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A pre-service teacher-child interactive learning approach for "mathematics education in early childhood": An example model with play and movement-based activities

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Abstract

The purpose of this study is to investigate the opinions of the pre-service preschool teachers and preschool teachers on the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach (with play and movement-based activities). This study was conducted in phenomenological research design based on qualitative paradigm. The study groups consist of second grade 62 pre-service preschool teachers, and 2 preschool teachers who are the teachers of the 12 children in the age group of four to five (48 to 60 months). Interview technique was used to collect the study data and descriptive analysis technique was used to analyze the obtained data. In this context, play and movement-based activities, containing concepts and learning outcomes for mathematics education (in the course of "mathematics education in early childhood") with pre-service teacher-child interactive learning approach, were implemented. As a result of the study, it was stated by the pre-service preschool teachers that the course carried out in this way has many contributions in terms of providing classroom management, communicating effectively with the children, preparing and applying interesting activities for mathematics education, preparing for teaching profession, and raising awareness for themselves. In this context, pre-service preschool teachers' opinions indicated that there are some challenges faced by pre-preschool teachers with regard to finding suitable activities and applying them effectively, as well as challenges based on environment-material opportunities and time management. The opinions of preschool teachers also emphasized that these processes carried out within the scope of the course have remarkable contributions both to the pre-service preschool teachers and preschool children and to the preschool teachers themselves in their development-learning dimensions. It is considered necessary to achieve sustainable contributions in the context of pre-service teacher–child–teacher, organizing courses in preschool teaching undergraduate program so that cooperation between university and school is ensured.

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1. Introduction

In this current period, which is named as the era of technology and innovation, there is a need for designs and engineering products that serve for any kind of needs. A great importance is given to mathematics to meet this need as it contains learning outcomes such as strategic thinking, analyzing, comparing, and inference. It is necessary to follow mathematical processes, understand the concepts related to mathematics, and have a positive attitude towards mathematics, in order for mathematics to have an active place in human life. In this sense, educational approaches adopted and methods and techniques applied within the scope of educational policies by countries are highly important (Boaler, & Dweck, 2015; Burns, 2015; James, & Dyke, 2019). At this point, it can be an effective way to include methods and techniques with proven effectiveness into mathematics education and to follow approaches of the countries that rank at the top in the field of mathematics, in this scope. According to the results of PISA (Programme for International Student Assessment), an internationally recognized assessment criteria (Organisation for Economic Co-operation and Development [OECD], 2019; Ministry of National Education [MoNE], 2019), mathematics education approaches of the countries such as China, Singapore, Taiwan, Japan, Denmark, Finland, and Korea, which rank at the top in the field of mathematics, indicate that it is necessary to adopt innovative and functional educational practices in mathematics education. Inclusion of methods and techniques with proven effectiveness in the field of mathematics into mathematics education can have a share in mathematics literacies. According to the PISA results in this framework, it is seen that Turkey has an increase in the field of mathematics literacy in the recent years; however, it is below the OECD average (ranks 42nd) in the field of mathematics (including reading and science). It is emphasized that it is important to have a large number of learning experiences related to mathematics to develop the capacities in this regard.

Mathematics exists in human life as an interactive field of learning, as well as a multidimensional field of science. An individual's development and learning in mathematics is shaped depending on his/her life experiences. The first impressions on mathematics are gained during the early childhood years, and the attitude towards and the competence in mathematics begin shaping upon the experiences in this period. As stated by Jordan, Kaplan, Ramineni, & Locuniak (2009), mathematical skills of preschool children are predictive of their future mathematical success. According to the result of a national level study (Sackes, 2013), mathematical process skills of children in preschool period are a strong determinant of their mathematical performances in third grade. Nevertheless, if a child is subjected to an attitude that mathematics is a difficult course or

is grown up prejudiced against mathematics starting from the preschool period, this can cause the child to have a fear of or anxiety about mathematics (Potter, 2012). As detected by Bredekamp (2015), these situations can be a reason why many preschool teachers are afraid of performing mathematics activities. As an identification factor for child, if a teacher displays a negative attitude towards mathematics or displays behaviors in parallel to this, it will have a big part in canalizing this process to a negative direction. According to today's educational mentality, a teacher must not only be the person who presents information, but also be the person who teaches how to use information. The fact that teacher focuses not on what the child cannot do, but on what the child can do in the field of mathematics is important in structuring this process. National and international studies (Graham, Nash, & Paul, 1997; Pekince, & Avcı, 2016; Tarım, & Bulut, 2006) detected that preschool teachers do not perform mathematics activities directly or indirectly, which reveals a fundamental problem at this point. Further, in the study by Lee, & Ginsburg (2009) conducted in the United States of America sample, it was detected that early childhood period teachers focus more on practices related to language development, while they do not include mathematics activities sufficiently in their schemes of education. As a matter of fact, language skills are also used in activities of mathematics education that are conducted properly, and children are expected to express their own thoughts and answers. After all, mathematics is a language that is used to express concepts such as shape, quantity, and dimension. In addition, mathematics is a field that has a universal language and is a concept that is valid for children from different cultures. Thus, in order for children with different needs and talents to succeed in mathematics, there is a need for creating environments that are convenient for this. At this point, it is quite important to know the features of what children can do and learn (Bronshtein, Semendyayev, Musiol, & Mühlig, 2015; Courant, Robbins, & Stewart, 1996; Hersh, 1997; James, & Dyke, 2019).

The elements related to teacher and the ways followed by teacher are very important for the education delivered to children in early childhood period. Teachers must know well what concepts/learning outcomes the children should gain and when and how they should gain these (Clements, & Sarama, 2011). Teachers need to integrate mathematics activities into daily learning process. It is possible to process mathematical skills of children through the ways such as picking up toys in classroom by counting, and having a talk about the date of that day (Whitin, & Piwko, 2008). It is recommended that teachers prompt children's problem-solving and analytical thinking skills using questions such as *"Why is it like this?" and "How did you get that result?"* in the process (Lee, & Ginsburg, 2009). It is a fact that there is a need for the principle of equality for a qualified mathematics education, and teachers have important responsibilities for ensuring proper support and environment at children's level of development (National Association for the Education of Young Children/National Council of Teachers of Mathematics [NAEYC/NCTM], 2002). In this scope, teachers must know children's level of knowledge, follow up their development process, and make a good assessment on children (Schwartz, 2005). It should also be taken

into consideration that each child's self-confidence in learning mathematics should be supported and his/her progress should be appreciated. It is highly important that teacher be a good guide in this process.

