



Teachers' Views on Early Childhood Maths*

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Abstract – Some psychological factors related to preschool teachers significantly impact mathematics teaching in early childhood classrooms. Thus, examining teachers' views on preschool mathematics will guide teachers in understanding which concepts were included in early childhood mathematics and preparing an educational environment and program appropriate for children's developmental levels. This research was a descriptive-study and was implemented using general-survey model with 107 preschool teachers. Data were collected by teacher views form on early childhood mathematics. Data were evaluated with descriptive and non-parametric statistical methods. Results showed that the teachers used math activities with games, art, drama activities and used limited methods to assess whether children have learned mathematics concepts. In addition, most teachers stated that data analysis, proof, and probability cannot be taught in preschool. Finally, most teachers considered preschool mathematics moderately important and that there was no significant difference among ages, professional service periods, the institution and school types they work in, and the order of importance of mathematics ($p > .05$).

Keywords: early mathematics education, teacher views, early childhood education

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Introduction

In early childhood, mathematics has a significant role in children's cognitive development. Children can make sense of what is happening around them through mathematics. (Fromboluti & Rinck, 1999). The foundations of mathematical development in children are laid

mainly in early childhood (Clement & Sarama, 2007; Çelik & Kandır, 2011; 2013; Erdoğan, 2006). Mathematical experiences in the early years of childhood arise from children's awareness and understanding of the mathematical dimensions of the situations occurring around them from early ages (National Association for the Education of Young Children [NAEYC], 2002). From the first years of their life, children begin to learn mathematical concepts they will use in the future through the experiences they have gained during interacting with their environment. Observations about children's play and daily routines indicate that they acquire many mathematical concepts, develop mathematical thinking, perform mathematical operations, and start using the concepts they have learned (Buldu, 2012).

Mathematics in early childhood is also related to concept development and is closely associated with children's concrete experiences (Akman et al., 2000; Güçhan-Özgül & Saçkes, 2022). "*Classification, comparison, ordering, number concept, operation concept, geometric shapes, measurement and using symbols, etc.*" concepts contribute to children's future understanding and learning of mathematics. With the academic skills presented and supported in early childhood, children's readiness for primary school can be increased, and their achievements in later grades can be grounded (Çelik & Kandır, 2011; Uyanık & Kandır, 2010).

Results of numerous studies stated that academic skills gained in early childhood affect children's mathematical skills at later ages (Claessens & Engel, 2013; Çelik & Kandır, 2011; Ergün, 2003; Uyanık & Kandır, 2010) and the effect of teachers on the acquisition of formal math skills in this period (Copley, 2004; Hart, 2002; Jenkins, 2001; Le & Ginsburg, 2007; Orçan Kaçan & Karayol, 2017; Stites et al., 2022; Todd Brown, 2005; Zacharos et al., 2007). In addition, research revealed some problems and deficiencies (e.g. feeling inadequate in teaching math, not having enough knowledge of mathematics concepts and skills, having difficulties in planning mathematics activities etc.) regarding mathematics teaching at early ages within the scope of preschool education practices carried out in Turkey (Ağgül Yalçın & Yalçın, 2018; Güven & Gök-Çolak, 2019; Orçan Kaçan & Halmatov, 2017; Orçan Kaçan & Karayol, 2017; Pekince & Avcı, 2016).

It is known that achievements and experiences in mathematics in early childhood also influence children's future success (Clements & Sarama, 2008; Jordan et al., 2009; Lopez et al., 2008; Saxe, 1988; Wolfgang et al., 2001). Observable outputs related to this situation are seen when the scores and rankings of Turkish students are examined in the "*Program for International Student Assessment (PISA)*" project implemented every three years by the "*Organization for Economic Cooperation and Development (OECD)*." PISA exams determine

the levels of 15-year-old students in areas such as mathematical literacy, science literacy, and reading skills (Ministry of Education [MEB], 2012). In the 2018 PISA results, in which 79 countries participated, Turkey ranked 40th in reading (31 in 37 OECD countries), 39th in science (30 in 37 OECD countries), and only 42nd in mathematics (33 in 37 OECD countries) (PISA, 2019). When the PISA results are evaluated, Turkish students are far behind their international counterparts. The report published by the OECD (2004) states that learning experiences gained in early childhood significantly affect the performance of students from different participant countries in mathematics achievement.

