study. Each of these articles was matched with a code and the articles were mentioned in the findings through these codes. In the code system, each article was assigned a number and these codes were created by adding the letter 'M' to the beginning of these numbers. (For example, M1, M2, M3...) The codes and colophons of these 24 articles, which will be examined with the systematic literature review method, are given on the references.

Analysis

Data analysis was conducted through document analysis. Document analysis is used to analyze written materials containing information about the phenomena to be researched (Yıldırım & Şimşek, 2021). The information obtained was analyzed through document analysis. With the document review method, it is possible to reach a comprehensive and structured synthesis of a large number of studies conducted with similar methods in order to determine the trends of research conducted through experts in the field. For document analysis, there are processes such as determining the selection criteria used in analyzing research, searching for studies in the relevant field, evaluation, data analysis and synthesis of these data (Dybå & Dingsøyr, 2008).

Results

In this section, the results obtained from the examination of educational and educational research articles about "mathematics education" and "games" in Web of Science in terms of methodological and content characteristics are discussed in the terms of the research questions.

The methodological characteristics of the articles

The distribution of education and educational research articles about "mathematics education" and "games" in Web of Science according to the years of publication is given below in Figure 1

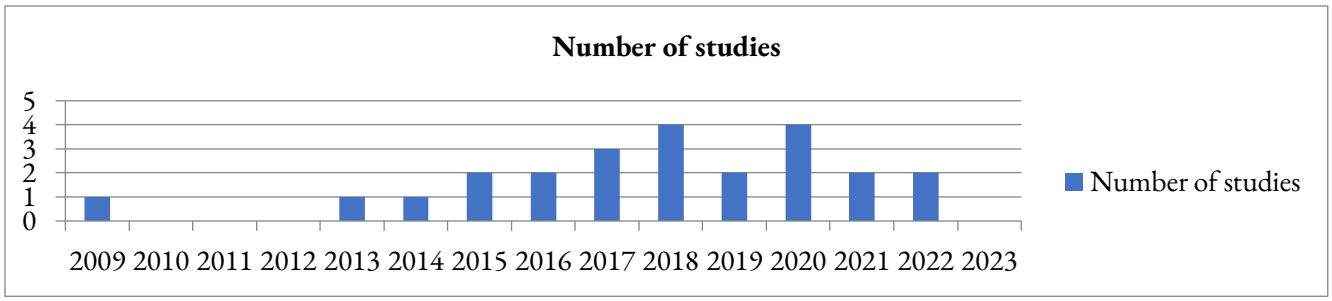

Figure 1. Change in the Number of Studies by Years

The distribution graph of the 24 studies that meet the inclusion criteria according to years is given in Figure 1. When the studies conducted until 2024 were examined, it was seen that the publications were generally published between 2013 and 2022. When we examine the table, we see that the most articles were written in 2018 and 2020 (f = 4). In 2009, there was 1 study on 'mathematics education' and 'games' within our criteria, and no articles were found in this context in 2010, 2011, 2012 and 2023.

The methods used in the articles

Information about the methods used in the studies is given in Table 1.

Table 1. Methods used in research

Method Used	**f**
Quantitative Method	9
Qualitative Method	8
Mixed Method	7
Total	**24**

According to the type of the 24 studies, it was analyzed whether they were quantitative, qualitative or mixed methods. As a result, it is seen that quantitative method (f=9) is preferred the most, followed by qualitative (f=8) and mixed (both qualitative and quantitative) (f=7) methods respectively.

The sample groups levels in the researches

After content analysis of the articles the finding information about the sample group in the studies is given in Table 2. Here's a screenshot of one of the activities at the Google Meet that took place in the calculus course.

Table 2. Sample group in the research

Sample group	**Article codes**	**f**
Primary school students	M4, M6, M8, M9, M13, M15, M17, M19, M20, M22, M23	11
High school students	M2, M3, M5, M7, M12, M14, M18, M23	8
University students	M1, M16	2
Graduate students	M46	1
Researchers	M7	1
Teachers	M6, M7, M21, M22, M24	5
Unspecified	**M2, M10, M11**	**3**

*****In some studies, more than one sample group was used.*

Table 2 shows the sample groups included in the studies. According to this table, the most studies were conducted on primary school students with 11 studies. This is followed by studies conducted on high school students (f=8). In the studies in this field, graduate students and researchers were included in the least number and it is seen that 1 study was conducted with each of these sample groups. In some studies, no specific sample group information could be reached. The information of such articles is also included in the 'unspecified' section in the table.