Mathematics education for early childhood period should contain processes that ensure children's active involvement and learning by doing/experiencing. Mathematics activities that are only limited to paper and pencil prevent children from gaining real life experiences and distract children from concrete experiences. These cause learning mathematical concepts later than it should be (Çimen Erdoğan, & Baran, 2003). Accordingly, it is highlighted that memorization studies should not be done in mathematics education and mathematics studies should not be done directly through books, but be done through a way of more practical teaching. Various materials and well-equipped learning centers support children's sense of wonder and eagerness to learn in early childhood. At this point, it is important to allow children make mistakes, which creates a positive impact (Önel, 2018). It is recommended to utilize concrete materials and examples from real life for mathematics content activities towards preschool children. Hence, educational environments that allow children to learn by doing/experience and to make mistakes and that arouse wonder in children are useful for developing mathematical skills (Aktaş Arnas, 2005). It is highly important that education for children be enjoyable and intriguing (Kline, 2000). Children have to collect information by investigating, trying, and discovering in order to learn. It should be considered to include mathematics activities in which children can try, discover, and experience things at first hand inside a preschool curriculum. It beyond doubt that children learn more permanently by having fun and playing. Children find answers to their questions about the world, test new ideas and concepts, and put their problem-solving and reasoning skills into practice by means of plays (Akman, 2002). It is seen that a mathematics education delivered with plays ensures that information is understood better and increases children's motivation (Randel, Morris, Wetzel, & Whitehill, 1992). Involvement in a learning environment is a factor that increases success, while educational plays are a way of ensuring active involvement (Charles, Bustard & Black, 2009). It is remarked that giving children a chance to play and discover will contribute to their learning (Ginsburg, Lee, & Boyd, 2008); besides, contents of learning processes in this framework are considered important, as well.

It is recommended to include integrated mathematics studies in addition to performing activities with mathematical content to support learning experiences of preschool children (particularly ages 3 to 6) on mathematics (NAEYC/NCTM, 2002). In this scope, an educational environment needs rich and various objects and materials such as blocks, jigsaws, and a learning center that is convenient for teaching mathematics in classroom. It is also another important point that children should learn mathematics independently and using their own experiences. Mathematics programs for preschool period have a strong impact on supporting mathematical skills of children in future periods (Ginsburg, Lee, & Boyd, 2008). It is seen that science and mathematics programs adapted with project-based

activities (GEMS; Great Explorations in Math and Science) are effective on preschool children's concept acquisition and readiness (for dimensions such as comparing, shapes, numbers, dimensions, directions, location, quantity, and time) for primary education (Sarıtaş, 2010). The study conducted by Bal (2018) on the effects of FeTeMM activities on scientific process skills of 48 to 72 months old preschool children revealed similar results. In the end, it was detected that FeTeMM activities are effective in developing children's scientific skills in the dimensions of inference, estimating, classifying/sorting, and analytical thinking and problem-solving skills. The study by Karademir (2017) showed that questioning-based mathematics activities that are convenient for development characteristics, interests, needs, and expectations of 60 to 72 months old children are effective in developing mathematical skills of children. There is a day-by-day increase in the importance given to the research-based studies related to mathematics programs, such as Building Blocks (Clements, & Sarama, 2002; Clements, & Sarama 2007), Big Math for Little Kids (Ginsburg, Greenes, & Balfanz, 2003), and Pre-K Mathematics (Klein, Starkey, & Ramirez, 2002) developed for preschool children. These programs also emphasize that factors such as materials, teacher's approach, and content are important in mathematics education.

Studies performed with students from different age groups also showed that mathematics education delivered interactively contributes to developing children's various skills related to mathematics. For example, Altunay (2004) detected that mathematics education is more effective on mathematics success/gain level of preliminary students when supported with play, and Ata Doğan, & Akman (2019) detected that musicalized mathematics activities are more effective from preschool to high school, compared to traditional teaching. Vankúš (2008) detected that educational plays are important for structuring mathematical knowledge of middle school students and for them to develop a positive attitude towards mathematics. According to Stone's (1997) study result, problem-solving skills of children develop and teachers gain positive experiences through mathematics education delivered through collaborative teaching. Boaler's (1998) study detected that project-based teaching is more effective in developing analytical thinking skills required by mathematical problem solving, compared to traditional teaching. Children at different levels of education expect their teachers to use interesting teaching methods in mathematics teaching (Dağdelen, & Ünal, 2017). Methods/techniques adopted in the process of mathematics education are a factor that should be taken into consideration to lead development of a positive attitude towards mathematics and to ensure an effective/efficient learning process.

There are study findings indicating that play and movement-based activities are important for ensuring preschool children's conceptual development related to mathematics (e.g. Hanline, Milton, & Phelps, 2008; Şirin, 2011). The study conducted by Altun, Dönmez, İnan, Taner, & Özdilek (2001) showed that when given an opportunity, preschool children show success in terms of problem-solving skills. According to the study

by Lee (2007), children perform mathematical thinking in socio-dramatic plays when there is no adult intervention in educational environment. It was found as a result of the study by Tarım, & Bulut (2006) that teachers have limitations on conducting mathematics activities and performing effective practices related to mathematics. Further, it is remarkable that Quinn, & Wilson (1997) detected that teachers have a positive attitude towards feedback functionality in mathematics education, while they do not put this belief into practice. It was seen in another study (Ay, 2018) that preschool teachers think open are is important for mathematics activities, while they do not reflect this opinion into their practices. In this scope, it is also remarkable that activities conducted by teachers mostly contain free time and play activities, whereas they do not contain mathematics activities. According to the educational principles suggesting that development is a whole, it is necessary to present different types of activities to give children the opportunity to achieve multidimensional learning in preschool education. The result of the study by Lewis Presser, Clements, Ginsburg, & Ertle (2012) emphasized that a mathematics education that is prepared with due care and regard to preschool children's developmental understanding has a positive effect on mathematical success of children. The results of the studies (Brown, 2015; Dağlıoğlu, 2017; Hackey, 2013; Karakuş, Fırat, Akman, & Dinçer, 2019; Markovits, 2011; Tokgöz, 2006; Zehir, Zehir, & Ağgül Yalçın, 2019), which investigated attitudes, beliefs, and self-competencies of preschool teachers/pre-service teachers agree that if they have knowledge and experience related to mathematics education in preschool period, they will have positive attitudes, acceptance, and self-competency, too. Given that pre-service teachers will run their professional lives in the light of knowledge and approaches they acquire in their undergraduate education, it is necessary that they are well trained in terms of activities and practices related to mathematics in preschool period. There are findings in the literature indicating that mathematics literacy levels of pre-service preschool teachers increase owing to mathematics courses and courses related to mathematics they receive during their education (Kesicioğlu, 2014), and pre-service preschool teachers do not have enough knowledge on the subject content of mathematics education in general (Umay, 2003). Assessing the entire information and findings together, it is of great importance to conduct a study on pre-service preschool teachers and preschool children with regards to mathematics education. From this point of view, the problematic of this study is *"What are the opinions of the pre-service preschool teachers and preschool teachers on the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach (with play and movement-based activities)?"*. In this line, the results to be achieved are anticipated to act as a source for studies on ensuring the connection between theoretical information and practice in mathematics education and to act as a guide for creating functional learning processes for preschool children and pre-service teachers, who will serve for this age group, in terms of coordinated mathematics education.

1.2. Purpose of the Study

The general purpose of the current study is to investigate the opinions of the pre-service preschool teachers and preschool teachers on the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach (with play and movement-based activities). Answers to the following questions were sought in line with this general purpose.

1. What are the contributing aspects of the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach (with play and movement-based activities) according to the opinions of pre-service preschool teachers?
2. What are the challenging aspects of the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach (with play and movement-based activities) according to the opinions of pre-service preschool teachers?
3. How do preschool teachers assess the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach (with play and movement-based activities)?

