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Analysis of Pre-school Teachers' Knowledge and Opinions about Play in Mathematics Educational Process

Özlem DOĞAN TEMUR[1] Sedat TURGUT[2*]
1.Assoc. Prof. Dr., Faculty of Education Department of Elementary and Early Childhood Education, Dumlupınar University, 43100 Kütahya, Turkey
2.Dr., Faculty of Education Department of Elementary and Early Childhood Education, Bartın University, 74100 Bartın, Turkey

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Abstract
In this research, it was aimed to reveal the knowledge and opinions about play in pre-school teachers' mathematics educational process. The research was designed as a mixed method. The qualitative dimension of the study included the analysis and interpretation of the data obtained through a semi-structured interview form. The quantitative dimension of the research was composed of statistical analysis of the data collected by means of "Pre-school Mathematics and Play Scale'' according to various variables. In the analysis of the data obtained from the scale in the study, one-way ANOVA was used for unrelated samples and t-Test for unrelated samples. The data obtained from semi-structured interview form were analysed using content analysis technique. It was found in the research that the pre-school teachers emphasized the play to be an effective tool in achieving concretization in mathematical teaching and supporting the activities so as to meet the children's entertainment needs. However, teachers stated that they had difficulty in finding and using plays on various topics of mathematics. Teachers were seen not to be able to distinguish between play and activity.
Keywords: Pre-school, mathematics education, play

1. Introduction

Pre-school children get mathematical experiences in their daily lives. Sometimes these experiences are formed by sharing in a play, sometimes by counting, adding and subtracting. In the pre-school educational process (about learning, teaching, methods, class atmosphere, materials etc.), it can be said that teachers have an important task such as designing a mathematics educational process appropriate for them by accepting the experiences of children acquired in non-formal ways as opportunities. Teachers can also fail to provide children with informal experiences and ideas in the mathematics learning process when they don't take advantage of such opportunities in teaching mathematical concepts within the classroom. It can be said that one of the most important causes of this, along with its various reasons, is that preschool teachers do not have adequate methods and strategies for teaching mathematical concepts.

Teachers rarely realize the struggle children have in the process of learning mathematical concepts (Clements and Sarama, 2011). This struggle may sometimes stem from the learning process, sometimes from teaching, and sometimes from the child itself. Children often get experiences through which they can gain mathematical ideas with such activities in which they create patterns while playing with blocks, discover shapes, create symmetry, and so on (Seo and Ginsburg, 2004). Thus, they begin to gain experience in areas such as classification, sorting, patterning, measurement, geometry and number concepts, which require many math skills. These experiences can be supported and strengthened by a play-based program in all areas of the class. For example, children who group objects with similar characteristics experience the classification process. Although this cognitive skill seems simple to us, it is important for children to understand classification (Henniger, 2013). Thus, it can be said that mathematical experiences are formed effectively in the play process.

Clements and Sarama (2009) stated that mathematics can be integrated into children's plays smoothly. But the role of the teacher is important here. The teacher should create a supported environment, offer suggestions and tasks. Plays in which the teacher is involved and has made arrangements allow for strong learning and are valuable for education. Such plays can be described as pedagogical plays. It is important to define and use pedagogical play in the mathematics teaching process. Edwards, Cutter-Mackenzie and Hunt (2010) reported that pedagogical plays sometimes give students a chance to experience a discovery process when the teacher introduces materials and process to them and sometimes allow for an effective interactive process with the children when the teacher acts as a planner, observer and modeller. Accordingly, it can be said that the tools and communication that pre-school teachers use in mathematics education will strengthen the interaction of the knowledge and experiences they have about pedagogical play. From a social point of view, in the process of learning mathematics, children's speech, the process of verifying their speech and the process of communication with their friends and teachers are important. Children can easily understand mathematical concepts before using them because mathematical thinking first evolves before language. For this reason, the proper use of

mathematical words can help children acquire mathematical concepts. The use of clear and descriptive language in the mathematical knowledge and skills acquisition process is vital (Presser, Clements, Ginsburg and Ertle, 2015). It can be said that children mostly communicate during play during pre-school period. For this reason, it is important for pre-school teachers to have a good repertoire of plays that children play during pre-school period in terms of the development of communication skills in children. Also, pre-school teachers can use this play repertoire for their mathematics education. In doing so, teachers need effective strategies. Therefore, the teacher educational process must be well managed and supported in terms of plays and place of play mathematics education (Trawick-Smith, Swaminathan and Liu, 2016).

The process of learning mathematical concepts doesn't function effectively when they play with mathematical related materials on their own. For example, shape features may not be learned by the child in a play (Clements and Sarama, 2009). In the play phase, children will need guidance. Teachers should use an effective language as a good observer while children play with their instruments. The language that teachers use can facilitate children's learning. Children and adults use the same words, but the meaning that a child loads on a word is not the same as what an adult puts it. The smaller is the child, the more different is the meaning. As the child's interacting friend or individuals become different and contexts and actions change, the child repeatedly restructures the first meaning the child gives to a word (Bodrova and Leong, 2007). It is the play itself that opens communication-related channels and facilitates interaction with the child's environment. The use of play by teachers in their activities affects the school performance of preschool children. The play has an important place in children's thinking about numbers and in starting and using mathematical communication (Trawick-Smith, Swaminathan and Liu, 2016).

