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Opinions of pre-service pre-school teachers on the use of mathematics activities

Oğuz Serdar Kesicioğlu 

Department of Early Childhood Education, Faculty of Education, University of Giresun, Giresun, Turkey
kesiciogluserdar@gmail.com

The research reported on here was designed in a qualitative approach to present the opinions of pre-service pre-school teachers on the use of mathematics activities. The sample consisted of 10 pre-service teachers, who in their fourth year of pre-school education in the teaching department in 2017 to 2018. The pre-service teachers in the study group were selected from those with a grade point average (GPA) of above 3 and who completed the teaching practice course. In the research, the data were collected from the pre-service teachers through interviews. A semi-structured form, developed by the researcher, was used as a data collection tool in order to reveal the opinions of pre-service pre-school teachers on the application of mathematics activities. The results of the research show that the participating pre-service pre-school teachers used more than one-to-one correspondence in mathematics activities of which the most difficult concepts were classification and geometrical figures – difficult situations in which to attract the attention of children and a crowded class of 36 to 48 month old children. Most of the mathematics activities were integrated into games and art through the narration and gamification method. The participants mostly used prepared mathematics activities in practice.

Keywords: mathematics; pre-school; pre-service teacher

Introduction

There is a clear parallel relationship between the size of countries' economies and levels of education. While an increase of education levels contributes to the economy, economic growth also contributes to the education system. Studies conducted in various countries reveal that education has contributed significantly to economic growth. When comparing the budget allowance amounts set aside for either the Ministry of National Education or universities in Turkey with those in developing countries of the Organisation for Economic Co-operation and Development (OECD), this rate falls short. While Turkey spent 4.1% of its gross domestic product (GDP) on education in 2004, OECD countries set aside on average 5.7% of their budgets for education. The educational expenditure per student at all levels of education from pre-school to high school in Turkey is below the OECD average. For example, this rate was 7% in England, 14% in Belgium, 15% in the United States, 16% in Argentina, and 25% in Canada (OECD, 2005). Due to the lack of investment in education, the need for physical infrastructure and educators at all levels of education continues. The low expenditure negatively impacts the quality of education. While Japan, Germany, Italy, and Greece spent 950 dollars, 817 dollars, 523 dollars, and 240 dollars respectively, on education, the rate in Turkey is approximately 90 dollars. When Turkey is compared with the educational indicators of member countries to the European Union, Turkey is far below the European Union (EU) average. This situation shows that, if there is not enough investment in education, it is impossible to close the gap between development and income levels between countries (Ereş, 2005).

As the appropriation for education declines in most countries, the quality of education declines at a similar rate. The insufficiency of the education budget in Turkey negatively affects the pre-school education and teacher-cultivation system. This situation clearly shows itself in international exam results like Trends in International Mathematics and Science Study (TIMSS), The Progress in International Reading Literacy Study (PIRLS), and the Programme for International Student Assessment (PISA). The international exam results of developed countries like the United States of America, Finland, South Korea, and Denmark that set aside a large budget for education, are significantly higher compared to those of developing countries like Turkey, Chile, Uruguay, and Romania (OECD, 2018). The results of a study conducted by Orçan (2013:2) supports this view that problems like teachers not having sufficient information about the contents of programmes, not including adequate mathematical activities, the excessiveness of classroom materials, and a lack of insufficient instructional toys result in poorer education. Similarly, the results of an OECD (2018) report show that the status of insufficient or absent educational materials is greater in Turkey compared with the OECD.

Pre-school students in Turkey are children between the ages of 36 to 68 months, and schooling is not mandatory for these children. In Turkey, 38% of children aged 3 to 5, 50% of children aged 4 to 5, and 66% of children aged 5 attend pre-schools. Turkey lags significantly behind OECD and EU countries in terms of rates of schooling (ages 3, 4, and 5). In OECD and EU countries about 95% of children attend pre-schools at age 5, 90% at age 4 and 70% at age 3. In Turkey these numbers are 71%, 30% and 10% respectively. It is thus clear that the pre-school rate in Turkey needs to increase for ages 3 and 4 (Kazu & Yılmaz, 2018; Millî Eğitim Bakanlığı [MEB], 2019). These insufficiencies negatively influence mathematics education in particular. International exams generally reveal the quality of the education of countries in addition to success in mathematics. The fundamental aspect that sets developed countries apart from developing countries is the possession of knowledge and the capacity to use it. The most important people who apply knowledge are teachers (Koç Aytekin, 2015). For this reason, it was important to determine the problems that candidate

teachers' experience regarding mathematics instruction before they starting in the profession. In this study we sought to reveal the concepts that teaching candidates used, the struggles they faced, which materials they used and how, methods and techniques used, and the age groups with whom they struggled in order to provide a significant contribution to the national and international literature. The causes of failure in other developing or developed countries that are unsuccessful on international exams originates from similar situations. For this reason, the results of this research should give researchers and educators the opportunity to compare the current situation in their own countries. These international comparisons are quite important in terms of viewing the rearing preferences of different teachers. It is thought that comparative analyses conducted with consideration of countries' own social, cultural, and economic conditions will contribute to the educational processes of the countries (Altuntaş & Yeşiltepe, 2016).