2. Method

2.1. Research Model

This study was conducted in phenomenological research design based on qualitative paradigm. Phenomenon exist in different forms such as an event, experience, perception, and tendency in the daily life and express the cases, which are familiar but the meanings of which cannot be known exactly (Patton, 2002; Yıldırım, & Şimşek, 2016). In phenomenological studies, various reactions and perspectives of participants are revealed. Therefore, experiences and knowledge of participants on relevant phenomena are reached (Fraenkel, Wallen, & Hyun, 2012). Based upon this, preschool teachers and pre-service preschool teachers were asked for their opinions in order to reveal their experiences and knowledge on the course of "mathematics education in early childhood" that was conducted through a pre-service preschool teacher-child interactive learning approach (with play and movement-based activities). By this means, it was tried to reveal the opinions on a pre-service teacher-child interactive learning approach for "mathematics education in early childhood" in depth.

2.2. Study Group

This study contains two distinct study groups consisting of pre-service preschool teachers, and preschool teachers. The first study group consists of second grade pre-service teachers who continue their undergraduate education in Preschool Teaching program of Faculty of Education within the body of a public university in the Central Black Sea Region and who receive the course of "mathematics education in early childhood". In this scope, 62 pre-service preschool teachers in the class size represent the group of the main participants of the educational process of the study. The second study group consists of 2 preschool teachers who were involved in the process with their preschool students. These preschool children include 12 children at the age group of four to five (48 to 60 months), who received preschool education in a kindergarten within a private primary school at the city center where the university in the first study group is also located.

2.3. Data Collection Tools

Interview technique was used to collect the study data and relevant interviews were conducted after the practices related to "mathematics education in early childhood" ended. In this scope, the pre-service teachers and the preschool teachers who were involved in the process from each group were requested to answer the questions of the instructor researcher. In this scope, the instructor researcher met the pre-service teachers in each group (5-6 persons) by turns at a predefined and convenient time (in her office), and conducted a focus group interview that lasted around 45 to 75 minutes. During the process of identifying the interview questions, the literature was reviewed for studies on mathematics education in early childhood education and the opinion of an expert working on this subject was consulted. The interviews in this framework were conducted over the following questions: (*1) What we the contributing aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach for you?* and *(2) What were the challenging aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach for you?* In addition to these, individual interviews were conducted with the two preschool teachers who were the observers of the practice process together with the children, within the week following the end of the course time. These interviews were conducted as semi-structured interviews and were accompanied by an open-end question. In this scope, the preschool teachers were asked a question to receive a general level answer: *(1) How do you assess the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach?* During the interviews with the pre-service preschool teachers and the preschool teachers, the answers to the questions were noted and recorded by the instructor researcher lecturer. The entire data obtained in this scope were written in digital environment and made ready for data analysis.

2.4. Data Collection and Implementation Process

The study was conducted basing on a 12-week course (except for midterm/final weeks) for the course of "mathematics education in early childhood" that must be attended by the second grade pre-service preschool teachers in the first study group, (as one of the compulsory course in the scope of field education) in the scope of Council of Higher Education [CoHE] (2017) undergraduate programs. This course was conducted by a lecturer who has an undergraduate and master's degree in the field of preschool education, and who serves at the preschool education department in the university and carries out works on preschool children and preschool teachers, together with the pre-service teachers in the first study group. This course, named "mathematics education in early childhood", was conducted as a course of 3 hours as specified in the Preschool Teaching Undergraduate Program of CoHE (2017), and theoretical and practical information and training studies were included into its content. Participants were informed through the ways such as expression method, PowerPoint presentation, videos, presentations of material and activity samples, in order to provide a theoretical framework during the first six weeks of the course (weeks 1-6). Practices of the activities that were prepared in compliance with the order of the targeted learning outcomes to achieve in preschool period mathematics education were performed during the remaining other six weeks of the course (weeks 7-12). In this framework, while the theoretical part of the course (the first 6 weeks) was performed by the instructor with the pre-service preschool teachers, the practical part (the last 6 weeks) was performed by the pre-service preschool teachers with preschool children (12 children) in the age group of four to five (48 to 60 months). The teachers of the preschool children were involved in this process as observers, accompanying the instructor.

The content of the course named "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach that was performed in this framework is as follows:

1th Week: Birth, definition, and scope of mathematics

2th Week: Importance of mathematics in preschool period (its effects on development fields and learning)

3th Week: Principles and standards related to preschool period mathematics education, and roles and responsibilities of teacher in mathematics education

4th Week: Techniques and methods for teaching mathematical concepts and scientific thinking skills in preschool period

5th Week: Practical samples related to mathematics education through play-movement, story-poem-rhyme, drama, song-rhythm, art, and science activities

6th Week: Examples from preschool mathematics education programs (such as Building Blocks, STEM and GEMS; Great Explanation in Math and Science, Big Maths for Little Kids)

7th Week: Activity practices containing learning outcomes related to classifying-matching-comparing-ordering and forming patterns

8th Week: Activity practices containing learning outcomes related to counting (counting, recognizing numbers, and writing)

9th Week: Activity practices containing learning outcomes related to operations (addition, subtraction, and division)

10th Week: Activity practices containing learning outcomes related to geometry (spatial thinking and geometric shapes) and position in space

11th Week: Activity practices containing learning outcomes related to measurement (length, area, volume, mass (weight) and time)

12th Week: Activity practices containing learning outcomes related to data analysis/creating graphic

The content of CoHE (2017) Preschool Teaching Undergraduate Program was based on while forming the content of the course of "mathematics education in early childhood". In this scope, weekly lesson contents related to the course were created and the contents were arranged with an inclination from general to specific by the instructor lecturer. The pre-service preschool teachers were informed about the content and the process, and were encouraged to attend the course regularly in the first lesson of the semester. In this scope, within the first six weeks of the course, the importance of mathematics education and the responsibilities to be taken by teachers in this process, and the remarkable factors and the useful methods/techniques in preschool mathematics education were emphasized. Upon acquiring theoretical and practical based pure information, the phase of experiencing the acquired information in the dimension of practice was started in the other six weeks. In this process, activities containing learning outcomes related to classifying-matching-comparing-ordering, forming patterns, counting, operations, geometry, measuring, and data analysis/creating graphic were implemented with the preschool children. It was considered as the main criteria in the process of planning and practice that these activities consisted of play and movement based mathematics activities and were suitable for the age group of four to five (48 to 60 months). The materials required for the activities in this framework were made available for each child and various materials such as music, costume, materials, accessories, and stationery materials were made ready in the area in advance. In this scope, the activities such as distinguishing and classifying vegetables and fruits (Photo 1), comparing healthy and unhealthy food (Photo 2), finding the same things as the pictures on plates (Photo 3), matching balls with their stands basing on their colors (Photo 4), completing a caterpillar according to the pattern (Photo 5), aligning bottles

according to the pattern and trying to knock them with a ball (Photo 6), recognizing the numbers and counting (Photo 7), addition and subtraction operations with ladybug's spots (Photo 8), finding geometric shapes mentioned in a song (Photo 9), advancing on the play course according to the shape on the dice (Photo 10), creating a product using the shapes according to a riddle (Photo 11), guessing quantity with balloons (Photo 12), making a concrete measurement using a ruler-clock-thermometer (Photo 13), making a measurement with gloves (Photo 14), making an area calculation using chestnuts on the plates (Photo 15), guessing the weight of vegetables and fruits according to scales (Photo 16), analyzing the fish caught with fishing lines according to their species (Photo 17), and creating a graphic for fishmeal (Photo 18) were performed. These activities were exemplified by the photos in the below.

