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Views of Preschool Teachers Regarding the Achievement of Mathematics Gains through Early Childhood Game Activities

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ABSTRACT

This research aims to examine the effect of game activities on mathematics gains in the early childhood period. In line with this purpose, the holistic case study method, one of the qualitative research methods, was used. The study group of the research consists of 22 preschool teachers working in pre-school education institutions in the 2021-2022 academic year. The interview form developed by the researchers was used as a data collection tool in the study. The data obtained with the interview were analyzed using the content analysis method. The findings of the research revealed that preschool teachers mostly used game activities every day, that they generally included mathematics gains in game activities, that they generally used matching type games in teaching mathematics, and the pattern subjects were taught in game activities most, that game activities made learning mathematics fun, that there is no problem in teaching mathematics in game activities in general, that they are at a proficient and good level, and that they want to receive in-service training for effective mathematics teaching through game activities in general. It is seen that pre-school teachers have a positive attitude towards mathematics teaching through game activities.

Key Words: Early childhood period, early childhood period game activities, early childhood period mathematics gain, pre-school teacher.

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Erken Çocukluk Dönemi Oyun Etkinliklerinin Matematik Kazanımlarına İlişkin Okul Öncesi Öğretmenlerinin Görüşleri

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ÖZET

Bu araştırma, erken çocukluk döneminde oyun etkinliklerinin matematik kazanımlarına etkisini incelemeyi amaçlamaktadır. Bu amaç doğrultusunda nitel araştırma desenlerinden bütüncül durum çalışması deseni kullanılmıştır. Araştırmanın çalışma grubunu 2021-2022 eğitim öğretim yılında okul öncesi eğitim kurumlarında görev yapan 22 okul öncesi öğretmeni oluşturmaktadır. Araştırmada veri toplama aracı olarak araştırmacılar tarafından geliştirilen görüşme formu kullanılmıştır. Görüşmede elde edilen veriler içerik analizi yöntemi ile analiz edilmiştir. Araştırmanın bulgularına göre, okul öncesi öğretmenlerinin oyun etkinliklerine en çok her gün yer verdiği, oyun etkinliklerinde matematik kazanımlarına genel olarak yer verdikleri, genel olarak eşleştirme oyunlarını matematik öğretiminde kullandıkları, oyun etkinliklerinde en çok örüntü konusunun öğretildiği, oyun etkinliklerinin matematik öğrenmeyi eğlenceli hale getirdiği, oyun etkinliklerinde matematik öğretmede genel olarak sorun yaşanmadığı, yeterli, iyi düzeyde olunduğu ve genel olarak oyun etkinliklerinde etkili matematik öğretimi için hizmet içi eğitim almak istedikleri sonuçlarına ulaşılmıştır. Okul öncesi öğretmenlerinin oyun etkinliklerinde matematik öğretimi konusuna olumlu baktıkları görülmektedir.

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Introduction

In the early childhood period, games play a very important role. Children explore the world through games and thus they learn by having fun. In general, when children begin to get to know the environment in the first years of their lives, they learn by playing games, and games are considered essential activities in the development of preschool children (Yıkılmaz and Kurşun, 2018). In addition, mathematics education plays a very important role in early childhood and mathematics gains take place in children's games. The gains achieved in preschool years affect the mathematical skills of children in later years (Koç, 2017).

Games provide children with an opportunity to make sense of the world they live in and ensure that the knowledge gained through experiences is permanent and so must be a part of the formal education system (Burgas and Bozkuş, 2019). Game, which is played in every age group, is more important in early childhood. Games, which have great importance for young children, not only provide children with fun but also are of great importance to them to get to know the world and perform academic learning (Yılmaz and Pala, 2019). Therefore, it is necessary to organize children's learning through games.

Games allow children to explore their surroundings, and objects, solve problems and learn concepts (Aktas Arnas, 2017). Children gain learning experiences through the game, interact, learn about themselves and their surroundings, and gain new knowledge and skills (Boz, Uludag and Tokuç, 2018). The game is effective in the cognitive, social and emotional development and the acquisition of skills of children (Koçyiğit and Firat, 2020). In short, the game makes a positive contribution to all areas of development of children and develops their skills.