The sample sizes and the participation size

Information on the number of samples in the studies is given in Table 3.

Table 3. Number of samples used in research

Sample Size	Article code in which it appears	f
0-50	M1, M3, M5, M14, M12, M13, M21, M22	8
51-100	M9, M17, M24	3
101-200	M16, M18, M20	3
201-300	M7, M15, M19	3
301-400	-	0
401-500	-	0
501-1000	M23	1
501-1000	M4	1
Unspecified	M2, M6, M8, M10, M11	5
Total		**24**

In Table 3, we see the data on the sample sizes used in the studies. According to the table, the most preferred sample size is between 0-50 (f=8). This is followed by studies with sample sizes between 51-100, 101-200 and 201-300 with 3 studies each. We see that there are 2 studies with a sample size larger than 500 and no study has been conducted with a sample size of 301-500. We see that the study with the largest sample size among the studies is the M4 article with a sample size of 1001-10000. In this article, quantitative research was conducted with 9204 primary school students under the title of 'game-based learning'. In addition to these, the sample sizes of the studies under the heading 'not specified' in the table could not be reached.

The content analysis of the research articles

Information on the fields of the articles is given in Table 4.

Table 4. Fields of Articles

Fields	Article code in which it appears	f
Mathematics Education	M2, M3, M4, M5, M6, M11, M12, M14, M16, M17, M18, M19, M19, M20, M21, M22, M23, M24	17
Mathematics	M1, M7, M8, M9, M10, M15, M23, M24	8
Teacher training	M1	1
Technology	M13	1

Some articles were conducted in more than one field.

Table 4 provides information about the fields of the articles and the studies conducted in these fields. The heading 'fields of the article' is indicated within the articles, and the 'sub-fields' section was created in order to specifically categorize the categories based on the 'fields of the article'.

When the table is examined, we see that 'mathematics education' (f=17) and 'mathematics' (f=8) are the learning areas in which the most studies were conducted. Apart from these, it can be seen that 1 study each was conducted in the fields of teacher education and technology. When we examine the table by looking at the code of the articles, we can see that the articles M1 (mathematics and teacher education), M23 (mathematics and mathematics education) and M24 (mathematics and mathematics education) are included in two different fields. It is seen that the articles other than these 3 articles are included in only 1 field.

The keyword terms (game based learning, technology and learning, gamification, etc.) used in the content

Table 5. Keyword terms based on the content of the articles

Keyword Term	Keyword Sub Term	Includes article code	f	Total
Game-based concepts	Digital games	M14	1	11
	Game design	M13	1	
	Gamification	M14	1	
	Mobile games	M7	1	
	Serious games	M8, M13	2	
	Video games	M8, M9, M13	3	
	Intelligence games	M21	1	
	Computer game based learning	M20	1	
Concepts related to learning and teaching approaches	Game based learning	M1, M11, M13, M15, M16, M17, M19	7	13
	Interactive learning	M3, M19	2	
	Mobile learning	M1	1	
	Realistic math learning	M5	1	
	Remote teaching	M24	1	
	Gifted students' education	M23	1	
Concepts related to technology	Technology and learning	M3, M4, M24	3	4
	Computer games	M22	1	
Concepts related to culture	Culture and mathematics	M2, M6	2	3
	Ethnomathematics	M10	1	
Other concepts	Collaboration and group work	M12, M16, M17, M19, M22	5	7
	Problem solving	M18, M22	2	

*Some articles contain more than one keyword term.

Table 5 shows the keyword terms and their sub-terms based on the articles. The keyword sub-terms column was created using the keyword terms used in the articles. Some articles were based on more than one keyword term. The keyword terms in the articles have been grouped under 5 main headings by paying attention to which topics are mainly studied and predicting which fields they can be included in for easy classification. These main terms are 'game-based concepts', 'concepts related to learning and teaching approaches', 'concepts related to technology', 'concepts related to culture' and 'other concepts'. Under the heading of 'other concepts', keyword sub-terms from other subject areas (Collaboration and group work and problem solving) that are not included in these other 4 categories were taken as basis.

When the data in the table are analyzed, we can see that most of the studies are about "game based learning" (f=7) which is included in "concepts related to learning and teaching approaches". This is followed by the studies on "collaboration and group work" (f=5) which are written about 'other concepts'. When we look at the keyword terms in general, we can see that the most research was conducted under the title of 'concepts related to learning and teaching approaches' (f=13), followed by studies on 'game based concepts' (f=11). When analyzed in terms of the codes of the article, we see that the article coded M13 is the article with the highest number of keyword sub-terms. There are 4 keyword sub-terms based on this article and these are; 'game based learning', 'serious games', 'game design' and 'video games'.