Photo 1. An example for the activities related to classifying

Photo 2. An example for the activities related to comparing

Photo 3. An example for the activities related to matching

Photo 4. An example for the activities related to matching

Photo 5. An example for the activities related to forming a pattern

Photo 6. An example for the activities related to forming a pattern

Photo 7. An example for the activities related to counting

Photo 8. An example for the activities related to doing operation

Photo 9. An example for the activities related to geometrical shapes

Photo 10. An example for the activities related to geometrical shapes

Photo 11. An example for the activities related to geometrical shapes

Photo 12. An example for the activities related to volume

Photo 13. An example for the activities related to measuring (standard units of measurement)

Photo 14. An example for the activities related to measuring (non-standard units of measurement)

Photo 15. An example for the activities related to area

Photo 16. An example for the activities related to mass (weight)

Photo 17. An example for the activities related to creating graphics

Photo 18. An example for the activities related to creating graphics

In this framework, each week two cooperative learning groups were created (for 12 different groups in total), which consisted of groups of 5 to 6 persons out of the classroom of 62 persons in which pre-service teachers were involved. The pre-service teachers in these learning groups created draft activities that contained relevant week's learning outcomes for mathematics, by means of brainstorming and division of labor under the coordination of the instructor lecturer. In this way, the weekly mathematics activities created for mathematics education were reviewed each week on Friday, between 1:30 and 5:00 pm, with the participation of the instructor lecturer, and they were made ready to conduct upon

the required additions, feedbacks/corrections, and recommendations of the instructor lecturer. The pre-service preschool teachers who were not included in the practice group of weekly mathematics activities in the relevant week also took part as observers in the hall where the practices were performed. At this stage, the preschool children were prepared for the process and came to the institution where the university students in the first study groups were studying, on the day when they had the course of "mathematics education in early childhood", and the preschool children were present at the same environment with the university students, involving in the practice process of the mathematics activities that were made ready for them. In this scope, the principal and the teachers in the institution, where the preschool children's teachers who represented the second study group of the study were present, were interviewed at the stage of creating the content of the course and they were informed of the practices to be done in the context of content and process as needed. The main principle for the involvement in this process was considered as voluntariness of the preschool teachers and the parents. The parents of the preschool teachers granted consent for the education they would receive, and the required documents of consent were received. The practices in this framework were performed at a training practice hall (used as drama hall) located in the institution where the university students continued their education, on the same day and between the same hours. After the course of "mathematics education in early childhood" that was conducted through a pre-service preschool teacher-child interactive learning approach (with play and movement-based activities) ended, it was firstly assessed by the instructor researcher together with the pre-service preschool teachers and then together with the preschool teachers.

2.5. Data Assessment

Descriptive analysis technique was used to analyze the data that was obtained as a result of the interviews with the pre-service preschool teachers and preschool teachers within the scope of the study. The qualitative findings obtained were explained through frequency values (f) in order to clarify the analysis and to increase reliability. The findings in this scope were presented in tables, and by this means, it was tried to ensure that the study presents the data clearly and understandably. Samples taken from the expressions of the participants stated during the interviews were presented as direct citations. It was aimed to keep the participants' names confidential using codenames as Group 1, Group 2 … Group 12 for the pre-service preschool teachers and T_1 and T_2 for the preschool teachers, who involved in the study. There were no time limitations for the interviews with the study group and they were not given any explanation that would have an impact on their opinions. Due care was taken to report the points reflected during the interviews in line with the ethical study principles and to present these points neutrally. The findings that were presented descriptively were tried to explain in cause-effect relationships and the obtained study results were discussed in the light of the relevant studies in literature.

2.6. Credibility in the Study

It was tried to prevent prejudices that may arise during the study process and to create an atmosphere based on trust, by way of conducting the study between the researcher who is a specialist in the field of preschool education and pre-service preschool teachers, and preschool teachers who interacted for a while. Within the scope of the study, any interventions that might cause bias on the study group were avoided. In the data collection process of the study, it was aimed to reach multiple data by referring to the opinions of pre-service preschool teachers and preschool teachers. The data obtained in the study were reviewed by the researcher during the reporting process and care was taken to convey the findings reliably. For the results of the study process, the field expert, whose opinions were consulted for the clarifying of the interview questions, was also examined by the field expert and in this context, a consensus of the 97.1% according to the formula of Miles, & Huberman (1994) (Reliability= Agreement/ Agreement + Disagreement x 100) an excellent level of reliability was achieved. In order to show that the certifiable reliability of the study, citations from the sample expressions of the study group are also provided. Accordingly, the current study took steps to reveal valid and reliable study data.

3. Findings

The findings that were obtained within the scope of the study are presented in this chapter, under the headings based on the purpose of the study. The findings related to the pre-service preschool teachers under the first and second sub-purposes were explained in Table 1 and Table 2, while the findings related to the preschool teachers under the third sub-purpose were explained in Table 3. A certain part of citations from the interviews in this scope were presented in the relevant section.

3.1. Findings on the opinions of the pre-service preschool teachers on the contributing aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach

Findings on the contributing aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach according to the opinions of pre-service preschool teachers are presented in Table 1.

Table 1. Distributions related to the contributing aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach according to the opinions of pre-service preschool teachers

Contributing aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach	**f**
Learning how to prepare interesting activities for children	10
Discovering the ways to ensure children to learn mathematics with fun	9
Learning the ways to teach mathematical concepts to children	8
Learning how to make explanations for children while performing a practice	8
Overcoming the excitement/anxiety/concern about performing practices with children	8
Discovering the ways to ensure children to learn mathematics with active involvement	7
Knowing preschool children well	7
Learning about what kind of activities can be done with children	6
Realizing that mathematics education is enjoyable	6
Learning how to prepare materials suitable for preschool children	6
Catching clues about the process of performing a practice with children	6
Learning that mathematics education presents many learning outcomes	5
Gaining a positive point of view towards mathematics lesson	5
An increase in the interest in the profession of preschool teaching	4
Learning the ways of communicating with children	4
Realizing that the process of practice requires skills different from theoretical knowledge	3
An increase in the cooperation among the colleagues of the pre-service teachers	2

Table 1 shows that the pre-service preschool teachers stated that the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach is contributing in many terms. In this scope, it was detected that almost all of the groups achieved the learning outcomes of *learning to prepare interesting activities* (f=10) and then *discovering the ways to ensure children to learn mathematics with fun* (f=9). These considerations were concluded as per the following expressions.