Literature Review

Mathematics in early childhood

The pre-school period is the period in which children learn and practise basic concepts and scientific process skills. The experiences of children in this period create an appropriate environment for the acquisition of concepts that are considered to be building blocks of knowledge. And the education programme developed for pre-school children also aims to make children, who continue pre-school, grow up healthy by means of the rich teaching experiences; to make them reach the highest level in motor, social and emotional, language and cognitive development areas, to make them gain self-care skills and to prepare them for elementary school (Kamay & Kaşker, 2006; MEB, 2013). Children develop these skills at pre-school education institutions. Educational activities used in pre-school education institutions are stated as Turkish, art, drama, music, movement, games, science, mathematics, preparation for reading and writing and field trips. Mathematics is one of the mandatory and necessary activities taught in pre-school as well as in all levels. The increase in research that supports the opinion that mathematics is innate and a set of skills created during the first years of life emphasises the importance of mathematics in pre-school education (Tarım, S 2015). Regarding mathematical skills, the early academic skills in pre-school are skills such as size concepts (big-small), recognition, naming, matching, comparison, grouping, sorting, numbers, addition, subtraction and division, modelling, geometry, spatial logic, measuring, and charting (Charlesworth & Lind, 2007; Güven, 1999). Teachers are critical in enabling children to acquire these skills that will enable the effective practising

of mathematics efficiency. The teacher's beliefs/opinions/perceptions of mathematics will have an effect on the children (Kamay & Kaşker, 2006).

The role of teachers in early childhood mathematics teaching

As in all levels of education, the importance of teachers in any subject and how they convey mathematics affects the children's attitudes towards mathematics (Baki & Bektaş Baki, 2016; Karakuş, Akman & Ergene, 2018). That is why it is important to know how mathematics concepts are taught to children in pre-school. The teacher should make mathematics interesting for children and present it to children as a fun activity (Arnas Aktaş, 2005). The teacher can do structured/semi-structured/unstructured activities suitable for the physical condition of the class, the type of activity and the individual differences of the children, and the activities can be practised individually or in small or bigger groups. However, to keep children's attention, children should be provided with different strategies, materials and options (MEB, 2013; Tarım, K & Bulut, 2006). According to literature, it is stated that teachers' self-sufficiency affects the teaching of mathematics in the preschool period (Lee & Ginsburg, 2007; Ng & Rao, 2008; Wang, Elicker, McMullen & Mao, 2008). People who do not consider themselves proficient in mathematics do not want to use mathematics (Ashcraft & Krause, 2007; Ashcraft & Ridly, 2005; Finlayson, 2014). However, teachers' pre-service attitudes will affect the quality of education. For this reason, teachers, especially pre-school teachers, should be aware of the fact that children's mathematical perceptions develop in a process. Similarly, teachers' perceptions of mathematics and learning to teach mathematics also change throughout their teaching lives (Warfield, Wood & Lehman, 2005).

The importance of mathematics education in pre-service period

While pre-service teachers are equipped with the necessary theoretical knowledge, pre-service teachers are forced to learn how to transfer the information through their own experiences. When the undergraduate programmes are examined in detail, it is seen that the course contents and the practise forms that are expected to enhance knowledge of the field are not sufficient. In order for the undergraduate programmes to equip prospective teachers effectively in terms of teaching knowledge, there is a need for research on how to improve pre-service teachers' knowledge and make recommendations based on their results (Bektaş, 2016). From literature it seems that it is widely believed that pre-service teachers do not possess the required skills (National Research

Council, 2001; World Bank, 2011). However, in a report by Anne Çocuk Eğitimi Vakfı ([AÇEV], 2002), the qualifications of teachers in terms of the objectives of pre-school mathematics programmes and the courses and contents of these faculties are criticised. In this report, the mathematics course in the pre-school education department in the faculty is criticised and the proposed solution is to provide pre-school teachers with more practical lessons.