Influence of Teachers on Early Childhood Mathematics

Teaching is a complex process that requires three types of teacher knowledge: (1) field knowledge, (2) pedagogical content knowledge, and (3) curriculum knowledge (Youmans et al., 2018). Field knowledge points out an understanding of how mathematics is processed (its scope, depth, structure, procedures, relationship with other fields, etc.) in early childhood. Pedagogical content knowledge focuses on how mathematics can be taught effectively, while curriculum knowledge focuses on what mathematics means (Ernest, 1989). One of the sub-categories of the Ministry of National Education (MoNE) "*Teaching Profession General Competencies*" is "*Domain-Specific Knowledge*" (MEB, 2017). According to this sub-category, the teacher should possess the curriculum and pedagogical content knowledge of his field. In order for the child to gain, develop, and maintain the basic concepts and skills that they will use in their later school life, teachers have to design and provide "*appropriate and effective educational environments, materials, programs and guidance*". These can be provided by the teacher's possession of domain-specific knowledge.

Early math learning experiences affect young children's attitudes, perceptions, and knowledge levels toward mathematics and provide rich learning opportunities for disadvantaged groups. Researchers discovered that children from low-income families quickly close the gap with their peers with preschool math programs (Clements & Sarama, 2008; Dearing et al., 2009; Oktay & Güven, 1998; Starkey et al., 2004). Well-structured and qualified early childhood programs that take into account children's characteristics have a significant impact on and improve children's mathematical skills (Ayvaci, 2010; Clements & Sarama, 2008; Kartal, 2007; Tarım Gözübatık & Artut Dinç, 2004). Teachers will support bridging this gap by providing appropriate and efficient educational environments, materials, activities, and guidance for children in preschool education. Teachers in early childhood education classrooms are supposed to provide a suitable educational environment for effective mathematics teaching.

Besides a suitable learning environment being a prerequisite for teaching mathematics, teachers should prepare and implement an appropriate mathematics program considering the developmental characteristics of children. From this point of view, the significance of preschool teachers' domain-specific knowledge in facilitating mathematics learning becomes even more explicit.

Teachers' attitudes, beliefs, or views toward mathematics and mathematics teaching are generally reflected in their educational practices. Thus, they affect students' attitudes, interests, and achievements toward mathematics and can be important determinants of children's mathematics learning (Zacharos et al., 2007). One of the significant issues with teaching mathematics to young children is that teachers often have misconceptions about the subject, such as the notion that "*children are not ready to learn mathematics,*" "*not everyone can learn mathematics,*" "*language and literacy are more important than mathematics,*" "*mathematics cannot be taught as a subject on its own,*" and "*it should only be taught utilizing concrete objects and simple numbers and figures*" (Lee & Ginsburg, 2009). Along with misconceptions, some psychological factors (i.e., self-efficacy, beliefs, and attitudes) related to preschool teachers significantly impact mathematics teaching in early childhood classrooms. Teachers' attitudes towards mathematics can affect mathematics teaching. Although many factors affect teachers' attitudes toward mathematics, it is stated that they have a positive attitude (Çelik, 2019) as well as a negative attitude towards mathematics (Markovits, 2011; Zacharos et al., 2007) and even that these negative attitudes are mainly based on their previous learning (Maloney & Beilock, 2012; Zacharos et al., 2007). As Copley stated (2004), one of the reasons why teachers do not practice mathematics activities may be related to a lack of confidence. However, sometimes the importance they give and the frequency of application can also show an inverse ratio (Orçan Kaçan & Karayol, 2017).