Emotions can be shown through movement and play during learning in preschool years, and the movement of the body also helps to learn (Arabacı and Çıtak, 2017). The game is of great importance in the education of children, personality development, and skill acquisition and is an activity in every age period (Tuzcuoğlu, Azkeskin, Niran and Özkan, 2020). Games play an important role in developing children's abilities. Game activity is a must depending on the age group, development level and interests of children (Durualp and Aral, 2018). Games, which are important for children, are also important in educational processes, and the activities performed in game activities provide opportunities to adapt to the educational environment and ensure children’s permanent learning (Tok, 2018). In this regard, opportunities necessary to ensure such permanent learning through the game should be created in educational environments.

Mathematics education in the early childhood period contributes to the development of basic academic skills of children such as reasoning, scientific thinking and the quality of mathematics education also allows the child to approach mathematics positively and realize that they can integrate mathematics into everyday life (Şeker, 2020). In the preschool period, children acquire the first mathematics-related experiences important in their daily lives and begin to acquire concepts related to mathematics as well as use mathematics informally and implicitly (Köğce and Aykaç, 2017). Mathematics education at an early age is effective in children's acquisition of mathematical thinking skills for use in the future, preparation for primary school, as well as determining their profession in the following years (Altan, Genç and Dağlıoğlu, 2021). If the foundation of the mathematics course, which is an abstract

subject, is firmly established in preschool education, learning in the following years will be easy (Kurt, Dogan and Golezani, 2020). In this direction, the application of games that allow children to learn by having fun for mathematics education, which is very important in the preschool stage to achieve mathematics gains, can ensure permanent learning.

Children are engaged in thoughts about mathematics while playing games in their daily lives, they are curious about the engaged subject, they have the knowledge and they can learn complex mathematical knowledge (Ginsburg and Amit, 2008). Mathematics is experienced by children in everyday life, and they experience mathematics in their games (Şahin and Korkmaz, 2019). Developing the game skills of the child will have a positive effect on the mental skills required for the formation of mathematics-related gains in the following processes (Trawick-Smith, Swaminathan and Liu, 2016). Math games could be integrated into kids' games but this generally needs a favourable environment, and a knowledgeable adult who will help the child to integrate the game into his/her math knowledge and skills (Sarama and Clements, 2009). The fact that kids possess top-level mathematics learning capacities, and that informal math knowledge is gained through their experiences to design math classrooms, the roles that information and knowledge play should never be overlooked (Kale, Nur and Aslan, 2018). Therefore, necessary opportunities should be provided in the early childhood period so that they can gain basic math skills, and during this period considering the importance of learning through the game, helping children gain such skills through game activities should be given enough importance.

Bjorklund, Palmer, and Magnusson (2018) conducted research and examined how the teaching of mathematics and varying relevant activities in preschool education, such as game-based and goal-oriented application of mathematics in the teaching and learning opportunities affected children's learning using the sampling method and found out that using games in the teaching of mathematics confirmed children's interests, provided strategies, helped position the already known concepts and challenging concepts. Schmitt, Koruyucu, Napoli, Bryant and Purpura (2018) conducted a study, and examined the effects of using semi-structured block games and early math skills on preschool children's early mathematics and executive function skills and also examined if the children of the parents with low parental education benefitted more than the treatment group. It was found that the children participating in the semi-structured block game treatment were found to have a higher level of mathematics skills (digital figure recognition and mathematics language) and executive function in the post-test than the control group whereas they were not statistically significant. In a study conducted by Erbil, Yalçın, Kimzan and Avar (2017), it was found that pre-service preschool teachers considered that children learn better when having fun with games and therefore the game is the most effective teaching method that can be used in preschool education. In a study conducted by Yılmaz and Ünal (2020), it was found that almost all pre-service teachers could help preschool children learn mathematics and that they would not be uncomfortable with teaching mathematics. There is research on games and mathematics in early childhood in the literature. However, there has been limited research examining the effect of game activities on mathematics gains. In addition, considering the importance of learning through the game in the early childhood period, the opinion of preschool teachers is important in teaching mathematics acquisition in game activities and it is expected to lead to new applications. When the importance of learning through play in early childhood is considered, the views of preschool teachers regarding the use of game activities in teaching mathematics gains are significant to be able to examine the effects of game activities on mathematics gains, and this is considered to lead future implementations in the field regarding this issue.