Elementary school mathematics is strongly associated with the mathematical skills gained during pre-school (Benz, 2012). For this reason, perceptions of pre-school teachers towards teaching mathematics are very important. The erroneous conceptual point of view that teachers have may negatively affect the teaching. That the teachers are not ready for little children, mathematics is aimed only at some bright children, the great importance given to the presence of mathematics genes in mathematics learning, and the simple shapes and numbers taught during pre-school is enough are some of teachers' misconceptions about early childhood mathematics education (Ginsburg, Lee and Boyd, 2008). The most important thing, which a teacher who will dedicate himself to his students' learning mathematics by understanding will meet and has to overcome, is to determine the ways of mathematical thinking. These paths are basic cognitive processes, and learners who use these paths reorganize and internalize the information gained from external world and construe its meaning (Haylock and Cockburn, 2013). For this reason, pre-school teachers should exhibit appropriate pedagogical behaviours in the course of mathematics teaching. The pedagogical approach refers to children's conceptual development characterized by certain environment, their communication in giving feedback, encouraging children and enhancing information exchange. These will also increase children's metacognitive skills and communication skills. Teachers who pay attention to them are teachers who use time more efficiently rather than being an activity planner, bring out learning opportunities and push children into deep thinking (Cross, Woods and Schweingruber, 2009). Based on this information, it can be said that pre-school teachers have an important role to play in mathematics educational process. In this research, it was aimed to determine the knowledge and opinions of pre-school teachers about play in mathematics teaching.

2. Method

2.1 Research Model

The research is designed as a mixed method, which involves the collection and analysis of both quantitative and qualitative data in the same study (Creswell and Plano Clark, 2007). Thus, the research problem is better understood by using a combination of each method as compared to individual use (Creswell, 2012). The qualitative dimension of this study includes the analysis and interpretation of data obtained through a semi-structured interview form. The quantitative dimension of the research is statistical analysis of the collected data according to various variables through "Pre-school Mathematics and Play Scale".

2.2 Data Collection

In this study, quantitative data were collected using the "Pre-school Mathematics and Play Scale" developed by the researchers. The scale was designed to be answered in a five-point Likert format. Accordingly, the rating was scored as "5 entirely agree, 4 mostly agree, 3 moderately agree, 2 little agree, 1 entirely disagree". There are 21 items on the scale. The smallest score that can be taken from the scale is 21 and the highest score is 105. The scale was applied to 171 voluntary preschool teachers working in schools affiliated to the Ministry of National Education (MEB) during the spring semester of 2016-2017 academic year.

Qualitative data of the study were collected through a semi-structured interview form prepared by the researchers. There were five open-ended questions in the form. An appointment was made with the teachers before the interviews were held. The teachers were interviewed face-to-face in the working environment at the

specified date and time. The questions in the form were directed to 9 preschool teachers and the responses of the teachers were recorded by the researchers in writing.

2.3 Data Collection Tools

2.3.1 Scale of Pre-school Mathematics and Play

Firstly, the literature was reviewed by the researchers and an item pool was created. The draft form based on these items was presented to expert opinion in terms of content validity and clarity of the statements. A draft form consisting of 36 items was prepared in order to be applied to pre-school teachers in the direction of expert opinions. The size of the study group during the scale development phase is important for reliable estimations. It is generally accepted that this size should be at least five times the number of variables observed (Büyüköztürk, 2002). In this study, a draft form consisting of 36 items was applied to 255 preschool teachers.

Exploratory factor analysis was applied to determine the construct validity of the scale. With exploratory factor, analysis can be explained with a small number of factors by gathering a large number of variables that measure the same characteristics together (Büyüköztürk, 2012). Kaiser-Meyer-Olkin (KMO) value and Barlett Sphericity Test results were evaluated to test the suitability of scale items for factoring. A KMO value of 0.60 and above indicates that the scale items are suitable for factoring. The Barlett Sphericity test also allows us to examine the relationship between variables using a test (Büyüköztürk, 2012; Tavşancıl 2005). The KMO value of the scale was calculated 0.82 in the research. The Barlett sphericity test value (x^2=1337,42; df=210; p=.000) was found to be significant. Based on these findings, it was decided that the scale was appropriate to factor the scale.

As a result of the exploratory factor analysis, the items should have load values of 0.32 and above at the factor they are in while deciding whether they will be included in the scale (Tabachnick and Fidel, 2013). In addition, the difference between the load values of the items in more than one factor should be at least 0.1 (Büyüköztürk, 2012). Accordingly, 15 items out of 36 items in the survey form were extracted from the scale.

As a result of the exploratory factor analysis, 21 items were seen to cluster under three factors with greater than 1. Eigenvalue graph of the scale is given in Figure 1.