There is a relationship between teachers' beliefs and educational practices (Hart, 2002; Jenkins, 2001; Lee & Ginsburg, 2007) and between teachers' proficiency and mathematics practices (Todd Brown, 2005). Teachers with a high sense of efficacy find mathematics more critical, while teachers with a low sense of competence consider mathematics less important (Todd Brown, 2005). According to Ernest (1989), teachers' practice of teaching mathematics depends on several factors such as 1) mental contents or schemas related to mathematics, especially belief systems related to mathematics and its teaching and learning, (2) the social context of the teaching situation, especially the constraints and opportunities it provides, and (3) the teacher's thought processes and reflection. Ernest (1989) emphasized that "teachers'

mental models of mathematics" are critical because they include what constitutes appropriate and prototypical learning activities, the behaviours and activities the student will be involved in, and, most importantly, the teacher's views on the mathematics teaching process. For this reason, examining teachers' views on preschool mathematics will guide teachers in understanding which concepts are included in early childhood mathematics and preparing an educational environment and program appropriate for children's developmental levels.

Aims of the Study

This study was conducted to examine the views of the preschool teachers on early childhood mathematics. The study sought answers to the following questions:

1. Which concepts do the teachers include in early childhood mathematics?
2. What kinds of activities do the teachers use early childhood mathematics with, and how do they assess whether the children have learned mathematical concepts?
3. Is there a significant difference among the teachers' age, years of service, the type of institution and the school they work in and the importance they give to mathematics?

Method

This research was designed as a descriptive study, and general survey model was used in this study. Survey study model: "*It aims to describe the views or characteristics of a community on the subject. The data needed for the research is based on the answers to the questions posed to the participants, and the data is collected from a sample*" (Frankel & Wallen 2006 cited in Büyüköztürk et al., 2012, p.231). Survey studies are classified under three headings as "*retrospective, longitudinal, and cross-sectional*" (Johnson & Christensen, 2014). In this study, data were collected from the sample at one time, and an existing situation was tried to be generalized to the population in the light of collected data. Therefore, this research is cross-sectional and was conducted using survey model.

Participants

The population of the study consisted of teachers working in public or private kindergartens in various provinces of Turkey. The sample of this research consisted of 107 teachers (n=101 women [%94.4], n=6 men [%5.6]) reached through convenient sampling. 45.8% (n=49) of these teachers are between 23-27 years old, 25.2% (n=27) of them are between 28-32 years old, and 22.4% (n=24) of them are 33 years old and over. The convenient sampling

method was used in the study. *"In convenient sampling, the researcher selects individuals who represent some of the characteristics is investigating. When determining the participants, it considers the suitability and willingness of the participants to work. This provides useful information to answer sample questions and hypotheses."* (Creswell, 2014, p.193).

Data Collection

Within the scope of the study, the *"Teacher Views Form on Early Childhood Mathematics"* prepared by the researchers was used. The form was developed after consulting with two researchers in the field of early childhood mathematics. In the *"Teacher Views Form on Early Childhood Mathematics"*, there were eight questions about the demographic characteristics of the participants, the prioritization of activity types in early childhood programs, the concepts that could be used in activities related to mathematics, the use of early childhood mathematics, and two open-ended questions about early childhood mathematics. Data were obtained online from participants using the *"Teacher Views Form on Early Childhood Mathematics"* after getting ethics commission permissions (16.04.2021, No:E-35853172-900-000015808390) from Hacettepe University for the study's implementation .

Data Analysis

The data were analyzed with the SPSS-24 package program. Descriptive and non-parametric statistics were operated in the examination of data. Frequency and percentage calculations were used to analyze teachers' gender, years of professional service, the type of institution and school they work in, the level of importance they attach to early childhood mathematics, the mathematics concepts they deal with in the classroom, and their views on early childhood mathematics. Moreover, The Chi-square Independence Test examined the relationship among the teachers' age, years of professional service, the type of institution and the school they work in, and the importance they attach to mathematics.

Findings

The frequencies and percentages of the answers given by the participants to the questions about gender, age, professional service period, the type of institution and the school they work in, the importance given to mathematics, being able to associate mathematics with other fields, preparing an appropriate activity for mathematics and using an appropriate mathematical language are given in Table 1.