Aim of the Research

This study aims to investigate the effect of game activities on mathematics gains in the early childhood period. Fort his purpose, answers were sought for the following questions:
1. How often are mathematics gains included in game activities?
2. What are the games used in mathematics teaching?
3. What are the mathematics subjects that children learn in game activities?
4. What contribution do game activities make to children's gains in mathematics?
3. What are the mathematics subjects that children learn in game activities?
4. What contribution do game activities make to children's gains in mathematics?

Method

Research Model

This study used a holistic case study design as one of the qualitative research patterns. In the case study, a case and the elements related to the case are holistically investigated in detail, and how these elements affect the case and how they are affected by the case are focused on (Yıldırım and Şimşek, 2018). A case study can be carried out for the short or long term, it aims at observations, audio or visual recordings, detailed descriptions of documents, logical inference and interpretation (Paker, 2021). The observations regarding the sampling in case studies, in general, do not aim to obtain general findings for the whole research universe, rather it aims to understand and explain the unique characteristics of the sample and a systematic description of these characteristics (Ersoy, 2016). In this regard, this study used the case study pattern to gather the opinions of preschool teachers about the realization of mathematics gains in game activities in the preschool period. In this direction, this study intended to gather data about the games used in the teaching of mathematics in preschool education, mathematics subjects learned in mathematics activities, problems that preschool teachers experience, their status of being proficient, and their willingness to receive in-service training under the light of the opinions of preschool teachers.

Research Group

The study group of this research consists of 22 volunteer preschool teachers working in preschool educational institutions during the fall semester of the 2021-2022 academic year. A purposeful sampling method was used to determine the sample of the study. As qualitative research aims to reach varying individuals with varying knowledge regarding the examined subject and cases, it does not intend to make generalisations, so it uses a purposeful sampling method (Yazar and Keskin, 2020). Purposeful sampling is a sampling method which identifies participants with the help of pre-determined characteristics, which the researcher considers appropriate for the problem of the study based on the observations made by a researcher (Gürbüz and Şahin, 2018).
Table 1. Demographic information about the participants.

Demographic Characteristics	**Categories**	**F**	**%**
Gender	Female	20	90.9
	Male	2	9.09
Institutions worked	Public School	20	90.9
	Private School	2	9.09
Year of seniority in	1-5 Years	0	0

Profession	6-10 Years	9	40.9
	11-20 Years	9	40.9
	21 Years and Above	4	18.18

20 female preschool teachers and 2 male preschool teachers participated in the study. Of the preschool teachers participating in the study, 20 teachers work in a public school and 2 teachers work in a private school. Of the preschool teachers participating in the study, 9 have professional seniority in the range of 6-10 years, 9 have professional seniority in the range of 11-20 years, and 4 have a professional seniority year of 21 years and over. There are no preschool teachers whose professional seniority is in the range of 1-5 years in the study.

Data Collection Instrument

In the study, a semi-structured interview form titled "Opinions of Preschool Teachers on the Mathematical Gains through Game Activities in early childhood" with 8 items was used as a data collection tool. During the creation of the Interview Form, a literature review was conducted and 8 open-ended questions were developed to gather the opinions of preschool teachers. After that, interview questions were submitted to the opinions of two experts in the field of preschool education and an assessment and evaluation specialist. In line with the feedback of experts, the final version of the interview questions was obtained. The final version of the Interview Form consists of two parts. In the first part, there are demographic questions about the participants, and in the second part, there are interview questions. The interviews lasted between 25-30 minutes. With the interviews conducted with preschool teachers, in-depth information was obtained regarding the examined issue.

Data Analysis

This study was conducted on the volunteered participants. The data obtained with the interview form were transferred to the computer environment. The content analysis method was used in the analysis of the obtained data. The content analysis aimed to reveal the presence of words, sentences, concepts and themes in one or more texts and convert them into numbers (Kızıltepe, 2021). In the research, codes and themes were created using the content analysis method. Reliability: It is calculated using the Consensus/ Consensus + Dissensus formula and reliability is achieved as the result calculated with the reliability formula is over 70% (Miles and Huberman, 1994). The result of the calculation revealed 83% consensus between the researcher and the field experts. This result was found to be reliable as it was higher than 70%. In the content analysis, similar statements were grouped in the same category. The preschool teachers participating in the study were given code numbers instead of their names (OÖ1, OÖ2, OÖ3, OÖ4 ...) and explanations were presented in this way in the study. The data of the research were grouped into codes and expressions and then divided into themes.