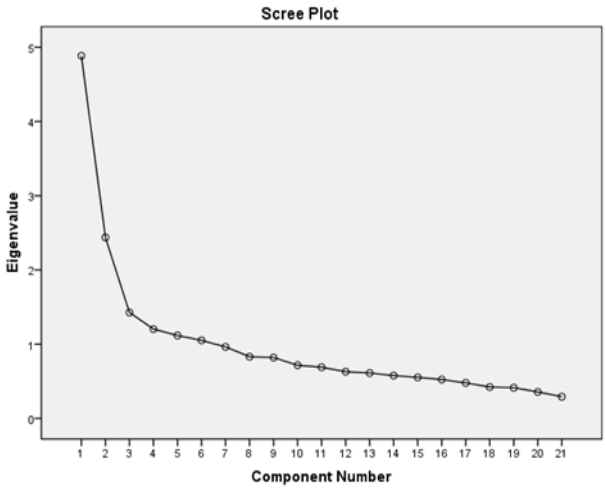

Figure 1. Eigenvalue Graph of the Pre-school Mathematics and Play Scale

As seen in Figure 1, Pre-school Mathematics and Play Scale have three factors with eigenvalue greater than 1. The variance these factors explained on the scale was calculated as 15.05% for the first factor, 13.77% for the second factor and 12.84% for the third factor. The total variance explained for the three factors is 41.66%.

The Cronbach Alpha internal consistency coefficient calculated to determine the reliability of the scale consisting of 21 items is 0.82. Alpha reliability coefficient of 0.70 and above is considered sufficient for scale reliability (Büyüköztürk, 2012). The alpha value was calculated as 0.77 for the first factor, 0.75 for the second factor and 0.66 for the third factor. It can be said that the internal consistency of the scale is at a good level.

Factor load values of the scale items in their factors varied between 0.44 and 0.73 and item total score correlations ranged from 0.24 to 0.65. It can be said that the items with a total item score correlation of 0.30 and above are at a good differential level, those with a total item score correlation between 0.20 and 0.30 can be corrected to be included in the scale due to force majeure and those with a total item score correlation below 0.20 should not be included in the scale (Büyüköztürk, 2012). Rotated factor load values, corrected item total score correlations, mean and standard deviations of the items in Pre-school Mathematics and Play Scale are given in Table 1.

Table 1. Rotated factor load values, corrected item total score correlations, mean and standard deviations of the items in pre-school mathematics and play scale

Factors	Item Number	Rotated Factor Loads	Corrected Item Total Correlation	Mean	Std. Deviation
Factor 1	22	0,71	0,63	3,24	1,02
	14	0,68	0,53	3,98	0,80
	32	0,61	0,47	3,98	0,87
	23	0,58	0,56	3,30	1,14
	19	0,57	0,33	4,07	0,89
	21	0,54	0,55	3,35	0,93
	20	0,54	0,30	3,65	0,97
	13	0,50	0,39	3,80	0,89
Factor 2	2	0,73	0,65	4,25	0,90
	9	0,70	0,50	4,18	0,82
	8	0,70	0,53	4,36	0,82
	6	0,57	0,39	4,34	0,81
	15	0,52	0,51	4,02	0,90
	3	0,51	0,40	3,99	0,90
	28	0,47	0,30	3,95	0,89
Factor 3	17	0,65	0,48	3,18	0,94
	36	0,63	0,41	3,20	1,15
	16	0,57	0,45	3,19	0,92
	27	0,56	0,33	3,61	0,91
	18	0,55	0,46	3,50	0,86
	4	0,44	0,24	3,68	1,05

Table 1 shows that only one item (M4) has a total score correlation value of 0.24 and the item expression is corrected to be included in the scale. Item total score correlation values of other items range between 0.30 and 0.65. Therefore, it can be said that the scale items are well- differential.

Scale factors were named by looking at the relationships between the items in the factors. Factor names and item expressions of the scale are given in Table 2.

Table 2. Factor names and item expressions of pre-school mathematics and play scale

Factor Name	Item Number	Item Expression
Usage and Purpose of the Play	M22	I use play in problem solving activities most
	M14	I use play to draw children's attention to mathematical concepts
	M32	I teach mathematics concepts that are hard to learn by making students play a game
	M23	I frequently use play in data and geometry activities
	M19	It is important in the mathematics educational process that children ask each other questions
	M21	I use play in operation activities more often
	M13	I use play to see children’s misconceptions of mathematical concept
	M20	I use play in counting activities most
Planning of the Play Process	M2	When choosing a play for mathematics teaching, I pay attention to its suitability for my purpose
	M9	When I play games in math activities, I question the questions children ask
	M8	I try to understand what kids understand when making them play games in mathematics education
	M6	I check children's prior knowledge before making them play games in math activities
	M15	I determine related concepts if I am to make students play games in math activities
	M3	I have specific preconditions for selecting the appropriate play for the math topic I will teach
	M28	I plan every phase of the play I will use in the mathematics educational process
Activity and Play Relation	M17	I use free plays most in the mathematics educational process
	M36	I accept children's dancing in math activities as a play
	M16	I use musical plays most in the mathematics educational process
	M27	I regard mathematical teaching activities using mathematical materials as mathematical plays
	M18	I use physical plays most in the mathematics educational process
	M4	I would like the mathematical plays I have chosen to be enjoyable rather than instructive

Table 2 shows that as a result of explanatory factor analysis, the 21 items on the scale dispersed as 8 items

in the first factor, 7 items in the second factor and 6 items in the third factor. The first factor was named as *Usage and Purpose of the Play* and the second factor as *Planning of the Play Process* while the third factor was named as *Activity and Play Relation*.