Research shows that it is important to determine pre-service teachers' attitudes towards mathematics (Brown, 2003; Krows, 1999). Studies show that teachers find it difficult to support mathematical skills and have limited knowledge about early mathematics education. In this case, it is seen that teachers do not present pre-school children with proper mathematical skills as a result (Griffin, 2004; Smith, 2001; Starkey, Klein & Wakeley, 2004). In his study named "Analysis of Educational Activities of Preschool Teachers" Kesicioğlu (2018) states that pre-service pre-school teachers use art activities, Turkish activities, and game activities – mathematics activities are among the least used activities. Oskay, Erdem, Akkoyunlu, Soran and Yılmaz (2010) found that pre-service education is theoretical and disconnected from practice. Aydın (2009) states that although they thought that it was necessary to plan mathematics education for pre-school teachers, they could not find good examples and models for planning mathematics teaching, and that sufficient infrastructure was not provided in pre-service. While the literature review revealed the existence of many studies about pre-service teachers, we could only find a limited number of studies about the quality of pre-school teacher education (Yıldırım, K 2016). Based on all of this information, we aimed to present the opinions of pre-service pre-school teachers about the use of mathematics activities. For this purpose, answers for the following questions were sought:

- 1) What are the concepts most used by pre-service pre-school teachers in mathematics activities?
- 2) What are the concepts that pre-service pre-school have the most difficulty with in using mathematics activities?
- 3) What are the situations in which pre-service pre-school teachers have the most difficulty in applying mathematics activities?
- 4) What are the pre-service pre-school teachers' use of materials in mathematics activities?
- 5) What are pre-service pre-school teachers' integration of mathematics activities with other activities?
- 6) What are the methods/techniques used by pre-service pre-school teachers in applying mathematics activities?
- 7) Do the pre-service pre-school teachers write their own mathematical activities?
- 8) How much difficulty do pre-service pre-school teachers have in using age-appropriate mathematics activities?

Methodology

Model of the Research

In this research a qualitative design was used to present the opinions of pre-service pre-school teachers on the use of mathematics activities. Qualitative research is defined as research that follows a qualitative process to reveal perceptions and events in a natural environment as realistic as possible using qualitative data collection methods such as observations, interviews and document analysis (Creswell, 2013:183).

Study Group

The sample for this research consisted of 10 pre-service teachers in the fourth year of their education in the pre-school teaching department in 2017 to 2018 education year. The pre-service teachers in the study group were selected from the students whose GPA was above 3 and had completed the teaching practice course. Purposeful sampling was thus used to create the study group (Patton, 1987). Purposeful sampling methods have literally emerged in the process of qualitative research. Purposeful sampling allows in-depth study of situations thought to present rich data (Yıldırım, A & Şimşek, 2006). The sample selected according to these criteria was considered to represent the research universe with all its qualities (Tavşancıl & Aslan, 2001).

Limitations of the Research

The research is limited to the statements given in semi-structured interviews by 10 pre-service teachers who were fourth-year students in the pre-school education department during the 2017 to 2018 academic year, spring semester.

Data Collection

The data for the research were collected from the 10 pre-service teachers in June of the 2017 to 2018 education year. In the research, the data were collected from the pre-service teachers through the interview technique. Prior to each interview, pre-service teachers were given preliminary information about the subject and an appointment was made to conduct the interview. With the participants' consent, interviews were recorded with a voice recorder. Each interview lasted for 50 to 60 minutes. I transcribed the audio recordings as MS Word documents on computer and printed the documents, which were approved by the relevant participants.

Data collection tools

A semi-structured questionnaire, which consisted of eight questions developed by the researcher, was used as a data collection tool in order to gauge opinions of pre-service pre-school teachers about the application of mathematics activities.

During the compilation of the questionnaire, a question pool was created and the questions that served the purpose of the research were selected. The identified questions were expressed for the data sources and the questions were arranged according to the ranking principles set out in the literature (Patton, 1987; Yıldırım, A & Şimşek, 2006). The following criteria were taken into consideration while preparing the questionnaire: the questions should be open ended, the questions should not guide the participants' answers and the questions should be easily understood by the participants. The prepared questionnaire was presented to three experienced expert academic members (one professor, two associate professors), in this field to look at the scope and face validity thereof. The questionnaire was piloted with five pre-service teachers, and two questions, which they did not understand and were incoherent, were corrected.