Validity and Reliability

In the study, a validation study was carried out by obtaining the consent of the participants and explaining the selection method of the study group, the data collection tool, the data collection process and the data analysis process in detail. A reliability study was carried out by objectively discussing the data and making direct extracts in the study.

Findings

"Opinions of preschool teachers about the impact of game activities on mathematics gains in the early childhood period" were examined as a problem in the research, and the research was conducted with some preschool teachers.

Time Spared for Game Activities in a Week by Preschool Teachers

The findings related to the duration of preschool teachers' game activities in a week are given in Table 2.

Tablo 2. Duration of Game Activities

Theme	Category	F	Code
Number of Days	Every Day	8	OÖ8, OÖ9, OÖ10, OÖ11, OÖ13, OÖ17, OÖ19, OÖ20
Length of Activities	Five Hours	5	OÖ1, OÖ6, OÖ12, OÖ16, OÖ22
	Two and Half Hours	3	OÖ3, OÖ7, OÖ14
	Three Hours	2	OÖ15, OÖ18
	Two Hours	1	OÖ4
	Four Hours	1	OÖ2
	Seven and Half Hours	1	OÖ5
	Twelve Hours	1	OÖ21
	Total	22	

When Table 2 is examined, it is seen that eight preschool teachers used game activities every day. Five preschool teachers stated that the weekly time that they spared for the game activity was five hours. Three preschool teachers stated that the weekly time they spared for the game activities was two and a half hours. Two preschool teachers stated that the weekly time they spared for the game activities was three hours. On the other hand, one preschool teacher stated that the weekly time they spared on the game activity was two hours, one preschool teacher stated four hours, one preschool teacher stated seven and half hours and one preschool teacher stated four hours, and one preschool teacher stated as twelve hours.
Some of the opinions of preschool teachers are as follows:
"I use every day (OÖ10)."
"I use 5 hours (OÖ12)."

Inclusion of Mathematics Gains by Preschool Teachers in Game Activities

The findings regarding the responses given by preschool teachers regarding the planned inclusion of mathematics gains in game activities are given in Table 3.
Table 3. Inclusion of Mathematics Gains in Game Activities

Theme	Category	F	Code
Number of days spared for game activities	Every Day	6	OÖ2, OÖ5, OÖ12, OÖ15, OÖ19, OÖ21
How many times	Often	5	OÖ3, OÖ8, OÖ11, OÖ18, OÖ20
	Three times	3	OÖ9, OÖ14, OÖ17
	Sometimes	3	OÖ6, OÖ7, OÖ13
	Two times	2	OÖ1, OÖ4
	Four times	2	OÖ16, OÖ22

	Five times	1	OÖ10
	Total	22	

As seen in Table 3, six preschool teachers were found to have used game activities every day, which is the most frequent use of game activities among preschool teachers. Five preschool teachers stated that they used such activities often. Three preschool teachers stated that they have used it three times, three preschool teachers stated that they have used it sometimes, two preschool teachers stated that they have used it twice and two preschool teachers stated that they have used it four times. A preschool teacher stated that s/he used five times, which is the least use.

Some of the opinions of preschool teachers are as follows:

"At least once during the game activities at different times of the day (OÖ5)."

"I use four or five times a week, sometimes it could be more (OÖ10)."

Games That Preschool Teachers Use in Teaching Mathematics

Table 4 contains the findings regarding the responses of preschool teachers about the games they use in teaching mathematics.

Table 4. Games Used in Mathematics Teaching

Theme	**Category**	**F**	**Code**
Using material	Matching Games	8	OÖ1, OÖ2, OÖ4, OÖ6, OÖ14, OÖ17, OÖ20, OÖ21
	Musical games	4	OÖ5, OÖ7, OÖ14, OÖ15
	Number games	4	OÖ9, OÖ12, OÖ13, OÖ16
	Jigsaw	3	OÖ14, OÖ19, OÖ20
	Grouping Games	2	OÖ1, OÖ4
	Grading Games	2	OÖ3, OÖ16
	Tongue Twister game	2	OÖ7, OÖ8
	Pegging	2	OÖ13, OÖ17
	Educational Cards	2	OÖ14, OÖ17
	Puzzle	1	OÖ1
	Green bottle game	1	OÖ4
	Coding	1	OÖ2
	Hopscotch	1	OÖ5
	Bowling	1	OÖ5
	Blocks game	1	OÖ7
	Pattern games	1	OÖ9
	Geometry Games	1	OÖ12
	Educational Games	1	OÖ19
	Nature Games	1	OÖ15
	Play dough games	1	OÖ17
	Ball games	1	OÖ18
	Competition Games	1	OÖ19
	Sudoku	1	OÖ20
	Number Hunting	1	OÖ18
	Calculator game	1	OÖ21
	Addition Wheel	1	OÖ21
	Number wheel	1	OÖ21
	Manipulative game	1	OÖ22