2.3.2 Semi-structured Interview Form

The semi-structured interview form was designed to reveal the knowledge and opinions of pre-school teachers about play in the mathematics educational process. There were five open-ended questions in the form. Prior to the preparation of the questions, specialist teaching staff in the pre-school area and pre-school teachers who had Master's degree in this area were interviewed and the questions were prepared according to expert opinions. The questions on the form were prepared in a way that they could express their opinions about what pre-school teachers think when "mathematics and play" is mentioned, in teaching of which attainments they need plays more, what kind of plays they prefer to play in the mathematics teaching process, what kind of materials they use while playing plays and the content and their structural status of the plays they use.

2.4 Study Group

There are two separate study groups in the study; one in the stage of scale development and another in the implementation stage of the Pre-school Mathematics and Play Scale. These study groups were selected according to the convenience sampling from non-random sampling methods. Interviews were held with 9 preschool teachers selected on the basis of voluntary participation among the teachers who applied the scale.

During the scale development stage, the study group constituted 255 preschool teachers working in schools affiliated to the MEB in various cities of Turkey in the spring semester of 2016-2017 academic year. The descriptive characteristics of the study group during the scale development stage are given in Table 3.

Table 3. Descriptive characteristics of the study group during scale development stage

Variables	Properties	f	%
Gender	Female	244	95,7
	Male	11	4,3
Professional Experience	1-5 years	108	42,4
	6-10 years	116	45,5
	11-15 years	17	6,7
	16 years and over	14	5,5
Teaching Group	Age 3-4 years	99	38,8
	Age 5-6 years	156	61,2
Total		255	100

According to Table 3, it is seen that the majority (95.7%) of the pre-school teachers participating in the research were female. In terms of professional experience, participants were mostly composed of pre-school teachers who had been working between 1-5 years (42.4%) and 6-10 years (45.5%), and when the age groups of pre-school teachers are examined, the number of 3-4 years age group (38.8%) was fewer than that of 5-6 years age group (61.2%).

The final scale was applied to 171 voluntary pre-school teachers working in schools affiliated to MEB in various cities of Turkey in the spring semester of 2016-2017 academic year. The descriptive characteristics of the final scale are given in Table 4.

Table 4. Descriptive characteristics of the final study group during implementation stage

Variables	Properties	f	%
Gender	Female	162	94,7
	Male	9	5,3
Professional Experience	1-5 years	70	40,9
	6-10 years	81	47,4
	11-15 years	11	6,4
	16 years and over	9	5,3
Teaching Group	Age 3-4 years	63	36,8
	Age 5-6 years	108	63,2
Total		171	100

Table 4 shows that the majority (94.7%) of pre-school teachers participating in the research were female. In terms of professional experience, the number of preschool teachers whose term of office was 1-5 years (40.9%) and 6-10 years (47.4 %) was more than the number of those with term of office was 11-15 years (6.4%) and 16 years and over (5, 3%). When we look at the age groups of the students these teachers were teaching, it is seen that the rate of 3-4 years age group (36.8%) was less than 5-6 years age group (63.2%).

2.5 Data Analysis

In the research, the data obtained by means of Pre-School Mathematics and Play Scale were analysed using SPSS program. While the scores of pre-school teachers from the scale were analysed according to the variables, t-Test was used for unrelated samples and one-way ANOVA was used for unrelated samples.

Content analysis was used to analyse the data obtained as a result of the interviews. In content analysis, the data are analysed in detail and categories and dimensions are revealed (Yıldırım and Şimşek, 2011). Thus, the data can be presented in a systematic way. The data were analysed separately by two investigators. In the analysis process, meaningful categories were created from similar expressions based on the replies of preschool teachers. When creating the category, the teachers were coded as Ö1, Ö2, … Ö8, Ö9. Later, the researchers came together to discuss the categories they had created and agreed on the categories.

3. Findings

3.1 Findings Obtained from Quantitative Data

First of all, it was examined whether the total scores pre-school teachers got from the scale had a normal distribution. The distribution was determined to be normal according to the results of Kolmogorov-Smirnov[a] (n = 171, p = 0.20, p> 0.05) normality test and the ratio of skewness-kurtosis values to standard error (skewness = -1.58, kurtosis = 1.84). Accordingly, t-Test was used in the analysis of the total scores pre-school teachers got from the scale according to gender and student age group variables, and One-Way ANOVA was used according to the professional experience variable.

In Table 5, t-Test results of the total scores pre-school teachers got from the scale according to gender variable are given.