> Group $2_{(1)}$; *When it comes to mathematics education, many things like concepts, materials, different methods, activity types... come to our minds now. While performing mathematics education with preschool children, we learned to include fun into it, too. By this means, we realized that preparing and practicing mathematics activities is not challenging. We also happened to learn how learning with fun would occur by observing and trying. It was really a special course; it was a good experience for all of us with its contributions and challenges…*

> Group $6_{(1)}$; *When you mentioned about the information on the content of the course at the beginning of the semester, you explained us that we would perform a practice with children in the next periods. At that time, we had thought about how we would do it; but now we have gained self-confidence. If we have a similar practice again, we will not feel such uneasy. Further, it was the first time for us to come together with children in that way. Now we can make estimations on how to make explanations, what kind of activities keep their interest alive, or in what way children will understand us better while doing a practice, and so on.*

Following these considerations, it was seen that the pre-service teachers stressed that "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach is useful in terms of *learning the ways to teach mathematical concepts to children* (f=8), *overcoming the excitement/anxiety/concern about performing practices with children* (f=8), and *learning how to make explanations for children while performing a practice* (f=8). Statements of Group $1_{(1)}$ are an example for this.

> Group $1_{(1)}$; *It was a very fruitful course for us to improve ourselves and to be better teachers. We had the opportunity to adapt to the process by getting into one-to-one interaction with children so early. Owing to the practices in our course, we learned how to establish communication with children, we experienced how to explain a subject related to mathematics to children, and we overcame our excitement. Even our concerns disappeared thanks to this practice. If we have a course like this as an elective course for the next grades, I would like to take it voluntarily…*

The majority of the pre-service preschool teachers stated that the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach helped them *know preschool children well* (f= 7) and *discover the ways to ensure children to learn mathematics with active involvement* (f=7). Following this, they stated that it was contributing in terms of *learning about what kind of activities can be done with children* (f=6), *realizing that mathematics education is enjoyable* (f=6), *learning how to prepare materials suitable for preschool children* (f=6), and *catching clues about the process of performing a practice with children* (f=6). Examples for these are presented by the following statements.

> Group $3_{(1)}$; *As we met the children by the very first week, we became acquainted with them. Owing to this, our concerns about the practice decreased day by day. We began to make out who behaves how, who has any difficulty, or who gets bored more quickly. We also got excited thinking we would be in a similar situation with our students when we become teachers… It was gorgeous to be together with the children. We were also very*

concerned as it was our first experience in this sense, but we understood when we performed the practice that there was no reason for being concerned. The practice was fruitful and good in many aspects. Thank you so much for giving us these opportunities…

Group 10(1); *Actually, mathematics class was always difficult for me when I was a student. I did not like it much in my student life. However, I always thought while continuing our course that I would certainly have liked it more if there had been such practices. Perhaps it would not have seemed such difficult to me. In this sense, I feel so pleased that I hope at least I will be able to provide my students with such practices that they will like. Also, when it comes to mathematics, I would think of addition-subtraction operations, or counting and so on. But now, I am thinking that we could teach our students so much about mathematics. For instance, I would not think that creating graphics is a subject of mathematics or making measurements with non-standard units should be learned at these ages. We talk among each other, too; what we have learnt has been so much beneficial for us in so many aspects.*

Besides, it was seen that the pre-service preschool teachers considered the course to be contributing in terms of *learning that mathematics education presents many learning outcomes* and *gaining a positive point of view towards mathematics lesson* (f=5), *an increase in the interest in the profession of preschool teaching* and *learning the ways of communicating with children* (f=4). In addition to these, they also highlighted the contributions of the course in terms of *realizing that the process of practice requires skills different from theoretical knowledge* (f=3) and *an increase in the cooperation among the colleagues of the pre-service teachers* (f=2). The followings are the examples for these situations.

Group 4(1); *Preparing a practice to develop mathematical skills of preschool children and performing it together with the children in a course of our undergraduate education have absolutely been a trial and a good experience for our future teaching life. We found answers for many questions in our minds about what kind of challenges we can face and what kind of solutions we can adopt for these challenges, during the time in which we planned and performed the activity. Probably we will generate ideas not only for mathematics education, but also for our other courses, basing on what we have learned in this course…*

Group 8(1); *We have gained experiences with children practically. It ensured us to see the perspectives and approaches of the children closely. Activities of other groups gave us ideas, too. It allowed us to correct our mistakes and perform better activity practices, ensuring us to see our own mistakes and other group's mistakes. We understood that*

there is a difference between theoretical knowledge and practice and that we have to be ready for the conditions depending on the moment. We have had a more permanent and effective learning process.

3.2. Findings on the opinions of the pre-service preschool teachers on the challenging aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach

Findings on the challenging aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach according to the opinions of the pre-service preschool teachers are presented in Table 2.

Table 2. Distributions related to the challenging aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach according to the opinions of the pre-service preschool teachers

Challenging aspects of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach	**f**
Finding interesting activities for children	8
Performing the prepared activities with children without any problems	6
Performing transitions/connections between activities	5
Preparing suitable/sound materials for teaching children mathematics	5
Finding activities for gaining mathematical concepts that are suitable for development	5
Performing a practice in an area that is not large enough	4
Activity preparation takes too much time	3

According to Table 2, it was detected that the pre-service preschool teachers stated that the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach is challenging in several aspects. In this scope, it was determined that the pre-service preschool teachers had difficulty mostly in *finding interesting activities for children* (f=8) and *performing the prepared activities with children without any problems* (f=6). The following statements reflect these situations.

Group 1(2); *We had difficulty in keeping children's attention fixed on the activities while performing them, they would lose their attention and we would have difficulty in passing to a new activity promptly. Already, we would spend too much time thinking if they would be able to do the activities or not, in the preparation process. It is because; we saw every week that it is very important to catch their attention. Of course, nowadays we have*

got used to do something with children frequently. However, we would think more over how we could deliver the learning outcomes we chose to children easily…

Group 8(2); *As it was our first face-to-face experience with children, we had difficulty in finding activities that would be suitable for them, as well as finding activities that we could perform. In fact, you told us that we could use loose materials, too; you recommended us natural materials. Thus, we could start generating some more materials… But, we would get flurried as the children lost their attention and we had to keep them during the practices… Of course, nowadays we are more self-confident and we can manage the process more easily if we experience the same situation once more…*

It was seen that the pre-service preschool teachers stated that they had difficulty in *performing transitions/connections between activities, preparing suitable/sound materials for teaching children mathematics,* and *finding activities for gaining mathematical concepts that are suitable for development* (f=5) within the scope of the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach. The following expressions present these situations.

Group 3(2); *We had difficulty in finding suitable activities for preschool children's development and in establishing connection between the activities while making the preschool children gain the concepts related to mathematics. And, you stressed that our activities must be creative and original. We always thought over it asking, "How can we give this concept more differently?", "How can we adapt another example that we have seen?"… While we were studying with you, you would made interconnections so rapidly, which helped us much. In fact, we established the connections between the activities that we changed, inspired by your ideas… Another point is that the area where the practice was performed was not large enough, which posed challenges both for the children and for us, as the practitioners.*

Group 7(2); *The more materials and possibilities there are for performing a mathematics activity in classroom with children, the better it will be, but we cannot say that a mathematics activity cannot be performed with children on the excuse that there are no materials. We think that we were sufficient for both having fun and learning with children, with our activities and materials. We would always be discouraged due to the fact that mathematics contains many abstract concepts… The main activity of the children of this age is to play. Children can increase their learning capacities by means of play or entertainingly, and we have seen it. I think we will not have this much difficulty again, but at first it was difficult in our minds to involve children with*

mathematics in this way. We are really pleased that we have overcome these… We think we will perform such activities in our classes as far as we can do in the future.