Without any material use	Finger game	4	OÖ2, OÖ7, OÖ11, OÖ16
	Action games	2	OÖ8, OÖ10
	Push in the corner game	1	OÖ5
	Total	55	

As seen in Table 4, eight preschool teachers stated that they used matching games in the teaching of mathematics, which is the highest use. This game is followed by musical games, number games and finger games for each of which four teachers were found. One preschool teacher stated that they used different games in general.
Some of the coded opinions of preschool teachers are as follows:
"Hopscotch, push-in-the-corner, bowling, musical games are the games that I use in free times (OÖ5)."
"Games developing intelligence such as rhythmic counting, musical games with numbers, educational cards, matching, matching differences, line studies, puzzles about. (OÖ14)."

Opinions of Preschool Teachers regarding Mathematics Subjects Learned in Game Activities
Table 5 presents the mathematics subjects learned in game activities.
Table 5. Mathematics Subjects Learned in Game Activities

Theme	**Category**	**F**	**Code**
Pattern and Coding concepts	Pattern	20	OÖ1, OÖ2, OÖ3, OÖ4, OÖ5, OÖ6, OÖ7, OÖ8, OÖ9, OÖ10, OÖ11, OÖ12, OÖ13, OÖ15, OÖ17, OÖ18, OÖ19, OÖ20, OÖ21, OÖ22
	Coding	1	OÖ3
Concept of Number	Number	14	OÖ1, OÖ3, OÖ5, OÖ6, OÖ7, OÖ8, OÖ11, OÖ12, OÖ13, OÖ17, OÖ18, OÖ19, OÖ20, OÖ22
	Rythmic Counting	8	OÖ2, OÖ4, OÖ6, OÖ9, OÖ10, OÖ13, OÖ14, OÖ16
	Figures	2	OÖ8, OÖ14
	Counting backwards	1	OÖ13
Concept of Operation	Addition	7	OÖ7, OÖ13, OÖ14, OÖ16, OÖ17, OÖ18, OÖ21
	Extraction	7	OÖ7, OÖ13, OÖ14, OÖ16, OÖ17, OÖ18, OÖ21
First concepts	Grouping	6	OÖ1, OÖ4, OÖ15, OÖ16, OÖ19, OÖ20
	Grading	5	OÖ5, OÖ7, OÖ10, OÖ15, OÖ16
	Matching	5	OÖ9, OÖ10, OÖ19,

			OÖ20, OÖ21
Space and Geometry	Figures	4	OÖ5, OÖ10, OÖ12, OÖ20
	Space	1	OÖ9
Colour and Concept	Colours	2	OÖ15, OÖ20
	Concepts	2	OÖ15, OÖ19
Problem Solving and cause and effect relation	Problem Solving Skills	1	OÖ15
	Establishing cause and effect relationship	1	OÖ15
Concept of Symmetry and Camouflage	Symmetry	1	OÖ22
	Camouflage	1	OÖ22
	Total	89	

When Table 5 was examined, the most learned mathematics subject was found to be the pattern. Then, the most learned subject is found to be numbers. It is seen that the mathematics subjects that preschool teachers learned the least are counting backwards, coding, space, problem-solving skills, establishing a cause-effect relationship, symmetry and camouflage subjects.

Some of the opinions of preschool teachers are given below:

"Number, pattern, rhythmic counting, backward counting, addition and subtraction (OÖ13)."
"Number. Pattern. Matching. Grouping, figures, colours. (O20)."

Opinions of Preschool Teachers about the Effects of Game Activities on Mathematics Gains

Table 6 presents the findings regarding the contribution of game activities to the achievement of mathematics gains.