Table 5. t-Test results according to gender variable

Factors	Gender	N	Mean	Std. Deviation	t	df	Sig.
Factor 1	Female	162	30,51	4,49	3,46	169	0,00
	Male	9	25,00	7,07			
Factor 2	Female	162	29,66	3,65	4,48	169	0,00
	Male	9	23,88	5,51			
Factor 3	Female	162	21,35	3,54	2,06	169	0,04
	Male	9	18,77	5,19			

Table 5 shows that there is a statistically significant difference between the groups in three factors in terms of gender variable (p <0.05). The average score of women is higher than that of men. This result shows that awareness of female teachers about the use of plays in mathematics education is higher.

Table 6 shows the ANOVA results of the total scores pre-school teachers got from the scale according to the professional experience variable.

Table 6. ANOVA results according to professional experience variable

Factors	Source of Variance	Sum of Squares	df	Mean Square	F	Sig.	Significant Difference
Factor 1	Between Groups	86,37	3	28,79	1,25	0,29	-
	Within Groups	3821,73	167	22,88			
	Total	3908,10	170				
Factor 2	Between Groups	39,99	3	13,33	0,84	0,47	-
	Within Groups	2633,24	167	15,76			
	Total	2673,24	170				
Factor 3	Between Groups	86,26	3	28,75	2,16	0,09	-
	Within Groups	2214,73	167	13,26			
	Total	2300,99	170				

According to Table 6, there is no statistically significant difference between the groups in terms of professional experience variable in three factors (p> 0.05). According to this result, it can be said that pre-school teachers have similar characteristics regarding the use of plays in mathematics education in terms of professional experience.

In Table 7, t-Test results of the total scores pre-school teachers got from the scale are given according to the student age group variable.

Table 7. t-Test results according to student age group variable

Factors	Teaching Group	N	Mean	Std. Deviation	t	df	Sig.
Factor 1	Age 3-4 years	63	29,53	4,75	1,43	169	0,15
	Age 5-6 years	108	30,62	4,79			
Factor 2	Age 3-4 years	63	28,66	4,02	1,74	169	0,08
	Age 5-6 years	108	29,75	3,89			
Factor 3	Age 3-4 years	63	21,09	3,20	0,32	169	0,74
	Age 5-6 years	108	21,28	3,94			

According to Table 7, there is no statistically significant difference between the groups in terms of the age group variable in three factors ($p > 0.05$). According to this result, it can be said that the student age group variable does not lead to a difference in preschool teachers' use of play in the mathematics education.

3.2 Findings Obtained from Qualitative Data

Within the scope of qualitative findings, meaningful categories were generated from replies of pre-school teachers to the questions in the semi-structured interview form. Sample statements that describe the categories with direct quotes from the responses given by the teachers are included. As a result, the findings are presented in tabular form.

In Table 8, the findings obtained in the direction of the replies of pre-school teachers to "What comes to your mind when you hear mathematics and play during preschool? Explain" are presented.

Table 8. What comes to your mind when you hear mathematics and play during preschool?

Category	Sample Statement
Skills (Ö1, Ö2, Ö3, Ö4, Ö5, Ö6)	"It expresses mathematical counting skills, estimation skills, matching, classification, etc. for preschool children" (Ö1) "The place of play is an indisputable fact in gaining the basic skills in mathematics" (Ö4) "It develops cognitive thinking skills" (Ö6)
Easy (Ö1, Ö7)	"I think it is one of the easiest and most effective ways of teaching mathematics to children" (Ö1) "When mathematics is involved in play activities, children will begin to enjoy mathematics, which will facilitate learning mathematics" (Ö7)
Tool (Ö1)	"The play is an indispensable tool with which a child learns and internalizes what is going on in the world" (Ö1)
Basic (Ö2, Ö4)	"Activities that base the most primitive aspects of mathematics on children's minds" (Ö2)
Necessity (Ö2)	"In this period, I think that mathematics education should be given mainly with plays" (Ö2)
Number (Ö3)	"Plays based on number concept come to my mind" (Ö3)
Deficient (Ö3)	"I feel myself particularly lacking in this matter" (Ö3)
Fun (Ö7, Ö8)	"Teaching mathematics concepts through play is both easier and more fun" (Ö8)
Concretization (Ö9)	"Mathematics is a difficult field for children to understand without concretization, so when play is mentioned, mathematics should be concretized" (Ö9)

As seen in Table 8, nine categories labelled as "Skills, Easy, Tool, Basic, Necessity, Number, Deficient, Fun, Concretization" were created from the replies of preschool teachers to the question. Pre-school teachers emphasized "skills" the most when they associate mathematics and play, and stated that they used plays to furnish pre-school children with basic skills. In addition, they also pointed out that plays make mathematics education easier, is an effective tool, makes mathematics teaching fun and concretizes it. Also, a teacher said he felt himself inadequate in play in mathematics education.

Table 9 shows the findings obtained in pre-school teachers' replies to "During the educational process of which attainment (counting, operation, geometry, data, etc.) about mathematics from cognitive attainments in pre-school curriculum you require plays more? Why?"