Table 1 Descriptive Statistics

Variables	N	%	sd
Gender			.23
Male	101	94.4	
Female	6	5.6	
Age			.82
23-27	49	45.8	
28-32	27	25.2	
33 years and above	24	22.4	
No answer	7	6.5	
Professional Service Period			.70
0-4 years	77	59.8	
5-10 years	30	28	
11 years and over	13	12.1	
Type of Institution			.45
Public school	77	72	
Private school	30	28	
Type of School			.95
Kindergarten affiliated to primary school	36	33.6	
Kindergarten	44	41.1	
Nursery	16	15	
Other (High school etc.)	11	10.3	
Importance of Mathematics			.67
Less important	25	23.4	
Moderately important	58	54.2	
Very important	24	22.4	
Relating Mathematics to Other Fields			.19
Yes	103	96.6	
No	4	3.7	
Being Able to Prepare an Appropriate Activity for Teaching Mathematics			.16
Yes	104	97.2	
No	3	2.8	
Using Appropriate Mathematical Language			.24
Yes	100	93.5	
No	7	6.5	

Based on the Table 1, 94.4% of the participants are women, and 5.6% are men. When the ages of the participants are examined, it is seen that 45.8% are between 23-27 years old, 25.2% are between 28-32 years old, and 22.4% are 33 years old and over. 59.8% of the

participants have 0-4 years of service period, 28% have a service period of 5-10 years, and 12.1% have a service period of 11 years or more. While 72% of these participants work in public schools, 28% work in private education institutions. When the school types of the participants are examined, 33.6% work in kindergartens affiliated to primary school, 41.1% in kindergartens, 15% at nursery school, and 10.3% in other institutions (classes opened based on high school, institution, etc.). 22% of the participants consider mathematics very important, 54.2% consider it moderately important, and 23.4% consider mathematics less important compared to other activities. 96.6% of the participants stated that they could associate mathematics with other fields, 97.2% were able to prepare an appropriate activity plan for mathematics teaching, and 93.5% stated that they could use mathematical language.

Math Concepts Used in Early Childhood

The answers given by the teachers about the mathematical concepts that can be included in early childhood are shown in Figure 1.