Analysis of the Data

Content analysis was used to analyse the obtained data. The process content analysis process involves placing similar data together as concepts and themes, and interpreting and presenting these in a way that the reader can understand. Content analysis was used in four stages in the processing of the qualitative research data obtained from documents: (1) coding of the data, (2) finding the themes, (3) regulating the codes and the themes, and (4) identifying and interpreting the findings (Yıldırım, A & Şimşek, 2006). The data obtained in

this study were analysed by coding separately for each pre-service teacher. The purpose of the research was taken into consideration during the coding of the data and the codes were created to suit the purpose of the research. Codes were created with the open coding method. The codes obtained were tabulated first and then interpreted. During the research, we individually examined the interviewees' statements in terms of the themes specified, and performed inter-rater reliability analysis. In this process, the formula, Inter-rater Reliability = $[\text{Consensus} / (\text{Consensus} + \text{Dissidence})] \times 100$ (Miles & Huberman, 1994) was used, and the percentage of inter-rater reliability was calculated as 84%. According to Kabapınar (2003), if consistency between two raters is 80% and above, the research is said to be reliable. In this context, since the percentage of consistency obtained from the study was above 90%, the resulting data were considered to be reliable. In a study in which descriptive analysis is used, it is essential for validity to include direct quotes from the interviewees and to base the results on these quotes (Yıldırım, A & Şimşek, 2006). In order to ensure the transferability of the obtained results, the data were described in detail and partly supported with direct quotes. In the direct quotes, the actual names of the participants were kept confidential, and the direct quotes were expressed as those of pre-service teacher 1, 2 (PT1, PT2) etc. We included quotes that we considered important and similar comments by different respondents were combined.

Results

Table 1 The distribution of the concepts most used by pre-service pre-school teachers in mathematics activities

Classification	One-to-one correspondence	Geometrical figures	Numeration/ numbers	Operation	Pattern	Sorting	Creating graphics
PT3, PT4, PT7, PT9	PT1, PT2, PT3, PT4, PT7, PT9, PT10	PT3, PT5, PT6	PT8	PT7	PT7	PT7	PT1

From Table 1 it is clear that the pre-service teachers used one-to-one correspondence ($f = 7$), classification ($f = 4$) and geometrical figures ($f = 3$) the most in mathematics activities. It is also clear that numbers/numeration, operation, pattern,

sorting and creating graphics were only used once and time and measuring concepts were used almost never. The pre-service pre-school teachers' opinions on the results in Table 1 were examined in detail (see Table 2).

Table 2 The opinions of pre-service pre-school teachers about the concepts that they used in mathematics activities

Pre-service teacher	Concepts	Opinions
PT1	One-to-one correspondence, creating graphics	“... mostly one-to-one correspondence and graphic study. Because the correspondence are the studies that can easily be made by children. In graphic study, the child uses basic skills such as numeration, comparison and correspondence ...”
PT2	One-to-one correspondence	“... I use correspondence. I think it is on the level that can be applied to every age group ...”
PT3	Classification, one-to-one correspondence, geometrical figures	“... I use one-to-one correspondence, geometry and classification activities the most. I can use these activities with other activity fields as integrated easily. Along with this, it is easier to relate these activity types with life and they can be applied in every age level easily. And in terms of developing material, I feel myself sufficient in these types ...”
PT4	Classification, one-to-one correspondence	“... in classes I use classification and correspondence activities more, because I found these easier to adapt ...”
PT5	Geometrical figures	“... the mathematical activity that I use most is geometrical figures. Because, I think that the children are mostly having a hard time when learning geometrical figures ...”
PT6	Geometrical figures	“... geometry, because when I looked for mathematics activities, I came across more activity types related to geometry ...”
PT7	Classification, one-to-one correspondence, operation, pattern, sorting	“... pattern, classification, sorting, addition, correspondence. I can make them wonder about all of them. And I can get benefit from any kind of different materials in these activities. Gamification is easy and I can offer practical solutions at an instant ...”
PT8	Numeration, numbers	“... I use mostly numbers. Because the practise class that I am doing my internship with is unskilled in terms of numbers because they have just started training ...”
PT9	Classification, one-to-one correspondence	“... I made mostly classification and correspondence studies. Because it is easier to find activities about classification and correspondence studies and the studies that children can easily do can also be found easily.”
PT10	One-to-one correspondence	“... generally I used correspondence activities. I think it is important to understanding the relations between objects. I find it beneficial in terms of giving much conceptual information with the mathematical activity of correspondence ...”