Tablo 9. During the educational process of which attainment (counting, operation, geometry, data, etc.) about mathematics from cognitive attainments in pre-school curriculum you require plays more? Why?

Category	Sample Expression
Grouping (Ö1)	"I think play is more effective for attainment of grouping specified objects according to their colours, shapes, etc." (Ö1)
Operation (Ö2, Ö3, Ö5, Ö7, Ö8)	"I need play more in the operation, geometry, charting activities" (Ö2)
Geometry (Ö2, Ö3)	"The plays I know are usually on counting and geometry, but I have difficulty in operation; it is complex and boring" (Ö3)
Graphics (Ö2)	
Counting (Ö4)	"Because counting is a basic skill and involved in all plays, counting attainment is the one in which play is needed most" (Ö4)
Pattern (Ö5, Ö9)	"Operation and pattern the most" (Ö5)
Matching (Ö9)	"He matches as many objects as specified because there are a lot of plays" (Ö9)

Table 9 shows that seven categories labelled "Grouping, Operation, Geometry, Graphics, Counting, Pattern, Matching" were formed according to preschool teachers' replies to the question. Teachers indicated that they needed play most in operation attainment. One of the teachers used the expression *"The plays I know are usually on counting and geometry, but I have difficulty in operation; it is complex and boring"* in the operation category. This expression gives the impression that the teacher didn't know enough plays to teach operation. Again, in a matching category, a teacher's expression *"He matches as many objects as specified because there are a lot of plays"* suggests that he related the use of play in teaching matching to the excessive number of plays in that subject.

Table 10 shows the findings obtained in pre-school teachers' replies to "What kind of plays do you use in the mathematics educational process in preschool? Explain."

Table 10. What kind of plays do you use in the mathematics education process in preschool?

Category	Sample Expression
Finger game (Ö1, Ö5)	"Finger game, competitive games, hopscotch, musical games" (Ö1)
Musical game (Ö1, Ö3)	"Rhythmic counting with music, beating out a number" (Ö3)
Solo game (Ö2)	"I prefer collaborative games and solo games more" (Ö2)
Collaborative game (Ö2)	
Action game (Ö3, Ö5, Ö7, Ö9)	"I think that action games have a more positive effect on children" (Ö3)
Activity (Ö1, Ö4, Ö5, Ö6, Ö7, Ö8)	"Matching, one-to-one correspondence, colour grouping, matching geometric figures with music, patterning drills" (Ö4) "Dramatizing educational materials" (Ö5) "Mathematical activities with materials such as various matching cards, finding objects as many as the number of objects made from residual materials are warmer" (Ö6) "Counting the windows in class" (Ö8)

Table 10 shows that six categories labelled "Finger game, Musical game, Solo game, Collaborative game, Action game, Activity" were formed according to preschool teachers' replies to the question. Replies of the teachers show that the pre-school teachers called classroom activities as play and couldn't make the activity-play distinction exactly. Teachers stated that they used finger games and music games as well as animated games.

Table 11 shows the findings obtained in pre-school teachers' replies to "What kind of equipment do you benefit from when playing games in mathematics education in preschool? Give examples".

Table 11. What kind of equipment do you benefit from when playing games in mathematics education in preschool?

Category	Sample Expression
Counting Material (Ö1, Ö3, Ö4)	"Counting bars, construction papers, educational materials, any king of material in class" (Ö1)
Construction Papers (Ö1, Ö7)	
In-class Materials (Ö1, Ö2, Ö3, Ö4, Ö5, Ö7, Ö8, Ö9)	"All materials from square frames to plush toys can be used in many parts of mathematics education" (Ö2)
Toys (Ö4, Ö6, Ö7, Ö8, Ö9)	"Number cards, beads, concept cards, coloured balls, geometric figures, pattern cards" (Ö4) "Dice, Legos, stones, buttons, beads, bars, lids, number cards, geometric figures, watch, bingo cards, checkers etc." (Ö8)

Table 11 shows that four categories labelled "Counting Material, Construction Papers, In-class Materials, Toys" were formed according to preschool teachers' replies to the question. Teachers often indicated that they used the equipment and toys they had in class. Teachers were seen not to mention any materials specific to teaching technology and mathematics in their replies.

Table 12 shows the findings obtained in pre-school teachers' replies to "Describe a play that you use for any attainment (counting, operation, geometry, data, etc.) in the mathematics educational process in preschool".

Table 12. Describe a play that you use for any attainment (counting, operation, geometry, data, etc.) in the mathematics educational process in preschool.

Category	Sample Expression
Musical game (Ö1, Ö4, Ö5, Ö6, Ö7, Ö8)	"I make them play 'ten small bottles swaying'. Its objective is to teach how to count rhythmic backwards from 10" (Ö1)
Group games (Ö2)	"I made the kids into two groups. Each child whose turn comes takes a figure from the box before him and runs to put it into the box" (Ö2)
Activity (Ö3)	"In geometry class, they are asked to find square triangles in class" (Ö3)
Active (Ö9, Ö2, Ö5, Ö8)	"Drawing geometric figures on the floor, children are made to dance to music" (Ö5) "They dance to music. When the music is stopped, the children hug are a friend who wears the crown with the same number as their" (Ö8) "I mostly use plays in which children will use their body" (Ö9)

Table 12 shows that four categories labelled "Musical games, Group games, Activity, Active" were formed according to preschool teachers' replies to the question. Teachers generally talked about plays of counting and geometry. Most of the examples given by teachers were plays that could be an example of active and musical games. A teacher's reply *"Students are asked to find square triangles in class in geometry lesson"* suggests that he didn't have enough information about the play.