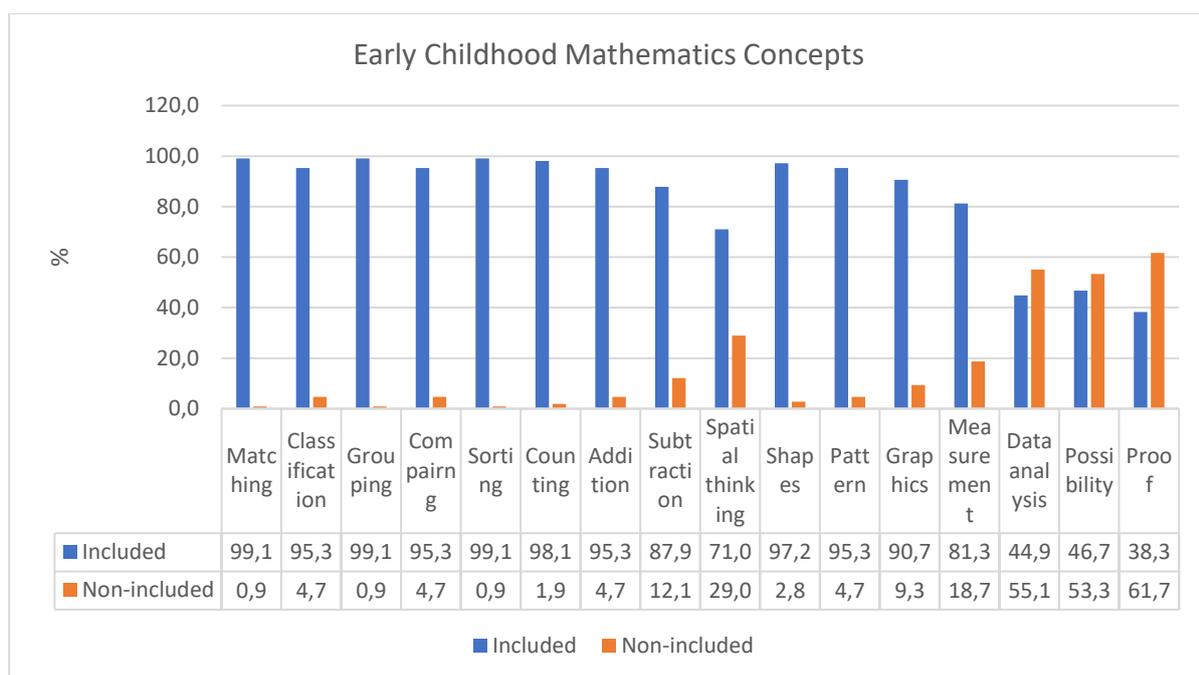


Figure 1 Early Childhood Mathematics Concepts

The majority of the teachers indicated that matching (99.1%), classification (95.3%), grouping (99.1%), comparison (95.3%), sorting (99.1%), counting (98.1%), addition (95.3%), geometric shapes (97.2%), pattern (95.3%), graphics (90.7%), subtraction (87.9%), measurement (81.3%), spatial perception 71% should be included in math activities, while

others were stating that the concepts of proof (61.7%), data analysis (55.1%), probability (55.3%) not be included in early childhood math activities.

Activities Integrated with Math

The answers given by the teachers to the question of which activities you integrate with math to help children learn early childhood mathematics concepts are shown in Figure 2.

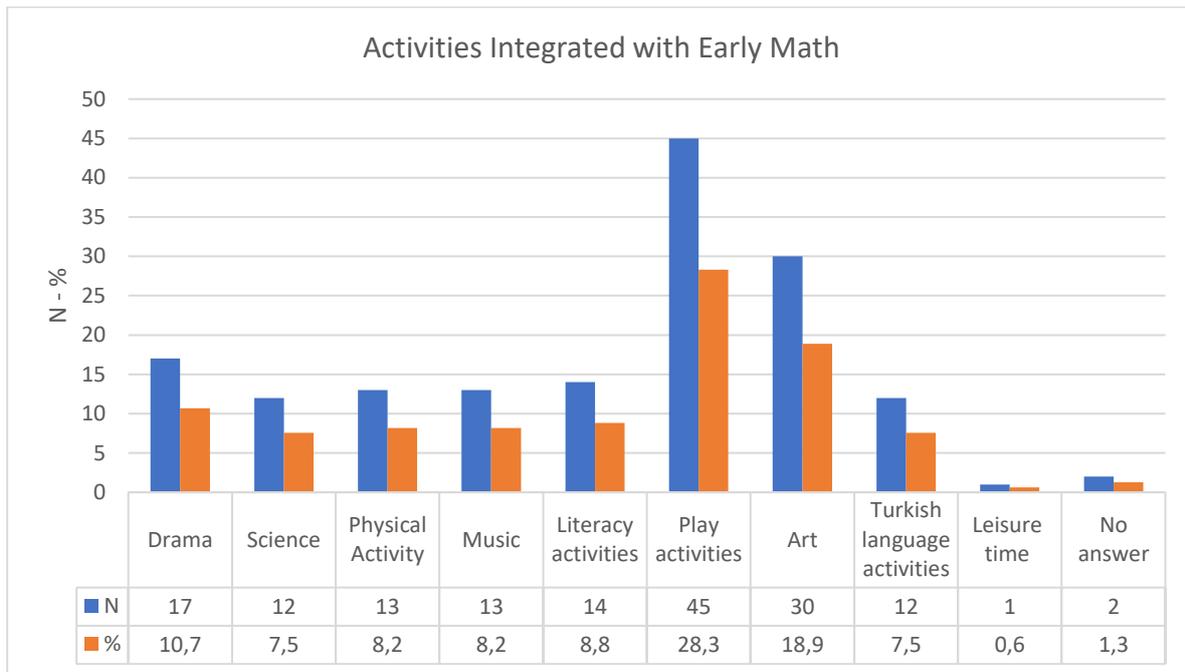


Figure 2 Activities Integrated with Math

When the answers are given to the question of what kind of activities you integrate to teach early childhood mathematics concepts to children, the teachers mostly prefer play (28.4%) and art (18.9%) activities to teach mathematical concepts. These activities were followed by drama (10.7%), literacy (8.8%), physical (8.2%) and music (8.2%) activities. The least preferred activities by the teachers for teaching math concepts were leisure time (0.6%), Turkish-language (7.5%), and science (7.5%) activities.

