Investigation of the Relationship Between Preschool Teachers' Perceptions of Efficacy in Mathematics Education and Their Attitudes Towards Mathematics Education

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Abstract

In this study, the relationship between preschool teachers' perceptions of efficacy in mathematics education they give and their attitudes towards mathematics education was investigated. The research method of the study is the relational screening model, one of the quantitative research methods. The research was carried out on 122 preschool teachers actively working in 2018-2019. Random sampling method was used to determine the sample of the study. In this research, self-report based measurement tools were used to collect data. In the analysis of the data obtained, t-test, one-way analysis of variance and correlation coefficient were used. As a result of the analyzes, it was found that teachers' perceptions of efficacy in mathematics education they gave and their attitudes towards mathematics education were generally high. It was seen that teachers' perceptions of efficacy in mathematics education did not differ according to the teachers' professional seniority and the in-service training they received. No significant relationship was found between preschool teachers' perceptions of efficacy in mathematics education they give and their attitudes towards mathematics education. These results were discussed in the light of the relevant literature, and a number of suggestions were made.

Keywords: Preschool, Mathematics, Attitude, Perception of Efficacy

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INTRODUCTION

Mathematics is a field that involves a lot of knowledge and skills which an individual will need in their social life. For mathematics to be able to be used correctly and properly in all areas of social life, teaching processes should be constructed so as to support meaningful and permanent learning (Franke & Kazemi, 2001; Smith, 2000). The foundation of mathematical development is laid during early childhood (Clements, Sarama & DiBiase, 2003; Bekman, Aksu-Koç & Erguvanlı-Taylan, 2012; NAEYC, 2010). The conditions to be offered to the child during the preschool education, which is the most important and first step of education, are important in achieving this purpose.

Mathematics education is a significant part of early childhood education (Ginsburg et al., 2006). Mathematics competences acquired in the early period were found to be related to children's school life (Duncan et al., 2007). Longitudinal research results show that there is progress in mathematical development and school achievement of preschool children (Peisner-Feinberg et al., 2001; Sylva, Melhuish, Sammons, Siraj-Blatchford & Taggart, 2004; Yoshikawa et al., 2013). In this context, it is extremely important to support the mathematical skills of the children from the preschool period for the desired mathematics achievement (Yıldırım, Özgür, Parlak, Gönen & Polat, 2016).

The mathematics education described in the Ministry of National Education (MNE) (2013) Preschool Educational Program aims to contribute to the cognitive development of children, to give children a positive attitude towards mathematics, to help children associate their previously acquired conceptual information with the new information, and to help understand why and how to use mathematical concepts. In addition, it should be aimed with mathematical activities to improve mathematical inquiry skills in children. With the mathematical activities performed, children should be able to recognize the patterns around them, develop hypotheses and try them out, solve problems, reason, and communicate using mathematical concepts. It is stated that mathematics should be supported by examples that children may encounter in daily life. Accordingly, one of the purposes of preschool educational programs implemented in our country is to support children's mathematical skills.

Children with low mathematics skills in the preschool education period are likely to experience negative mathematical experiences throughout their school life (Dornheim, 2008). On the other hand, the mathematics achievement of the children whose mathematical skills were supported was found to be higher in the following educational levels (Krajewski & Schneinder, 2009). The different levels of mathematics competence of children are associated with the different household environments they are from (Anders et al., 2012; Sonnenschein & Galindo, 2015). The mathematics competence of primary school children differs, and this difference either remains the same or increases throughout school life (Anders, Grosse, Rossbach, Ebert & Weinert, 2013; Magnuson, Meyers, Ruhm & Waldfogel, 2004). A deliberate effort is required to ensure that children's mathematical skills are supported regardless of their background and environment (Grüßing & Peter-Koop, 2008). It was found that children's mathematical thinking developed when they had any guidelines to improve their mathematical thinking, and especially, when they were asked questions (Laine, Näveri, Pehkonen, Ahtee, & Hannula, 2017).

Since the individual's perspective of mathematics is related to how they learn mathematics (Hare, 1999), it can be argued that children should be supported by teachers with high levels of efficacy in mathematics from the preschool period.

The importance of the teacher in mathematics teaching has been demonstrated by the results of the research conducted in the relevant literature (Bergqvist & Lithner, 2012; Kilpatrick, 2001). In this context, teachers should be informed of what they need to do, when they need to do it, and the consequences of their actions (Lester & Cai, 2016; Liljedahl, 2016). Pedagogical beliefs about mathematics are known to be related to the level of motivation required to establish a supportive environment in acquiring mathematical skills (Denny, 2009).