4. Conclusion, Discussion and Suggestions

As a result of the research, no statistically significant difference was found between the scores of the teachers in terms of the professional experience and age group variables according to the findings obtained from the scale. Accordingly, it can be said that the variables of age group and professional experience do not significantly affect the knowledge and opinions of preschool teachers about play in mathematics education. In terms of gender variation, female teachers' scores were found to be higher than male teachers in all factors of scale. This suggests that female teachers who participated in the research have higher awareness of play in mathematics education.

In the study, it was seen that while relating mathematics and play, pre-school teachers described play as an effective and amusing tool in the concretization process. Educators today emphasize that effective learning is important for the full development of human potential. Play in child-centered preschool programs is an important factor in building an effective learning environment that supports all areas of development. Accordingly, it can be said that a child is active and develops more concrete structures in learning by playing (Sevinç, 2009). It is therefore a positive approach that the pre-school teachers in the research emphasized play is an effective means of ensuring both concretization in learning and that activities are supported in a way that meets children's entertainment needs.

Preschool teachers stated in the interviews that they needed a play in designing or implementing the educational process related to attainment in operation. However, they added that they had difficulty in finding and using plays about operation. A teacher expressed his opinion about the attainments as *"I find plays about counting more easily and so I make them play a game about counting."* Accordingly, it can be said that pre-school teachers need play activities related to mathematical attainments. Play dominantly reflects the activity characteristics shared between the teacher and child, child and child. Shared activities will reveal children's advanced thinking skills. In these activities, teachers can be both a planner and a participant. When planning activities, attentive teachers know that they must use a variety of techniques in the learning process and constantly modify their presentations (Bodrova and Leong, 2007). Play has an enriching and supportive role in activity planning process. Concepts and rules that are difficult to teach can be taught more effectively when given to the child through play (Yalçınkaya, 2004). For this reason, it can be said that pre-school teachers need to have an effective play repertoire about the attainments that reflect the entire mathematics, and need to be supported in this respect.

Teachers stated that they used finger games, musical games, solo games, collaborative games, action games and activities in the mathematics education process before the school. What stands out in the answers teachers gave is that they named activities as play. For example, the answer of a teacher as *"counting the windows in the*

classroom" suggests that there is no difference between the activity and the play for him. Preschool teachers think of routine activity as a play, and they express these opinions in their answers. However, gaming and classroom routines can be perceived differently by preschool children. Whitebread, Coltman, Jameson, and Lander (2009) refer to activities in which children can make choices or control their own processes as plays. Koçyiğit and Başara Baydilek (2015) state that in order to be able to define any activity in the pre-school period as a play, there must be a toy, entertainment, movement and choice within the activity. It was observed that preschool teachers could not distinguish between play and activity. Therefore, it can be said that the teachers need to be supported in play and mathematics education.

Pre-school teachers indicated that they benefited from such material groups as counting material, construction papers, in-class materials and toys while playing games in mathematics education. However, the teachers couldn't give enough information about the materials they used specifically for mathematics education during play. In general, it appears that the materials in the class are used during the play process. The National Council of Teachers of Mathematics (NCTM) emphasizes that preschool programs should provide materials that allow children to learn mathematics with fun activities that encourage how to count, measuring, building blocks, playing board and card games, and engaging in music and arts (NCTM, 2000). Accordingly, it can be said that pre-school teachers should be supported about with what materials they can enrich the plays in mathematics educational process. Again, when pre-school teachers were asked to give example plays, they often mentioned about plays that could be examples of musical and action games, which suggests that the teachers took care to use plays that were appropriate to the developmental characteristics of pre-school children and that would draw children's attention. Numerous studies have proven that dealing with music affects the functions of the brain. When sound is produced, different areas of the brain such as motor skills, senses, and emotions are used together, nerve cells become active, new connections occur (Nitsch and Hüther, 2009). However, it may be necessary to emphasize that play does not always provide mathematical development. Clements and Sarama (2009) emphasize that the ability of the play to be useful in the mathematics educational process depends on the fact that children should be able to follow and understand the mathematical ideas the pre-school teachers reflect during the play. Again, questions that pre-school teachers ask during the play to provide opportunity for children to make explanations and develop new insights will improve their mathematics learning.

As a result, it can be said that in the pre-school mathematics educational process, teachers need theoretical and practical support to use play effectively and dynamically. In addition, it was also seen that pre-school teachers emphasize play as an effective tool in achieving concretization of mathematical concepts and supporting the activities so as to meet children's entertainment needs. Broström (2017) stated that having the knowledge of the plays the teachers will make students play and the implementation of these plays will go beyond realizing learning and will positively affect the social interaction between the teacher and the child. This interaction is also important in terms of children's cognitive development because children learn when they are active members of social interaction.