Table 3 The distribution of the concepts that pre-service pre-school teachers struggled the most with in mathematics activities

Classification	Geometrical figures	Sorting	Creating graphics	Time	Measuring
PT8, PT10	PT7	PT4, PT8	PT5	PT2	PT3

From Table 3 it is clear that pre-service pre-school teachers struggled most with classification, geometrical figures, sorting, charting, time, and

measuring. The pre-service pre-school teachers’ opinions on the results in Table 3 were examined in detail (see Table 4).

Table 4 The opinions of the pre-service pre-school teachers about the concepts that they struggled the most with in mathematics activities

Pre-service teacher	Concepts	Opinions
PT1	-	"...the activities that require space in class gives me a hard time. Because it is a physically insufficient institution ..."
PT2	Time	"... I am having a hard time with time concept activities. It is hard to teach and practice an abstract concept ..."
PT3	Measuring	"... I am having a hard time when doing measuring activities. The fact that the children do not properly understand concepts such as time, volume, mass is restrictive ... And I think that they cannot properly understand measuring when making measurements with non-standard measurement units."
PT4	Sorting	"... I am having a hard time in sorting activities, because I have used more materials and this costs me more time before the activity ..."
PT5	Creating graphics	"... the mathematical activity that I am having a hard time when practising is creating graphics. Because they are having a hard time understanding it because they have less experience with the preparation of graphics compared to other activities ..."
PT6	-	"... there is no activity that I had a hard time with, if I had prepared properly ..."
PT7	Geometrical figures	"... sometimes, I can have a hard time in geometry, because I can have a hard time in making it interesting and make them wonder ..."
PT8	Classification, sorting	"... classification and sorting. Sometimes there can be disruption because it wants one-to-one training and care, and this disruption causes some children to get bored and withdraw from the activity ..."
PT9	-	"... There is no activity that I particularly have a hard time with ..."
PT10	Classification	"... I am having a hard time with classification activities. I see that children cannot make the classification appropriate to the given instructions. I think that having multiple instructions in classification is creating the problem ..."

Table 5 The situations that pre-service pre-school teachers struggled the most with in mathematics activities

Cannot draw their attention	PT1, PT4, PT5, PT6, PT9
The fact that physical space is not suitable	PT1, PT3, PT6
Having a crowded class	PT2, PT6, PT8, PT10

From Table 5 it is clear that the pre-service pre-school teachers struggled most with capturing the children's attention ($f = 5$), having a crowded class ($f = 4$) and the unsuitability of the physical

area ($f = 3$). The pre-service pre-school teachers' opinions on the results in Table 5 were examined in detail (see Table 6).

Table 6 The opinions of the pre-service pre-school teachers about the situations that they struggled the most with in mathematics activities

Themes	Pre-service teacher	Opinions
Could not draw children's attention	PT1, PT4, PT5, PT6, PT9	"... the children are having a little hard time understanding what we are going to do" (PT1). "... When practising mathematics activities, the situation that I had the hardest time with was that the children were bored quickly and got distracted" (PT5). "... and the fact that mathematics activities are a process that needs attention causes me to have a hard time." (PT6)
Having a crowded class	PT2, PT6, PT8, PT10	"... I try to give feedback to the children about individual mathematics activities. And this situation sometimes causes difficulty and is time consuming" (PT2). "... When I explain the activity to the children, and help those who are unable to do it, the children who have finished got bored and got distracted" (PT8).
The physical area is not suitable	PT1, PT3, PT6	"... the activities that require space in class gives me a hard time. Because a physically insufficient institution" (PT1). "... there are so many deficiencies, such as material and the insufficient conditions of the class and it is not suitable" (PT6).

Table 7 The pre-service pre-school teachers' use of materials in mathematics activities

I use	PT1, PT2, PT3, PT4, PT5, PT6, PT7, PT9, PT10
I do not use	PT8

From Table 7 it is clear that the majority of pre-service pre-school teachers ($n = 9$) used materials in mathematics activities. The pre-service

pre-school teachers' opinions on the results in Table 7 were examined in detail (see Table 8).