Table 6. Effects of Game Activities on Mathematics Gains

Theme	**Category**	**F**	**Code**
Social-emotional gains	Amusingness	10	OÖ1, OÖ3, OÖ4, OÖ6, OÖ8, OÖ10, OÖ12, OÖ13, OÖ14, OÖ20
	Liking the field of mathematics	3	OÖ4, OÖ13, OÖ16
	Learning without any boredom	2	OÖ5, OÖ12
Cognitive gains	Permanent	8	OÖ1, OÖ3, OÖ7, OÖ9, OÖ10, OÖ19, OÖ20, OÖ22
	Learning easily	3	OÖ4, OÖ19, OÖ20
	Raising consciousness	3	OÖ5, OÖ13, OÖ17
	Learning numbers	3	OÖ14, OÖ16, OÖ18
	Focusing attention	2	OÖ5, OÖ7
	Using as an intro to subjects	1	OÖ5
	Preliminary preparation	1	OÖ16
	Reinforcement	1	OÖ5
	Quick Learning	1	OÖ7
	Using every day	1	OÖ11

	Learning the subject	1	OÖ15
	Learning new concepts	1	OÖ15
	Learning values	1	OÖ15
	Preparation for primary school	1	OÖ17
	Learning addition-Subtraction	1	OÖ21
	Matching numbers	1	OÖ21
	Total	45	

When Table 6 was examined, ten preschool teachers stated that game activities contributed to the achievement of mathematics gains and made it fun for learners. Then, eight preschool teachers stated that game activities provided the most lasting learning. Three preschool teachers stated that game activities helped learners love the field of mathematics, facilitated easy learning, increased awareness and helped them learn numbers. Two preschool teachers stated that game activities contributed to children's learning without getting bored. One preschool teacher stated that s/he used game activities when introducing subjects, one pre-school teacher stated that s/he used game activities for pre-preparation, one pre-school teacher for reinforcement, and one for quick learning. One pre-school teacher stated that s/he used game activities every day, one pre-school teacher stated that s/he used game activities for subject learning, and one pre-school teacher stated that s/he used game activities for concept learning. Similarly, one preschool teacher stated that s/he used game activities for value learning, and one pre-school teacher stated that s/he used game activities for preparing children for primary school. One pre-school teacher stated that s/he used game activities for learning addition-subtraction, and one pre-school teacher stated that s/he used game activities for matching numbers.

Some of the opinions of preschool teachers are as follows:

"Games primarily help me to raise awareness of students about the issues I choose to teach. I usually use games when introducing subjects. It allows me to teach without boring children. They pay attention to me or something for a longer time. They are very effective in reinforcing the learned items. (OÖ5)."

"Children learn more quickly and help permanent learning by gathering attention, etc. (OÖ7)."

Opinions of Preschool Teachers regarding the Mathematics Gains through the Game Activities

Table 7 presents the findings of the responses of preschool teachers about whether they have problems in achieving mathematics gains through game activities.

Table 7. Mathematics Gains in Game Activities

Theme	**Category**	**F**	**Code**
Experiencing no problem	No	19	OÖ1, OÖ2, OÖ3, OÖ4, OÖ5, OÖ6, OÖ7, OÖ8, OÖ9, OÖ11, OÖ12, OÖ13, OÖ15, OÖ17, OÖ18, OÖ19, OÖ20, OÖ21, OÖ22
	Entertaining	1	OÖ10
Experiencing problem	Sometimes	1	OÖ16

	When equipment is not available	1	OÖ14
	Total	22	

As presented in Table 7, nineteen preschool teachers stated that they had no problems in achieving mathematics gains through game activities. One preschool teacher, on the other hand, stated that s/he sometimes had problems.
Some of the opinions of preschool teachers are as follows:
"Problems occur when there are no tools (OÖ14)."
"I have not had any problem with the teaching of mathematics gains in game activities. (OÖ15)."