Group 9(2); *We had difficulty in ensuring connections between the activities in some way while preparing them in our group, but we ultimately learned how to do it. You said, "if you involve the children in the activities with an adventure, it will support their active learning", and we tried to establish connections that would ensure it each of the time… Thankfully we performed practices as a group, supported each other during the practices, and we could create activities since we got prepared commonly. Of course, there were many parts that you reviewed and corrected, and it also helped us learn how to make connections. In fact, we learned many things in this way…*

Group 12(2); *I think what we did does not seem to be extremely challenging anymore… But, considering the parts in which we had difficulty, it was challenging to perform mathematics activities without making the children feel bored… If we were to perform mathematics education with preschool children now, I am sure we would be concerned about it less and we would have more courage to do our best in this matter…*

In addition to the situations stated above, the pre-service preschool teachers considered the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach as challenging due to *performing a practice in an area that is not large enough* (f=4) and since *activity preparation takes too much time* (f=3). These situations are reflected in the following statements.

Group 4(2); *I think there were so many observers in the activity area other than children, which can be defined as a problem… Since the classroom was not very large, it was a bit difficult for us to both perform the activity and ensure the children to focus on it. However, when we become teachers, our colleagues will not be in our classrooms, there will only be children. Thus, it will not be a problem to be faced in the future.*

Group 6(2); *We can tell that preparing the activities took too much time. Because, we could not generate activities as it was the first time we had ever had such a course… Therefore, we constantly visited you in your room and asked questions via e-mails. I know, we took too much of your time, but we have learned it so good, perhaps thanks to it… For example, when we consulted you about our activities, you said, "You can allow them to pick fruits from basket in order to give them the right of choice, then you can pass on to the activity" … At that time, we started to realize that "we should prepare activities to keep children active, too; rather than telling them 'you are doing this' and 'you are doing that'" … Probably we had never thought in that way, neither we could*

think about it instantly. Hence, these situations challenged us. We told each other, "Everybody should think about an activity, then we will talk over them when we gather" … In this way, we started to be able to generate many activities…

Group 10(2); *It was an exceptional experience to perform a practice with children, but we were concerned about the possibility that we could make a wrong impact on the children since we were not qualified enough. It would have given us more convenience if the observers had not communicated with the children during the practice, as children can easily become distracted. In fact, the area where the practice was performed was not very large. The fact that there were so many people together with the children in the same place during the practice made it difficult to focus on the activities… In fact, it was challenging to ensure attention in a crowded classroom for our group from time to time …*

3.3. Findings on how the preschool teachers assess the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach

Findings on the opinions of the preschool teachers on the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach are presented in Table 3.

Table 3. Distributions related to the process of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach according to the opinions of the preschool teachers

Assessments on the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach	**f**
Giving multidimensional support for mathematical skills of preschool children	2
Ensuring an efficient learning process for preschool children	2
Presenting different examples to preschool teachers for mathematics activities	2
Being a model for the preschool teacher in various aspects	2
Creating a new environment for preschool children	1
Ensuring preschool children to socialize	1
Ensuring preschool children to experience the rules related to social life	1
Ensuring parent satisfaction	1
Introducing preschool children to university	1
Creating active learning process for preschool children	1

Considering how the preschool teachers assess the process of the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive

learning approach in the study, it was seen that both of the preschool teachers in the study group suggested that the course process has a positively contributing content. The opinions in this scope remark the contributions both for the pre-service preschool teachers and preschool children and for the preschool teachers themselves. This situation is revealed by the following statements.

> T_1; *First of all, I would like to tell you that the pre-service teachers who are your university students are very lucky. Because, they will be readier for their professional lives, as they have received such an education in an undergraduate program, and they will already be able to start producing since they have learned it. Frankly, I joined you eagerly and ambitiously each week, too, together with the children. I was wondering about what they had prepared for that day, what activities we would see. You were really a good model for us, in fact, we repeated most of your activities on different days in our school, and we conducted activities in our own school, based on what we saw from you. The parents asked me to send them photos on WhatsApp group at the evening of the day we left this place. They were also glad; at the end of the day, their children were receiving education in a university, were socializing, and were learning actively. Moreover, the children would ask if that day were the university day in the school, then I would make explanations for them saying, for example, "university day is two days later"… Your students really presented very elaborate activities. Of course, it should have been so with your support. For this reason, I got so surprised; our children did never get bored although we stayed in a classroom for several hours. I was observing; they participated in the activities as if competing with each other… They were in a new atmosphere, as well as there was a group of people, who welcomed them meticulously and sent them off with love… I think this also kept their attention live. Even, one of our students had an earache one day, I called his parents saying that they could pick the child up, then, the child started to cry, he did not want to go home, since we would come here… I respect both your students' and your efforts, we would like to involve in if you perform such a practice again…*

> T_2; *First of all, I would like to thank you for inviting us and ensuring both us and our children to get benefits. I would never think that an undergraduate course could be conducted in this way. My own undergraduate courses did not contain such practices. They had the chance to experience many concepts such as adapting to a new environment, getting in a line to get on the shuttle bus, following classroom rules and taking their shoes off, and sitting on cushions without getting ahead of each other. In fact, I realized personally that actually we do not conduct mathematics activities with such variety. Even, the children sometimes remembered examples from some activities after your course, told about them in the classroom, and talked about them among themselves. This group was lucky for the future, because mathematics is very important*

also for academic achievement. As for your activities, they were pleasing for the children as the children were dynamic and did mathematics in a play. The pre-service teachers performed the activities without any intervention even if they were still students, which shows they learned it very well. Perhaps they had difficulty in preparing the activities, I believe they brought them to such a level studying with you, but it was a good process for the pre-service teachers to learn performing practices with children. Now I am thinking you performed so many activities that I have realized we rarely perform activities such as measuring length with gloves, making graphics with the fish we just hunted, performing addition operation with the spots on a ladybug… We would follow some journals, we could not allocate time to them from time to time, but your activities have been a source for us. If you come to our school, we have a playing hall, too; we can perform similar practices for other courses…

4. Conclusions, Discussion and Recommendations

In the current study, it was seen that the course of pre-service teacher–child interactive "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach (with play and movement-based activities) is contributing to pre-service teachers, preschool children, and preschool teachers in different aspects. Assessing the contributions achieved in this scope; the most remarkable aspects were that the pre-service preschool teachers *learned how to prepare interesting activities* and *discovered the ways to ensure children to learn mathematics with fun* owing to the course. Probably this is because, the content of the course emphasizes ways of mathematical practices and contains processes for experiencing them with activities based on play and movement. Owing to the experiences related to teaching mathematics by catching attention and with fun at this stage achieved by the pre-service teachers, they will possibly utilize mathematics in their future lives ambitiously. Supporting this, Tokgöz (2006) detected that if preschool teachers are assisted through supportive programs and practices for early mathematics education, their competencies in mathematics education will be increased at an important level. In this scope, it was highlighted that it is necessary to apply practice oriented educational programs in order to improve the competencies, as well as the attitudes of preschool teachers towards mathematics education. The findings of the preschool mathematics program named "Building Blocks" by Sarama, Lange, Clements, & Wolfe (2012) on teachers and children is also parallel with the result of the study.