Table 8 The opinions of the pre-service pre-school teachers about their use of materials in mathematics activities

Pre-service teacher	Reasons for using materials	Types of materials that they used
PT1	"... it is important in terms of effective learning of the child ..."	"... I generally use various cards in correspondence studies. I use actual objects ..."
PT2		"... I mostly try to use materials that children are already interacting with. I avoid using uniform materials. I try to use materials that children can compare with themselves and are open ended ..."
PT3	"... because most of the concepts are abstract and in their age group it is difficult for them to learn without materialising, draws the attention of the children more ..."	"... because I don't want them to think that they always have to play with toys so I prepare simple materials, and when I aim for activity rather than material, I do this. I prefer to create materials with the materials they may encounter in everyday life because I think that these will remind them of their learning and the activity when they encounter them outside of school"
PT4	"... creating the sense of wonder in children ..."	"... I mostly use the materials that I used in an activity which is not very robust. I mostly use correspondence cards ..."
PT5	"I mostly use these kind of materials because it provides children's learning with materialising ..."	"... especially manipulative gaming materials ..."
PT6	"... I use the activity for materialising ..."	"... I use materials such as paper, cardboard, latches, buttons, pebbles, play dough. I prefer materials that are easily available and cost effective ..."
PT7	"... the most important need for the pre-school children is seeing the concepts as palpable. It helps them to quickly understand and I feel that they have understood ..."	"... waste materials such as blocks, buttons, latches, plastic plates ..."
PT8	"... I usually make them do mathematics activities in the workbooks that we already have. That is why there is no certain material use ..."	
PT9	"... I use it to draw the attention of the children ..."	"I mostly use correspondence cards, waste materials (egg boxes, buttons, stones, etc.), pattern cards mechanisms that I prepared ..."
PT10	"... I use it to materialise the activity ..."	"... I use the materials that I have made myself from the objects such as cardboard, glass ..."

Table 9 The pre-service pre-school teachers' integration of mathematics activities with other activities

Game	Art	Science	Turkish
PT1, PT2, PT3, PT4, PT5, PT6, PT7, PT8, PT9, PT10	PT1, PT3	PT3	PT3

From Table 9 one can see that the pre-service pre-school teachers stated that they integrated mathematics activities mostly with games ($f = 10$), art ($f = 2$), science ($f = 1$) and Turkish ($f = 1$). It is clear that pre-service teachers have never integrated

mathematics activities with music, preparation for reading and writing, movement and field trips. The pre-service pre-school teachers' opinions on the results in Table 9 were examined in detail (see Table 10).

Table 10 The opinions of the pre-service pre-school teachers about the situations that they struggled most with in mathematics activities

Pre-service teacher	Integrated activity	Opinions
PT1	Game-art	"I mostly integrate them with art and gaming activities. Children are both having fun and actualise more lasting effective learning with these activities."
PT2, PT4, PT5, PT6, PT7, PT8, PT9, PT10	Game	"I combine it with the gaming activity. Because I think that children are more willing to participate in gaming activities" (PT2). "... the gaming activity is an activity that the children love more and thus they learn by having fun ..." (PT4).
PT3	Game-art-Science-Turkish	"... I'm integrating a lot with gaming activities and art activities. I find it very useful to integrate with science activities, but I can't do it all the time, because it's not easy. I feel that children enjoy more when I integrate it with gaming activities. Since the game remains in their minds, they can repeat this learning themselves."

Table 11 The methods/techniques used by pre-service pre-school teachers in applying mathematics activities

Narration	Gamification	Demonstration	Drama	Question-answer
PT4, PT7, PT8, PT10	PT1, PT2, PT5, PT9	PT3, PT5	PT8	PT6

From Table 11 it is clear that pre-service pre-school teachers stated that they mostly used the mathematics activities of narration ($f = 4$), gamification ($f = 4$), demonstration ($f = 2$), drama (f

$= 1$) and question-answer ($f = 1$). The pre-service pre-school teachers' opinions on the results in Table 11 were examined in detail (see Table 12).

Table 12 The opinions of the pre-service pre-school teachers on the methods/techniques used during the application of mathematics activities

Pre-service teacher	Methods/Techniques	Opinions
PT1	Gamification	"... I use the gaming method. For example, I prepare different cards and make it possible for children to use their memories and make correlations. Such activities are the activities that children participate in with great pleasure ..."
PT2	Gamification	"I use the gaming method because children are more enthusiastic and willing to participate in activities ..."
PT3	Demonstration	"... I use demonstration a lot, I start concepts with direct instruction and reinforce with demonstration. I think the right learning will happen ..."
PT4	Narration	"... I use the narration method more ..."
PT5	Gamification	"... I use the gaming method which I found the most beneficial in terms of the educational aspect in mathematics activities ..."
PT6	Demonstration-question answer	"... the method that I think is suitable for the development of the children, is demonstration-question answer ..."
PT7	Narration	"... gamification is the method that I use the most, because I think that it provides easier learning in mathematics activities ..."
PT8	Narration-drama	"... generally at first I used direct instruction in mathematics activities. Then when I needed, I use the drama method to make a lasting impression in the children's minds ..."
PT9	Gamification	"... so far I have only used gamification, because I find it more fun ..."
PT10	Narration	"... generally, I use verbal expression, I present what I want to say to the children with materialising ..."