The names and types of games used in the research articles

Table 6, Table 7 and Table 8 provide information on the names of the games in the articles and the game types in which these games take place

Table 6. Games Played Electronically

Game subtype	Game names	Article code in which it appears	f	Total
Computer game	Zeldenrust	M19, M20	2	5
	FIFA	M22	1	
	The Sims	M22	1	
	Candy Crush	M22	1	
Educational/serious play	MATHERIAL	M15	1	1
Online/Digital gaming	Digital inquiry game	M14	1	10
	First in Math	M4	1	
	Game Acres High	M13	1	
	Gem Game	M8	1	
	Grandma's Garden	M8	1	
	Kahoot	M24	1	
	MathQuest	M13	1	
	Blooket	M24	1	
	edPuzzle	M24	1	
	Caribou Math Contest	M23	1	
Phone game	Mapping My Math	M1	1	2
	UFraction	M7	1	
Video game	Semideus and WuzzitTrouble	M9	1	1

**Some studies include more than one game name and type.*

In this table, 5 main titles (computer game, educational/serious game, online/digital game, phone game, video game) including game sub-types related to 'games played in electronic media' are given. When the table is analyzed in general, we find the number of game names included in the studies on 'games played in electronic media' as 19. Online/digital game was the title with the highest number of game names (f=10). It is seen that there are 5 game names related to 'computer games', 2 game names related to 'phone games', 1 game name each related to 'educational/serious games' and 'video games'.

Table 7. Games not played electronically

Game Subtype	Game names	Article code in which it appears	f	Total
Classic game	Dice game	M12	1	6
	Mozkat- 5 Stone	M10	1	
	Seega games	M10	1	
	Snake and ladder board	M5	1	
	Mangala set	M21	1	
	Go team	M21	1	
Local/ Regional game	Congkak	M6	1	5
	Guli	M6	1	
	Long Galah	M6	1	
	Morabaraba	M2	1	
	Static	M6	1	

**Some studies include more than one game name and type*

In Table 7, we see that there are articles on 'games that are not played in electronic media', which consist of 2 game sub-types: 'classic game' and 'local/regional game'. When the table is examined, it is seen that there are 11 game names mentioned in the researches on 'games not played in electronic media' and 6 game names under the title of 'classic game' and 5 game names under the title of 'local/regional game'.

The codes (M3, M11, M16, M17, M18) were given for the articles that were not included under both titles and in which no information about the game or game genre could be found in the content of the articles. When this table is examined, we see that the number of articles that do not mention the name and type of game in the articles researched is 5.

When the tables are analyzed in general, it is seen that the game names mentioned in the articles under the title of 'games played in electronic media' (f=19) are more than the game names mentioned in the studies on 'games not played in electronic media' (f=11). When Table 6 and Table 7 are analyzed in terms of the game names mentioned in the articles, we see that the game 'Zeldenrust' (f=2) is mentioned more in the articles compared to other games. When these two tables are analyzed, it can be seen that other game names are mentioned once in the articles. If we analyze Tables 6 and 7 in terms of article codes, we can see that the article containing the most game types is M6 with 4 games. This is followed by the articles M24 and M22 with 3 games.

Conclusion and Discussion

In this section, it is aimed to present the conclusions and recommendations based on the findings of the study. In this study, articles between 2009 and 2024, in which the words "mathematics education" and "games" were included in the topic section, were analyzed by taking into account the criteria of being in the field of "education & educational research" in the open access and subject areas in the 'Web of Science' database. As a result of the analysis, 24 articles were found and it was decided to examine these articles with the systematic literature review method.

When the change in the years of publication of these 24 articles on 'mathematics education' and 'play' is examined, it can be seen that the studies were concentrated between 2013-2022. The reason why there were not many studies on this subject before 2013 may be that studies related to games and mathematics started to be given more weight after this period. Especially 2018 and 2020 are the time periods in which the most studies were conducted. The curriculum change made by MoNE in these years may be one of the reasons for this increase.

If we examine the analyzed articles in terms of the methods used, we see that quantitative method is adopted as the majority in the studies conducted in this field. It can also be seen that the number of mixed and qualitative studies is very close to the studies conducted with quantitative method. It is seen that qualitative, quantitative and mixed methods can be used equally in the studies to be conducted in this field and thus there is no accumulation towards a certain method in the literature.