In the study, the pre-service preschool teachers remarked also that the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach was contributing to them in terms of *learning the ways to teach mathematical concepts to children, learning how to make explanations for children while performing a practice, overcoming the excitement/anxiety/concern about performing*

practices with children, *discovering the ways to ensure children to learn mathematics with active involvement,* and *knowing preschool children well*. Yıldız (1998) found that a process of teaching applied by preschool teachers by means of collaborative learning increases mathematical success of kindergarten children and affects development of social skills positively, which is a result similar to that of this study. Kurtuluş (1999) detected that it becomes easier to teach children of five to six age group, who attend a preschool education institution, the concept of time (e.g. before-now-after, yesterday-today-tomorrow, morning-noon-evening-night, day, week, month, year, seasons, and hour) by means of creative activities. There are some results indicating that education delivered to preschool children through structured method is more effective for acquiring numbers and geometrical shapes, compared to the traditional method (Dere, 2000; Kırlar, 2006). In the study conducted by Davun (1997) on kindergarten children, it was detected that children learn shapes more effectively in plays where they implement what they learn while playing and in plays where they perform activities by tearing and sticking things, or putting or taking weights on and from a scales. As the content of the course that was the basis of the study had many practices in this framework, the pre-service preschool teachers possibly experienced these cases and besides they reflected their relevant outcomes into their opinions.

Moreover, the pre-service preschool teachers stated that the course was useful for them in terms of *learning about what kind of activities can be done with children, realizing that mathematics education is enjoyable, learning how to prepare materials suitable for preschool children, catching clues about the process of performing a practice with children, learning that mathematics education presents many learning outcomes,* and *gaining a positive point of view towards mathematics lesson*. There is a positive correlation between mathematical skills and social-emotional functioning of preschool children (Dobbs, Doctoroff, Fisher, & Arnold, 2006), which expresses that the contributions of the course are also important for supporting the outcomes related to different fields of development. Thus, the outcomes of the course in the study presented an opinion like *"we will generate ideas not only for mathematics education, but also for our other courses, basing on what we have learned in this course*" (Group $4_{(1)}$), which supports this situation. Li, Shavelson, Kupermintz, & Ruiz Primo (2002) detected that if mathematical success of children increases, their science success will also increase. Adagideli (2013) revealed that there is a relation between metacognition and self-setting skills and mathematical problem solving, measuring, classifying, and pattern-creating skills of children aged four to five, and it is significant to support these skills through educational plays. Accordingly, play-content activities that require multidimensional skills of children can be contributing to their mathematical skills in different aspects.

In addition to these, it was also revealed that the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach is contributing in terms of *an increase in the interest in the profession of*

preschool teaching, learning the ways of communicating with children, realizing that the process of practice requires skills different from theoretical knowledge, and *an increase in the cooperation among the colleagues of the pre-service teachers*. It is remarked that the success of a preschool teacher is directly related to his/her capability of establishing a good communication with students in his/her classroom, and it is necessary to run the communication processes between teacher and child for an effective learning (Ceylan, & Kılıç Mocan, 2017). Thus, it is a fact that a teacher who knows how to establish effective communication with child can contribute to the quality of education, using it in different fields of the process of education. It was seen that pre-service preschool teachers learn how to establish a healthy communication between teacher and student, prepare a plan, and establish a connection between theory and practice, owing to the courses of Teaching Practice that contains such processes (Özay Köse, 2014; Yıldırım, Özyılmaz Akamca, Ellez, Karabekmez, & Bulut Üner, 2019). Furthermore, it was also determined that it gives preschool teachers experiences in terms of classroom management, allows them to observe children, gives them the chance to solve problems, and provides them with various experiences for working with children (Karasu Avcı, & Ünal İbret, 2016). Accordingly, it can be said that the processes in this course produce learning outcomes related to mathematics, while they have preparative role on professional life.

Beyond the opinions of the pre-service preschool teachers, the opinions of the preschool teachers also showed that a course to be conducted interactively between pre-service teacher and child is contributing to pre-service preschool teachers and children, as well as to preschool teachers. It is highlighted that the contributions in this framework are prioritized for children. According to this, it was found that the course was contributing in terms of *creating a new environment for preschool children, ensuring preschool children to experience the rules related to social life,* and *ensuring preschool children to socialize,* as well as *giving multidimensional support for mathematical skills of preschool children* and *ensuring an efficient and active learning process for preschool children*. Melhuish et. al. (2008) detected that preschool education is positively effective on mathematical success of children in future periods. In this framework, it is remarkable that the contributions of the course to the children are possibly a predictor for their success in future periods. The opinions of one of the teachers in this study include statements indicating that *the preschool children who attended the course remember examples of some of the activities and tell about them in their classrooms and this group is lucky for the future, too*, which support this idea. Similarly, it was concluded in a study by Önel (2018) that learning will be more effective if children is given opportunities such as experiencing enjoyable aspects of learning, conducting interest-raising studies, taking part in an active process, and being allowed to solve problems while acquiring mathematical skills in early childhood period. Lewis Presser et. al. (2012) detected that the mathematics education program named "Big Math for Little Kids", which was prepared to be developmentally suitable for preschool children and implemented delicately, contributes to mathematical success of children.

Hacısalihoğlu Karadeniz (2013) detected that, 48 to 60 months old children's skills of "awareness of time" and "knowing tools that tell the time" can be developed by means of systematic activities. In a study conducted on the children of Latin families (Lopez, Gallimore, Garnier & Reese, 2007), it was revealed that it is required to conduct preschool education effectively to close the gaps in mathematical success of children. While these show that effective educational processes are contributing to different concept acquisitions of children, it also highlights a mathematics education aimed for the need.

Moreover, it is thought that this course is contributing because it allows preschool children to socialize and experience the rules related to social life. Satisfaction of parents as their children were involved in this educational process is further important on the point that the functions expected from educational institutions are met. In many studies at national and international levels (Ceylan, 2019; Glenn Applegate, Justice, & Kaderavek, 2016; Räty, 2013; Sevinç, 2006; Smreaker, & Honey, 2015), it was determined that parents consider the quality of teacher and the interaction between teacher and child important while choosing a preschool educational institution. Competency of preschool teachers in activities and practices related to mathematics and a positive communication between preschool teachers and children are also preferable in this context.