Assessing Math Concepts in Early Childhood

The answers given by the teachers to the question of how they assess whether children have learned early childhood mathematics concepts are shown in Figure 3.

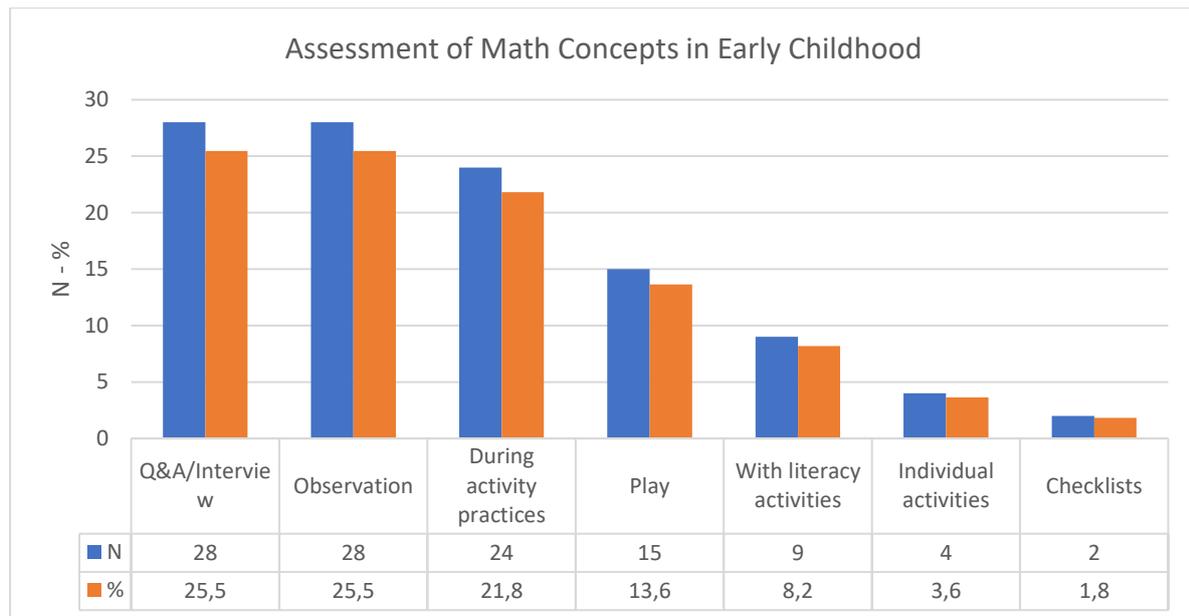


Figure 3 Assessment of Math Concepts in Early Childhood

When the answers given by the teachers to the question, "How do you assess whether children have learned early childhood mathematics concepts?" are examined, the teachers mostly prefer question-answer/interview (25.5%) and observation (25.5%). The type of assessment of mathematics activities was followed by assessing during activity practices (21.8%) and with play activities (13.6%). The activities that teachers used the least in assessment were literacy activities (8.2%), assessing during individual activities (3.6%) and checklists (1.8).

Importance Given to Early Childhood Math

The results of the Chi-square Independence Test, which was conducted to examine whether there is a relationship between the teachers' age, period of professional service, the type of institution and the school they work in, and the importance they give to early childhood mathematics, are shown in Table 2.