In this study, a scale and a semi-structured interview form were used to reveal the knowledge and opinions of preschool teachers about play in mathematics education. Different methods and techniques can be used in such studies. Opinions of pre-school teachers were taken in the survey but no observations were made. How pre-school teachers use play and what kind of plays they use in mathematics educational process can be revealed by the observation technique.

References

Benz, C. (2012). Maths is not dangerous: Attitudes of people working in German kindergarten about mathematics in kindergarten. *European Early Childhood Education Research Journal*, *20*(2), 249-261.

Bodrova, E., & Leong, D. J. 2007. *Tools of the mind. The Vygotskian approach to early childhood education.* New Jersey: Pearson Merrill/Prentice Hall.

Broström, S. (2017). A dynamic learning concept in early years' education: A possible way to prevent schoolification. *International Journal of Early Years Education*, *25*(1), 3-15.

Büyüköztürk, Ş. (2002). Faktör analizi: Temel kavramlar ve ölçek geliştirmede kullanımı. *Kuram ve Uygulamada Eğitim Yönetimi, 32*, 470-483.

Büyüköztürk, Ş. (2012). *Sosyal bilimler için veri analizi el kitabı.* Ankara: Pegem Akademi.

Clements, D. H., & Sarama, J. (2009). *Learning and teaching early math: The learning trajectories approach.* New York: Routledge.

Clements, D. H., & Sarama, J. (2011). Early childhood mathematics intervention. *Science, 333*, 968-970.

Creswell, J. W. (2012). *Educational research: Planning, conducting and evaluating quantitative and qualitative research.* Boston, MA: Pearson.

Creswell, J. W., & Plano Clark, V. L. (2007). Understanding mixed methods research. In J. W. Creswell (Ed.), *Designing and conducting mixed methods research* (pp. 1-19). Thousand Oaks, CA: Sage.

Cross, C. T., Woods, T. A., & Schweingruber, H. (Eds). (2009). *Mathematics learning in early childhood. Paths*

towards excellence and equity. Washington, DC: National Academies Press.
Edwards, S., Cutter-Mackenzie, A. N., & Hunt, E. (2010). Framing play for learning: Professional reflections on the role of open-ended play in early childhood education. In L. Brooker, & S. Edwards (Eds.), *Engaging play* (pp. 136-151). Maidenhead, UK: Open University Press.
Ginsburg, H. P., Lee, J. S., & Boyd, J. S. (2008). Mathematics education for young children: What it is and how to promote it. *Social Policy Report: Giving Child And Youth Development Knowledge Away, 22*, 1-24.
Haylock, D., & Cockburn, A. (2013). *Understanding mathematics for young children: A guide for teachers of children 3-8*. London: Sage Publications.
Henniger, M. L. (2013). *Teaching young children: An introduction.* Boston: Pearson Publication.
Koçyiğit, S., & Başara Baydilek, N. (2015). Okul öncesi dönem çocuklarının oyun algılarının incelenmesi. *YYÜ Eğitim Fakültesi Dergisi, 12*(1), 1-26.
National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: NCTM.
Nitsch, C., & Hüther, G. (2009). *Haydi oynayalım.* (Çev. G. Kızılca Yürür). İstanbul: Optimist Yayınları.
Presser, A. L., Clements, M., Ginsburg, H., & Ertle, B. (2015). Big math for little kids: The effectiveness of a preschool and kindergarten mathematics curriculum. *Early Education and Development, 26*(3)*,* 399-426.
Sevinç, M. (2009). *Erken çocukluk gelişimi ve eğitiminde oyun*. İstanbul: Morpa Kültür Yayınları.
Seo, K. H., & Ginsburg, H. P. (2004). What is developmentally appropriate in early childhood mathematics education? Lessons from new research. In D. H. Clements, J. Sarama, & A. M. DiBiase (Eds.), *Engaging young children in mathematics: Standards for early childhood mathematics education* (pp. 91-104). Mahwah, NJ: Erlbaum.
Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. USA: Pearson.
Tavşancıl, E. (2005). *Tutumların ölçülmesi ve SPSS ile veri analizi*. Ankara: Nobel Yayıncılık.
Trawick-Smith, J., Swaminathan S., & Liu, X. (2016) The relationship of teacher-child play interactions to mathematics learning in preschool. *Early Child Development and Care*, *186*(5), 716-733.
Whitebread, D., Coltman, P., Jameson, H., & Lander, R. (2009). Play, cognition and self-regulation: What exactly are children learning when they learn through play? *Educational & Child Psychology, 26*(2), 40-52.
Yalçınkaya, T. (2004). *Okul öncesi eğitimde eğitici oyun ve oyuncak yapımı*. İstanbul: Esin Yayınevi.
Yıldırım, A., & Şimşek, H. (2011). *Sosyal bilimlerde nitel araştırma yöntemleri.* Ankara: Seçkin Yayıncılık.