It was concluded that the practices within the scope of the course that was conducted by the researcher are a model in various aspects as *it presented activity examples for the preschool teachers* who observed the process. Moreover, it was detected that the practices observed during the course *presented different examples also for multidimensional mathematics activities*. In this scope, one of the preschool teachers stated that *"she realized she could not conduct mathematics activities of such a diversity and she would conduct activities from journals in this scope, and she could not allocate this much time sometimes"*, which is worth thinking in terms of the practices conducted in schools. It is a similar finding that Pekince, & Avcı (2016) detected preschool teachers who serve in classrooms of children aged four to five include mostly outcomes related to counting in their mathematics activities, and sometimes they even do not include any outcome or indicator that supports a mathematics activity throughout a week. Likewise, it was seen in the study by Tarım, & Bulut (2006), which assessed teachers' perceptions towards mathematics, that when mathematics is mentioned to teachers, they think about numbers and shapes in general. In the study by Aslan, & Aktaş Arnas (2007), it was detected that publications (e.g. journals, books, and CDs) for preschool children aged three to six to gain mathematical skills mostly contain typical examples and explanations, and have some limitations related to gaining different examples. This finding indicates that if teachers conduct mathematics activities only with journal studies, it will not be sufficient in terms of mathematical concepts and learning outcomes. These can be considered as the reasons why there are so many problems faced by preschool teachers in planning and assessment of mathematics education, according to the finding of Aydın (2009). In this scope, it was seen teachers state that mathematics in preschool period is quite different from mathematics in normal life,

while they also indicate that they face many challenges in life due to the fact that they do not like mathematics. Furthermore, Tokgöz (2006) detected that if preschool teachers feel that they are competent in mathematics education, their attitudes towards mathematics education become different. According to this, it can be said that there is a great need for such studies on supporting preschool teachers for mathematics education through practice-based activity examples.

As a different result, according to the opinions of the preschool teachers, the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach was found *to be contributing to university student pre-service teachers for being ready for professional life*. In other words, the preschool teachers emphasized that the content of the course prepares pre-service teachers to teaching life, too. Tarım, & Bulut (2006) detected that some of preschool teachers do not find mathematics education they receive during their university education sufficient and they try to close this gap by taking the advantage of experiences of teachers who are more experienced than they are in their professional lives. In this line, it can be said that it is an important point that a teacher is well educated in the process of undergraduate education in order to close any gaps that might arise in his/her professional life. These results reveal the important of the practices in the content of the course, supporting also the opinions of the pre-service preschool teachers. In the light of these results, it can be said that the process of conducting the course of pre-service teacher-child interactive "mathematics education in early childhood" can serve as a model for ensuring collaboration between university and school. The results showed that the course makes multidimensional contributions, as well as the role of university on different stakeholders of education is revealed once more time.

Several situations that were considered challenging by the pre-service preschool teachers in this process are remarkable. The primary situations are *finding interesting activities* and *performing the activities with children without any problems* and then *ensuring transitions/connections between activities, preparing suitable/sound materials for teaching children mathematics, and finding activities for gaining mathematical concepts that are suitable for development*. It can be said that these situations are mandatory to learn for pre-service preschool teachers to be good teachers, and they can be developed through experience. It is potential for the group of second grade university students to face challenges at these points, while it is an important step for their education to have developed awareness for these situations. In a study on pre-service teachers (Özdaş, & Çakmak, 2018), it was seen that the course of teaching practice is explained under the categories of experience, observation-imitation, challenges, adaptation, relationship, and beginning, which is a similar finding. According to Gürbüztürk, & Çalış (2019), pre-service preschool teachers have difficulty in preparing suitable activities for children and in involving children into activities in Teaching Practice, which explains the reason why the course addressed in this study is challenging. In the study by Ramazan, &

Yılmaz (2017), pre-service preschool teachers stated that it is late to perform practices with children in schools in the final year, and it is challenging in terms of preparing activities. According to Kim (2013), pre-service preschool teachers have some problems generating mathematical information and feeling comfortable in classroom environment during mathematics education, which is a result similar to that of this study. These can be considered as an indication of the fact that the course of "mathematics education in early childhood" that was conducted with the support of practice-based activities by the researcher is also a guide for the next periods.

It was also seen that pre-service preschool teachers considered the course of "mathematics education in early childhood" conducted through a pre-service teacher-child interactive learning approach challenging due to *performing a practice in an area that is not large enough* and because *activity preparation takes too much time*. This shows that it is important to improve physical facilities of faculties under the body of universities in terms of the functionality of courses conducted in universities. In a study (Doğan, 2013) in Turkey sample, it was found that universities have some physical insufficiencies such as ineligible and crowded classrooms/practice areas. Addressing each of the problems that touches pre-service teachers with solution-oriented approaches will serve positively for qualified teacher training policies. It is mandatory for the countries to make physical and educational facilities of education environments sufficient in order to achieve targeted level of education. It is beyond doubt that it is inevitable for pre-service teachers to experience the abovementioned challenges in order to yield the outcomes they achieved from the process related to the course. Part of the challenges faced by pre-service teachers may result from the fact that it was the first time they had ever been involved in such a course process, it is also thought that they can have a share on the development of skills such as self-confidence, being initiative, and problem-solving in the next stage.

According to the results obtained from the study, it can be said that the course of "mathematics education in early childhood" that was conducted through a pre-service teacher-child interactive learning approach contains processes related to establishing the connection between theory and practice in education. It is asserted that teacher-training process must contain practices from the early years of education (Ajayi, 2014; Ünver, & Kurşunlu, 2014). Otherwise, preschool teachers may have problems in professional life using the theoretical and practical knowledge that they acquire in university (Ertürk, Özen Altınkaynak, Veziroğlu, & Erkan, 2014). As stated by Zeichner (2010), it becomes difficult for teachers to implement what they learn simultaneously due to the fact that they receive an education insufficient for the connection between theory and practice in pre-service teacher training programs. It is thought that the practices in the scope of this study can be a guide for ensuring coordination between theory and practice in teacher training in Turkey.

Based on the results of the current study, it is recommended to present the courses in undergraduate education to pre-service preschool teachers with a content that will ensure them to learn the lessons eagerly and gladly and to experience them with active involvement. As a contribution to this, courses such as "mathematics education in early childhood" included in preschool teaching undergraduate program must be conducted by persons who are experts in the field of preschool teaching. In this scope, it is recommended that instructors should pay attention to deliver courses in their fields of competency and qualified teacher training approaches should be taken as a principle in universities. It is considered necessary to achieve sustainable contributions in the context of pre-service teacher–child–teacher, organizing courses in preschool teaching undergraduate program so that cooperation between university and school is ensured. It is recommended to follow optimum contributing steps, considering developmental features and individual expectations of target group in activities conducted for both preschool teachers and pre-service preschool teachers, as well as effective educational approaches, teaching principles and techniques peculiar to groups. In future studies, practices similar to that of this study can be conducted within the body of different courses at undergraduate level, and levels of scientific process, problem-solving, and self-setting skills of preschool children who are involved in such practices can be researched. Effect of practices that contain a pre-service teacher-child interactive learning approach on targeted group can be investigated in longitudinal studies, and contribution of these processes to knowledge and experiences of teachers about mathematics education can separately be assessed. In this context, other studies can be conducted to examine the effect of the process with data obtained from preschool children and that review preschool children's perceptions of the concept of university.

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