Table 13 The abilities of pre-service pre-school teachers in writing mathematics activities

I write my own	PT2, PT3, PT7
I use ready activities	PT1, PT4, PT5, PT6, PT8, PT9, PT10

Table 13 shows that pre-service pre-school teachers mostly use ready-made activities in mathematics activities ($n = 7$), although some of

them ($n = 3$) wrote their own activities. The pre-service pre-school teachers' opinions on the results in Table 13 were examined in detail (see Table 14).

Table 14 The opinions of the pre-service pre-school teachers on writing mathematics activities

Themes	Pre-service teacher	Opinions
I write my own	PT2, PT3, PT7	"... it changes according to the learning that I aim for, sometimes if I find something more creative, I plan it myself. It has to be suitable for my class, because the ready activity plans do not always suit the situation." (PT3) "... I plan my activities myself, because it has to be suitable for the children in my class ..." (PT2, PT7).
I use ready activities	PT1, PT4, PT5, PT6, PT8, PT9, PT10	"... generally I adapt and change the activity that I found online according to my place" (PT1, PT4). "... A ready activity plan is used in the institution where I am doing my internship" (PT8). "... I sometimes use online and ready plans to help ..." (PT9).

Table 15 Difficulties experienced by pre-service pre-school teachers in using age-appropriate mathematics activities

36–48 months	49–60 months	61–72 months
PT1, PT2, PT3, PT4, PT5, PT6, PT7, PT8, PT9, PT10	-	-

When Table 15 is examined, all pre-service pre-school teachers ($n = 10$) stated that they had difficulties in using mathematics activities with

children of 36 to 48 months old. The pre-service pre-school teachers' opinions on the results in Table 15 were examined in detail (see Table 16).

Table 16 The opinions of pre-service pre-school teachers on the difficulties encountered when using age-appropriate mathematics activities

Pre-service teacher	Opinions
PT1, PT2, PT3, PT4, PT5, PT6, PT7, PT8, PT9, PT10	<p>“... the children are having a hard time understanding and doing because it is an abstract activity type” (PT1, PT2).</p> <p>“... pre-learnings and gains prevent. Also, their attention span is too short, they have different focuses. Since the class management is harder, I think that the younger age group makes it hard” (PT3, PT5, PT7).</p>

Conclusion and Discussion

When the results of the research are examined, it is determined that pre-service pre-school teachers used more than one-to-one correspondence, classification and geometrical figures in mathematics activities. They used concepts like creating graphics and patterns very little and they did not use time and measuring concepts. Similarly, they stated that they had difficulty in using concepts such as classification, creating graphics, time, and measurement. The results of a study conducted by Orçan (2013) supports this view in that teachers did not have sufficient information related to content of the programme and did not include mathematics activities adequately. Furthermore, classroom size, overcrowding and problems such as training qualified teachers, inadequate concrete materials and training toys also contributed to the problem. Similarly, the results of an OECD (2018) report show that educational materials in Turkey are insufficient or absent compared with the OECD.

One might think that this situation originated from the fact that pre-service teachers did not have sufficient knowledge about the concepts of measuring, patterns, time and how to do the activities. The findings of this research are supported in literature. Öçal (2015) states that senior year pre-service teachers emphasise number concepts, correspondence, operation concepts, sorting and geometry in pre-school level mathematics teaching. Hachey (2013) states that pre-school teachers regard numbers and arithmetical skills as the most important focus. Aslan, Günay Bilaloğlu and Aktaş Arnas (2006) state that teachers spend most of their time on numbers. Based on this information, it can be said that teachers and pre-service teachers do not have enough knowledge about other mathematical concepts.

From the research results it is clear that pre-service pre-school teachers use integrated activities in mathematics activities. Köksal, Balaban Dağal and Duman (2016) found that 50% of pre-school teachers used integrated activities. However, no evidence was found in the literature on the integration of mathematics activities. The results of this research clarify this situation and show that teacher candidates integrate mathematics activities mostly with the gaming activities. Alat (2019) reports that integrated activities were not used and that not enough effort was put into relating