Table 2 Chi-Square Independence Test Results

			Less Important	Moderately Important	Very Important	Total	X^2	df	p
Age	23 – 27 years old	N	8	26	15	49	5.02	4	.285
		%	% 16,3	% 53,1	% 30,6	% 100			
	28 – 32 years old	N	8	16	3	27			
		%	29,6	59,3	11,1	% 100			
	33 years and older	N	7	12	5	24			
		%	% 29,2	% 50	% 20,8	% 100			
Period of Professional Service	0 – 4 years	N	13	35	16	64	1.26	4	.868
		%	% 20,3	% 54,7	% 25	% 100			
	5 – 10 years	N	8	16	6	30			
		%	% 26,7	% 53,3	% 20	% 100			
	11 years and above	N	4	7	2	13			
		%	% 30,8	% 53,8	% 15,4	% 100			
Type of Institution	Public school	N	19	40	18	77	.570	2	.752
		%	% 24,7	% 51,9	% 23,4	% 100			
	Private school	N	6	18	6	30			
		%	% 20	% 60	% 20	% 100			
Type of School	Kindergarten affiliated to primary school	N	11	16	9	36	9.77	6	.135
		%	% 30,6	% 44,4	% 25	% 100			
	Kindergarten	N	6	28	10	44			
		%	% 13,6	% 63,6	% 22,7	% 100			
	Nursery	N	4	11	1	16			
		%	% 25	% 68,8	% 6,3	% 100			

There was a decrease in the importance given to mathematics as the age and period of service of the teachers increased, and in the same way, those working in special education institutions gave less importance to mathematics. However, according to the results of the Chi-square independence test, no significant difference was found between ages ($X^2(4, n=100)=5.02, p=.285, \tau_b=-.160$), period of professional service ($X^2(4, n=107)=1.26, p=.868, \tau_b=-.098$), type of institution ($X^2(2, n=107)=.570, p=.752, V=-.073$), type of school ($X^2(6, n=107)=9.77, p=.135, V=-.214$) and the importance given to early childhood mathematics.

Discussions, Conclusions, and Suggestions

This research examined teachers' views on early childhood mathematics from a descriptive perspective. The teachers (1) can associate early childhood mathematics with other fields and prepare appropriate math activities, (2) state that some concepts that should be taught in early childhood math cannot be used, (3) they prefer non-permanent assessments such as observation and interview rather than assessment methods that children can record their learning and check later, (4) there is no relationship between the age of teachers, their professional service period, type of institution they work in, type of school they work in, and the importance they attach to mathematics. Still, there is a tendency to decrease the importance given to mathematics as age and length of service increase. Similarly, there is a decrease in the importance given to mathematics by those working in special institutions.

The majority of the teachers indicated that matching, classification, grouping, comparison, sorting, counting, addition, geometric shapes, pattern, graphics, subtraction, measurement, and spatial perception should be included in math activities. In contrast, others stated that the concepts of proof, data analysis, and probability not be included in early childhood math activities. Ernest (1989) stated that pedagogical knowledge is critical as it explains how to teach mathematics effectively. For this reason, preschool teachers need to know which concepts should be included in early childhood mathematics. NCTM (2000) listed the concepts that should be in early childhood mathematics as "number, operation, algebra, geometry, measurement, data analysis, probability, problem-solving reasoning, communication, association, and representation. Similarly, Smith (2009) identified early childhood mathematics concepts as "*matching, classification, grouping, comparison, ordering, counting, data analysis, graphics, pattern, problem-solving, operation, geometry, measurement.*" It is noteworthy that the participants in this study neglected to include some essential mathematics concepts in mathematics education activities. Considering that these

concepts could be addressed in early mathematics, teachers are expected to include them equally in mathematics activities. Research accounts for some reasons teachers' curriculum decisions stress domain-specific knowledge and psychological factors about mathematics. As Youmans et al. (2018) stated, early childhood education teachers have limited knowledge of mathematics education, but they emphasized that teachers should have content knowledge, pedagogical content knowledge, and curriculum knowledge. Accordingly, Lee and Ginsburg (2009) remarked that teachers' attitudes, beliefs, and opinions about mathematics are reflected in their educational practices.

The results of this study showed that the teachers mostly used mathematical concepts with play, arts, and drama activities. The teachers assessed whether children learned mathematics concepts such as question-answer/interview, observation, and activity applications, and they did not use applications such as checklists. Koç (2017) underlined that teachers feel inadequate in evaluating children's mathematics achievement. Contrary to the results of the current study, Yazlık and Öngören (2018) found that teachers mainly carry out math activities together with Turkish and science activities.