Preschool Teachers' Level of Achieving Mathematics Gains through Game Activities

Table 8 presents the findings regarding the opinions of preschool teachers about their level of proficiency in achieving mathematics gains when practising game activities.
Table 8. Level of Achieving Mathematics Gains in Game Activities

Thema	**Category**	**F**	**Code**
Level of proficiency	Proficient	9	OÖ2, OÖ7, OÖ9, OÖ11, OÖ13, OÖ14, OÖ15, OÖ17, OÖ18
	Good level	9	OÖ4, OÖ8, OÖ9, OÖ12, OÖ13, OÖ14, OÖ16, Ö19
	Partly proficient	3	OÖ3, OÖ6, OÖ10
	High Level	2	OÖ21, OÖ22
	Continuous progress	1	OÖ5
	Average Level	1	OÖ1
	Total	25	

As presented in Table 8, nine preschool teachers stated that they considered themselves proficient and good at achieving mathematics gains through game activities. Three preschool teachers stated that they are partly proficient. Two preschool teachers stated that they are highly proficient. One preschool teacher stated that s/he is in a state of constant development and at an average level.
Some of the opinions of preschool teachers are as follows:
"I consider myself proficient. I am planning my work in line with the university courses and resources I have benefitted regarding the teaching of mathematics (OÖ15)."
"I feel proficient, but I find the materials in the classrooms insufficient (OÖ17)."

Opinions of Preschool Teachers Regarding their Willingness to Receive In-Service Training

The results of the responses given by preschool teachers to the question about whether they want to receive in-service training to achieve effective mathematics gains in game activities are presented in Table 9.
***Table 9**. Willingness for In-Service Training*

Theme	**Category**	**f**	**Code**

Willingness for in-service training	Yes	15	OÖ1, OÖ2, OÖ4, OÖ5, OÖ8, OÖ10, OÖ11, OÖ12, OÖ13, OÖ14, OÖ15, OÖ17, OÖ18, OÖ21, OÖ22
	No	7	OÖ3, OÖ6, OÖ7, OÖ9, OÖ16, OÖ19, OÖ20
	Total	22	

When Table 9 is examined, it is seen that fifteen preschool teachers are willing to receive in-service training to achieve effective mathematics gains through game activities. Seven preschool teachers stated that they did not want to receive in-service training.
Some of the opinions of preschool teachers are as follows:
"*No. Thank you. (OÖ9).*"
"Yes, I'd like to receive it. I see my shortcomings and compensate with quality education (OÖ13)."
"Learning should be lifelong for teachers. Of course, I would like to receive in-service training. I have knowledge about new issues and techniques (OÖ15)."

Conclusion, Discussion and Recommendations

This study examined the effect of game activities on mathematics gains in the early childhood period. In this section of the research, the findings are discussed by comparing them with those found in the literature. In line with the findings of the research, some suggestions have been presented. Regarding the first sub-problem of this study, eight preschool teachers participating in the study stated that they used game activities every day. In addition, the duration of the used game activities varied. This revealed that preschool teachers are aware of the importance of using game activities. Tok (2018) conducted research to examine the perceptions of pre-service teachers regarding games and found that they had positive perceptions regarding games. This finding is in line with the positive perception of the participants of this research regarding game activities.

Regarding the second sub-problem of this research, when the opinions of preschool teachers were examined, six teachers were found to have used mathematics gains in game activities every day. When the other responses given by the teachers participating in the study are examined, it is seen that mathematics gains are targeted in different frequencies. According to the finding of the research by Yazlık and Öngören (2018), it was revealed that teachers mostly used mathematics concepts in their game activities daily. This finding is in line with that of this research. In a study conducted by Ergel and Aydoğan (2021) on parents, it was found that participants generally played games, do artwork, and use daily life activities to improve their children's mathematics skills. This result supports that of this research as it revealed that participants understood the positive contribution of play to the development of the mathematical field.

Regarding the sub-problem of this research, the participants of the research stated that the games they used most in mathematics teaching were matching games. Finger games, musical games and number games have also been found to be the most used games after matching games. Considering the importance of learning through games in early childhood, the use of different games in mathematics teaching is considered to provide positive results in learning.

In a study conducted by Koç and Kocaman (2018), children defined the play as explaining objects and events encountered to satisfy their curiosity. Since this finding reveals that play directs attention, it supports the idea that the use of different games will be effective in teaching mathematics. In this study, a preschool teacher stated that s/he used the game of playing with blocks in teaching mathematics. Aksoy and Aksoy (2018) conducted a study and found that teachers used block games in their daily educational flow in free time, mathematics, games, drama, and science-nature activities. This result supports that of this study.

Akıncı Coşgun and Yılmaz (2021) conducted a study and found that some of the participant preschool teachers used manipulatives such as blocks in mathematics activities. Yavuz and Şık (2022) conducted a study and found that wooden blocks were used in the teaching of the geometric shapes or toys manufactured specifically for these concepts. For example, colour blocks and a colour wheel were used in the teaching of colour. The findings of this study related to playing with blocks, the number wheel, and manipulative games in mathematics teaching are in line with those of this research.