If we look at the comparison of the studies in terms of sample groups, we can see that more studies were conducted with students in the primary education group. This is followed by studies conducted on high school students with a slight difference. We can see that fewer studies have been conducted in other sample groups compared to these groups. In future studies to be conducted in this field, it can be thought that including a different sample group from elementary and high school students will contribute more to fill the gap in the literature.

When we analyze the studies in terms of sample size, it is seen that there are more studies with small sample sizes (studies with sample sizes between 0-50) and fewer studies with large sample sizes. It is seen that the study with the highest sample size is the M4 article with a sample size between 1001-10000. In this quantitative study in the field of 'game-based learning', 9204 elementary school students were studied. If we talk about future studies, we can say that conducting a study with sample groups with a sample size of more than 50 will make a positive contribution to the literature.

When the fields of study in the articles are examined, it is seen that the articles are mostly written in the field of mathematics and mathematics education. Since research was conducted on 'mathematics education' and 'game' in this article, it is quite an expected result that the subject areas in the studies examined in this article concentrated on

mathematics and mathematics education. It can be thought that future studies in this field focusing on areas other than mathematics and mathematics education will contribute positively to the literature.

When the articles are analyzed in terms of the keyword terms used in the articles, it can be seen that the most research was conducted under the title of 'concepts related to learning and teaching approaches'. This is followed by studies on 'game-based concepts'. There are relatively fewer studies on 'technology-related concepts' and 'culture-related concepts' compared to other fields. When analyzed in terms of keyword sub-terms, it is seen that the most studies were conducted with the term 'Game based learning' under the title of 'concepts related to learning and teaching approaches'. When analyzed in terms of the codes of the article, we see that the articles containing the most keyword sub-terms are the articles coded M13. It can be thought that conducting studies in areas other than 'game based learning' in future studies will contribute positively to the literature. From the tables, it can be concluded that game based learning is a more preferable method in mathematics education. Therefore, it can be predicted that utilizing this type of teaching in today's mathematics education will contribute to mathematics education.

When the tables are analyzed in terms of the game names and game types included in the articles, it is seen that the games played in electronic media are more than the games not played in electronic media. When the games played in electronic media are analyzed within themselves, the title with the most game names is online/digital games. When the games that are not played in electronic media are analyzed within themselves, it is seen that the number of games under the title of 'classical games' and the number of games under the title of 'local/regional games' are very close to each other. If we make a general evaluation in terms of the game names and types in the tables, it can be said that with the development of technology, games have mostly started to become online/digital and there are more studies in this field. It can be thought that teachers who aim to convey mathematics education with games or researchers who are interested in this subject can benefit from the games in the tables (Table 7, Table 8). In future studies, it can be thought that focusing on studies related to games that are not played in electronic environment may be useful in order to close the gap in the literature in this direction.

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Appendix 1. Selected article for research