In the current study, 22.4% of the teachers stated that they considered mathematics very important, 54.2% moderately important, and 23.4% less important. Several studies indicated a relationship between teachers' beliefs and educational practices (Hart, 2002; Jenkins, 2001, Stites et al., 2022). Lee and Ginsburg (2009) pointed out that some teachers have false beliefs that children are not ready to learn mathematics. Such beliefs and attitudes may lead to ignoring the importance of early math practices in the classroom. Teachers' knowledge, competence, and beliefs about mathematics (Todd Brown, 2005; Zacharos et al., 2007), as well as negative attitudes (Markovits, 2011), can affect children's math development.

When the chi-square independence test results were examined, no significant difference was found between the age of the teachers ($p > .05$), the length of their professional service ($p > .05$), the type of institution they work in ($p > .05$), type of school they work in ($p > .05$), and the importance they attach to mathematics. Teachers' beliefs about math and the importance they give can be affected by numerous factors. It is believed that teachers' beliefs about teaching mathematics are related to their professional service time (Karakuş & Akman, 2009; Şeker & Alisinanoğlu, 2015). However, Karakuş et al. (2019) stated that teachers' beliefs about mathematical development did not differ significantly according to age, type of school they work at, education level, and professional service period.

This study has certain limitations, even though it is believed that the findings will help both preschool teachers and those interested in teacher education. This research was descriptive, and data were collected online based on teachers' expressions. It is recommended that the views of a larger sample group should be examined together with their classroom practices in future studies. It is also suggested to contrast the results of this study with the information to be gathered from various measurement instruments. In addition, when the research results were examined, it was observed that most teachers had false beliefs about some concepts, such as data analysis, probability, and proof, that could not be taught in the preschool period. More research is needed to better understand preschool teachers' false beliefs about early math teaching. Finally, the results of this study indicated that some critical implementation gaps in early math learning assessment exist. There is, therefore, a definite need for training teachers on early math assessments, which will allow them more permanent and evidence-based practices in assessing children's conceptual skills.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

No conflict of interest.

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None.

CRedit author statement

The study was a two-author study, with both authors contributing equally.

Research involving Human Participants and/or Animals

The study involves human participants. Ethics committee permission was obtained from Hacettepe University Ethics Boards and Commissions for the study's implementation (16.04.2021, No:E-35853172-900-00001580839O).

Erken Çocukluk Matematiğine Yönelik Öğretmen Görüşleri

Özet:

Okul öncesi öğretmenleriyle ilgili bazı psikolojik faktörler, erken çocukluk sınıflarında matematik öğretimi önemli ölçüde etkilemektedir. Bu nedenle öğretmenlerin okul öncesi matematiğe ilişkin görüşlerinin incelenmesi, erken çocukluk matematiğinde hangi kavramların yer aldığı anlamada ve çocukların gelişim düzeylerine uygun bir eğitim ortamı ve programı hazırlamada öğretmenlere yol gösterici olacaktır. Bu araştırma; betimsel araştırma olup, 107 okul öncesi öğretmeni ile genel tarama modeli kullanılarak gerçekleştirilmiştir. Veriler erken çocukluk matematiğine ilişkin öğretmen görüş formu ile toplanmıştır. Veriler tanımlayıcı ve parametrik olmayan istatistiksel yöntemlerle değerlendirilmiştir. Analiz sonuçları öğretmenlerin matematik etkinliklerini oyun, resim ve drama etkinlikleriyle birlikte kullandıkları ve çocukların matematik kavramlarını öğrenip öğrenmediklerini değerlendirmek için sınırlı yöntemler kullandıklarını göstermiştir. Ayrıca öğretmenlerin çoğu veri analizi, ispat ve olasılığın okul öncesi eğitimde öğretilmeyeceğini belirtmektedir. Son olarak öğretmenlerin çoğu okul öncesi matematiğini orta düzeyde önemli görmekle birlikte analiz sonuçları yaş, mesleki hizmet süresi, görev yaptıkları kurum ve okul türü ve matematiğin önem sıralaması arasında anlamlı bir fark olmadığını ($p > .05$) göstermektedir.

Anahtar kelimeler: erken matematik eğitimi, öğretmen görüşleri, erken çocukluk eğitimi

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