Regarding the fourth sub-problem of this study, preschool teachers stated that number games were the most used games following the pattern games in learning mathematics subjects. This reveals the contribution of game activities to the learning of mathematics subjects. Saygılı and Ercan (2021) conducted research and found that there is a positive difference between the effect of teaching performed with the game method and test results in the ability to make observations, classify, assess, record data and draw conclusions. Papandreou and Tsiouli (2020) conducted research and found that while different subjects related to numbers and operations, measurement, space and geometry are used quite often in children's games, findings regarding algebraic thinking are rarely obtained. These results support those of this study because the results revealed that games have positive contributions to the cognitive field and especially to the field of mathematics. Cohrssen and Niklas (2019) conducted a study and found that children in the immediate treatment group, i.e. children in classrooms where NT Preschool Mathematics Games were applied, had significantly more gains than their peers in the delayed treatment group during this time. This result supports that of this study because the positive contribution of mathematics games and the provision of learning mathematics subjects in game activities produce similar results to each other.

Regarding the fifth sub-problem of this research, it was found that game activities contributed to the achievement of mathematics gains and have made the learning of mathematics entertaining. The following finding was that it provided permanent learning. Since children learn while having fun, it seems that game activities are an effective method for achieving mathematics gains. In addition, the fact that it provides permanent learning also shows that it makes an important contribution. Tok (2018) conducted a study and examined the perception of pre-service teachers regarding games, it was found that they had positive perceptions about games. The findings of both studies seem to support each other as they supported a positive view regarding games.

Regarding the sixth sub-problem, nineteen preschool teacher participants stated that they had no problems in achieving mathematics gains in game activities. A preschool teacher, on the other hand, stated that s/he sometimes had problems. In line with these results, it could be concluded that there are no problems in general in performing mathematics gains in game activities. It is seen that this result can make a positive contribution to the achievement of

mathematics gains in game activities. Karakuş, Firat, Akman and Dinçer (2019) conducted a study and found that the beliefs of preschool teachers regarding mathematical development were slightly below the average level in general. This finding contradicts this research. This study found that preschool teachers mostly had no problems with achieving mathematics gains in game activities, while a similar study found that preschool teachers' beliefs about mathematical development were generally found to be below the average level. Gundogan and Aslan (2020) conducted a study and found that there is a positive and significant relationship between the mathematical development knowledge of teachers and the early mathematical abilities of children. This result seems to support that of this study because the knowledge of a preschool teacher regarding the field of mathematics affects the mathematical learning of children. The fact that preschool teachers generally do not have problems, which is one finding of this study, maybe since they have knowledge in the field of mathematics.

Regarding the seventh sub-problem of this study, nine preschool teachers found themselves proficient to achieve mathematics gains in game activities and nine preschool teachers found themselves good enough in the seventh sub-problem. Tantekin and Tonga (2020) conducted research on the roles of teachers in mathematics activities in the early childhood period and examined the views of the participants regarding the issue. It was found that preschool teachers should have enough knowledge about the mathematics activities, that they should be able to know children through observation, and that they could design the material and environment where children's interests, needs and desires should be met. This finding emphasized the importance of the teachers' role in mathematics teaching, and this ultimately supports the finding of this research that teachers' beliefs regarding their proficiency will contribute positively to mathematics teaching.

Regarding the eighth sub-problem of the research, fifteen preschool teacher participants expressed their desire to receive in-service training to achieve effective mathematics learning through game activities. Seven preschool teachers stated that they did not want to receive in-service training. The fact that the majority of preschool teachers want to receive in-service education leads to the conclusion that the contributions of in-service training are much and that preservice teachers should be provided support in this area.
In line with the results of this research, the following recommendations are presented:

1. More planned activities can be organized to help children achieve mathematics gains in game activities.
2. A varied range of games can be applied in the teaching of mathematics gains.
3. In order for preschool teachers to have a high level of mathematics teaching skills in game activities, subject-related courses in preschool education and child development undergraduate programs can be developed based on theory and practice.
4. In order for preschool teachers to be able to teach mathematics gains effectively in game activities, more comprehensive in-service training could be organized and the participation of preschool teachers could be increased.

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