mathematics to real life for children. It was determined that mathematics activities were limited in terms of the discussed skills and concepts and were carried out as extremely structured, teacher-focused, large-group events that required children to sit at their desks for long periods of time without individual differences among children being taken into account. Kesicioğlu (2018) found similar results in his research on the analysis of pre-school teachers' educational activities and stated that pre-school teachers integrated their mathematics activities mostly with gaming activities. From the literature it is clear that academic skills such as mathematics in pre-school programmes would be more beneficial if presented together with games, drama, music, language and science activities (Aktaş Arnas, 2009; Dere & Ömeroğlu, 2001; Eliason & Jenkins, 2003; Güven, 2000; Uyanık & Kandir, 2010). Many opportunities exist each day that may allow students to have mathematical experiences. Mathematics skills can be supported both formally during events and informally at any hour of the day and during any other activity. The teacher can consolidate mathematics skills whenever suitable, even if the children have not yet attained the gains and indicators regarding mathematics education in the flow of daily education (Aktaş Arnas, 2009). Aktaş Arnas (2009) indicates that the mathematical concepts could be supported with studies like comparing the dimensions of paper during artistic activities and ranking them from large to small, classification based on the colours of paint, and the lengths of the materials used. Fleming, Merrell and Tymms (2004) specify that many mathematical concepts could be made concrete and entertaining for children through drama activities. That is why it can be said that pre-service teachers insufficiently integrate mathematical activities with other activities.

One of the results of the research shows that pre-service pre-school teachers have difficulty in capturing the children's attention in mathematics activities. From the literature it is clear that one of the most important tasks of a teacher is to offer children different methods, techniques, strategies and options to keep them actively involved (Kirova & Bhargava, 2002; MEB, 2013; Tarım, K & Bulut, 2006). As mathematics development involves complex processes, it is known that mathematical concepts, skills to be acquired and the methods and techniques used in teaching these concepts depend

on the teacher (Uyanık & Kandır, 2010). One of the results of this study is that pre-service pre-school teachers prefer the most direct instruction method to traditional methods in mathematics activities. It can be said that pre-service teachers' inability to use different methods/techniques results in them not being able to draw and hold children's attention. Another reason for pre-service teachers having difficulty in implementing mathematics activities is that the physical environment is not suitable and the classes are crowded. From many studies (Kiwanuka, Van Damme, Van den Noortgate, Anumendem & Namusisi, 2015) where pre-schools were involved, it was clear that inadequate physical conditions and the large number of children in one class make it difficult to apply different activities. It is seen that another method used by pre-service teachers is gamification. Literature shows that the gamification of the mathematical skills is effective in drawing children's attention and materialising abstract concepts (Tucker, 2014).

The findings of the research show that the majority of pre-service pre-school teachers use materials in mathematics activities. When the opinions of pre-service teachers are examined, it is clear that they prefer more open-ended, real-life activities in which they often apply waste materials. From the literature it is clear that the materials used should be more social, support learners' communication skills, increase their creativity, support their imagination, develop their ability to produce solutions to the problems, affect life skills positively, and to colour, shape, manipulate and use every-day materials (Firat & Dinçer, 2018; Kavak & Coşkun, 2016). In this respect, it can be said that pre-service teachers' material choices are positive. The materials used during the activities are important for the success of pre-school education which has an important place in children's lives (Durmuşoğlu, 2013). Previous research has reported that classes taught with traditional rather than alternative methods and the use of concrete materials negatively affect students' learning of mathematics (Harper & Daane, 1998; Sloan, 2010).

Participant in this research stated that they had difficulty in using mathematics activities with children of 36 to 48 months old. From the literature it is clear that working with young children causes difficulties in some of the basic subjects of classroom management, such as taking instructions in accordance with the developmental characteristics, which result in teachers struggling with classroom management (Dinçer & Akgün, 2015). The rates of schooling in Turkey are 38% for age 3 to 5, 50% for age 4 to 5, and 66% for age 5. The low rate of schooling at a young age reveals that teachers and teaching candidates have fewer opportunities to experience teaching children in younger age groups. It can be said that they

struggle to convey the instructional experiences they experience with children in older age groups to younger ages (MEB, 2019). As pre-service teachers struggle with classroom management with children in the younger age groups, they also struggle with mathematics activities. In the light of this information, the following are suggested:

- To conduct studies that will increase the theoretical and practical knowledge on the concepts that prospective teachers struggle with in mathematics activities, such as classification, geometrical figures, sorting, creating graphics, time, and measuring.
- To determine the shortcomings of pre-service teachers in contemporary teaching methods and techniques and to inform them about how to adapt these methods and techniques for pre-school education activities.
- To provide pre-service teachers with information about the preparation and application of integrated activities for the teaching of mathematics.
- That pre-service teachers are provided with information and knowledge on class management in less conducive physical environments and crowded classes.

Notes

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