Code	Article bibliography
M1	Holden, J. I. (2016). Mobile inquiry-as-play in mathematics teacher education. VOL. 24, NO. 1 2016, pp. 71-81, DOI: 10.1108/OTH-08-2015-0046
M2	Nkopodi, N. & Mosimege, M. (2009). Incorporating the indigenous game of morabaraba in the learning of mathematics. South African Journal of Education, Vol 29:377-392.
M3	Çetinkaya, L. (2019). The Effects of Problem Based Mathematics Teaching Through Mobile Applications on Success. Vol 44, No 197 65-84, DOI: 10.15390/EB.2019.8119
M4	Ahn, J., Beck, A., Rice, A. & Foster, M. (2016). Exploring Issues of Implementation, Equity, and Student Achievement With Educational Software in the DC Public Schools. *AERA Open*, Vol. 2, No. 4, pp. 1–10, DOI: 10.1177/2332858416667726.
M5	Laurens, T., Batlolona, F. A., Leasa, M. & Batlolona J. R. (2017). How Does Realistic Mathematics Education (RME) Improve Students' Mathematics Cognitive Achievement? EURASIA Journal of Mathematics, Science and Technology Education, 14(2):569-578 DOI: 10.12973/ejmste/76959
M6	Rezeki, S., Andrian, D. & Safitri, Y. (2021). Mathematics and Cultures: A New Concept in Maintaining Cultures through the Development of Learning Devices. *International Journal of Instruction,* Vol.14, No.3, p-ISSN: 1694-609X , pp. 375-392
M7	Nygren, E., Blıgnaut, A. S., Leendertz, V. & Sutınen, E. (2019). Quantitizing Affective Data as Project Evaluation on the Use of a Mathematics Mobile Game and Intelligent Tutoring System. *Informatics in Education,* Vol. 18, No. 2, 375–402,DOI:10.15388/infedu.2019.18
M8	Chorianopoulos, K., , Michail N. & Giannakos, M. N. (2014). Design Principles for Serious Video Games in Mathematics Education: From Theory to Practice. *International Journal of Serious Games.* Volume 1, Issue 3, July 2014, http://dx.doi.org/10.17083/ijsg.v1i3.12
M9	Kiili, K., Devlin, K., Perttula, A., Tuomi, P. & Lindstedt, A. (2015). Using video games to combine learning and assessment in mathematics education. *International Journal of Serious Games,* Volume 2, Issue 4, http://dx.doi.org/10.17083/ijsg.v2i4.98
M10	Fouze, A. Q. & Amit, M. (2017). On the Importance of an Ethnomathematical Curriculum in Mathematics Education. *EURASIA Journal of Mathematics, Science and Technology Education,* 14(2):561-567, DOI: 10.12973/ejmste/76956
M11	Wahidah, N. I. (2020). Game Based Learning: Design a Multimedia with DDD-E Model for Mathematics Education. Vol. 15, No. 21, https://doi.org/10.3991/ijet.v15i21.16353
M12	Ryve, A., Nilsson, P. & Pettersson, K. (2012). Analyzing effective communication in mathematics group work: The role of visual mediators and technical terms. Educ Stud Math, 82:497–514 DOI 10.1007/s10649-012-9442-6
M13	Coleman, T. E. & Money, A. G. (2019). Student-centred digital game–based learning: a conceptual framework and survey of the state of the art. Department of Computer Science, Brunel University London, 79:415–457, https://doi.org/10.1007/s10734-019-00417-0
M14	Albano, G., Arzarello, F. & Iacono, U. (2020). Digital Inquiry Through Games. *Technology, Knowledge and Learning,* 26:577–595. https://doi.org/10.1007/s10758-020-09459-1
M15	Es-Sajjade, A. & Paas, F. (2020). Educational theories and computer game design: lessons from an experiment in elementary mathematics education. *Education Tech Research Dev,* 68:2685–2703 https://doi.org/10.1007/s11423-020-09799-w
M16	Gil-Doménech, D. & Berbegal-Mirabent, J. (2019). Stimulating students' engagement in mathematics courses in non-STEM academic programmes: A game-based learning. *Innovations in Education and Teaching International,* 56:1, 57-65, DOI: 10.1080/14703297.2017.1330159
M17	Van Putten, S., Blom, N. & Van Coller, A. (2022). The developmental influence of collaborative games in the Grade 6 mathematics classroom. *International Journal of Mathematical Education in Science and Technology,* 53:6, 1478-1501, DOI: 10.1080/0020739X.2020.1829139
M18	Hsiao, H. S., Lin, C. Y., Chen, J. C. & Peng, Y. F. (2017). The Influence of a Mathematics Problem-Solving Training System on First-Year Middle School Students. *EURASIA Journal of Mathematics, Science and Technology Education*, 1305-8215, DOI: 10.12973/ejmste/77902
M19	Vrugte, J., Jong, T., Vandercruysse, S., Wouters, P., Oostendorp, H. & Elen, J. (2015). How competition and heterogeneous collaboration interact in prevocational game-based mathematics education. *Computers & Education,* 89, 42-52.
M20	Vrugte, J., Jong, T., Vandercruysse, S., Wouters, P., Oostendorp, H. & Elen, J. (2017). Computer game-based mathematics education: Embedded faded worked examples facilitate knowledge acquisition. *Learning and Instruction,* 50, 44-53.
M21	Alkaş Ulusoy, Ç., Saygı, E. & Umay, A., (2017). İlköğretim Matematik Öğretmenlerinin Zeka Oyunları Dersi ile İlgili Görüşleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (H. U. Journal of Education)* 32(2): 280-294. Doi: 10.16986/HUJE.2016018494.
M22	Yong, S.T., Gates, P. & Chan, A. T. Y., (2018). A Gaming Perspective on Mathematics Education. *International Journal of Information and Communication Technology Education.* Volume 14, Issue 4, October-December .
M23	Ozdemir, D., (2022). An Examination of Students' Views about an International Math Contest. *International Electronic Journal of Mathematics Education*, 17(2), em0680. https://doi.org/10.29333/iejme/11817
M24	Martin, C. S., Harbour, K. & Polly, D., (2022). Examining How Emergency Remote Teaching Infuenced Mathematics Teaching. *TechTrends,* 66:338–350. https://doi.org/10.1007/s11528-022-00711-2