Teachers create learning opportunities by influencing the educational environment in which they choose the approach in the learning content and the educational objectives (Lerkkanen et al., 2012; Schoenfeld, 1998). It was observed that the goals determined by teachers in mathematics education had a supportive effect on children's motivation towards mathematical goals, and thus, their math performances during their transition to primary school (Aunola, Leskinen & Nurmi, 2006). Mathematics education in early childhood should include conceptual knowledge, cause and effect relationship, communication, and mathematics literacy to support children's learning in their future school life. Procedural knowledge (how to solve a problem) and conceptual information (why to solve the result of a particular strategy) generally support each other and are involved in the process of mathematical learning which develops simultaneously (Dowker, 2005; Sarama & Clements, 2009).

As knowledge progresses cumulatively, it is possible for students to be successful in later education levels through the fact that they have a solid foundation in all areas of development to support their preparedness for primary school. This increases the importance of the efficacies of preschool teachers. Teachers are the most important factor in children's achievement (Polly, 2008). Teachers' perspectives of mathematics seriously shape general pedagogical perspectives such as the teaching environment, teaching strategies and the choice of activities (Philippou & Christou, 1998).

According to the review of the related literature, one can say that teachers have a great responsibility in achieving the goals in mathematics teaching process. Teachers need to have certain personal efficacies so that they can fulfill these responsibilities. One can argue that raising individuals at the desired level in early childhood depends on teachers who have basic efficacies of their profession. Efficacies are important as performance indicators that should be exhibited in a profession, and include the minimum criteria required to fully demonstrate the professional performance both quantitatively and qualitatively (Şahin, 2004). Attitude is defined as a "tendency that forms an individual's thoughts, emotions and behaviors properly (Smith, 1968). Teaching is a profession that requires a positive attitude and behavior in a professional sense (Varış, 1988). From this point of view, it can be argued that teachers' attitudes about teaching in a qualified manner and overcoming the problems they experience during the teaching process are important.

In this respect, this study aimed to examine whether there is a relationship between preschool teachers' attitudes about early mathematics education and their relevant efficacies. The sub-questions of the research are as follows:

1. What is preschool teachers' level of efficacy in early mathematics education?
2. Do pre-school teachers' efficacies in early mathematics education differ by demographic variables (professional experience, participation in in-service training, adequacy of the materials, school's financial status)?
3. What is preschool teachers' attitudes towards early mathematics education?
4. Is there a significant relationship between preschool teachers' attitudes towards early mathematics education and their relevant efficacies?

METHOD

The research was designed in the relational survey model of the quantitative research methods. In relational survey models, coexistence and/or degree of variables are determined in an effort (Karasar, 2014).

Population/Sample

The population of the study consisted of kindergarten and preschool teachers who were actively working in the 2018-2019 academic year. The random sampling method was used for the

research sample. Accordingly, 122 scale forms distributed to public schools were filled and delivered by teachers. Of the 122 teachers who participated in the research, only 9 teachers are male and the others are female. The majority of the teachers were between 26 to 35 years old (45.9%). In addition to this group, 28.7% of teachers were 18 to 25 years old and 24.6% were 36 to 45 years old. As for the educational levels of the teachers, the majority had a bachelor's degree (82.8%). 11.5% of the teachers had a master's degree, 2.5% had an associate degree, 1.6% were vocational high school graduates, and 1.6% were high school graduates. Concerning the teachers' professional seniority, 29.5% of the teachers had been working for 2 to 5 years, 27% for 6 to 10 years, 18% for 16 to 20 years, 13.1% for 1 year and less, and 12% for 11 to 15 years.

Data Collection Instruments

Instrument for Identifying Preschool Teachers' Attitudes Towards Early Mathematics Education:

Developed by Tokgöz (2006), the instrument aims to measure the early mathematics education attitudes of teachers working in nursery schools or kindergartens. The 5-point Likert-type instrument has 22 items with 8 of them being reverse-coded. The instrument also consists of 3 subtests; however, in this study, only total attitude scores of the teachers were evaluated. The Cronbach's Alpha was found to be .712 in the reliability test. The internal consistency coefficient of the whole scale is .73. The highest score that can be obtained is 110 and the lowest score is 22 points in the whole instrument.

Instrument for Identifying Preschool Teachers' Competences of Early Mathematics Education:

The instrument was developed and its validity and reliability studies were conducted by Tokgöz (2006). The instrument aims to identify whether preschool teachers feel competent in early mathematics education. The 5-point Likert-type instrument developed to this end consists of 30 items. For the face validity of scale's, 7 experts received their opinions. Outlier group analyzes and item total correlations were examined for construct validity. Item total correlations ranged from .62 to .85 and were significant at $p < 0.01$. The item-corrected competence scores correlation values were between .59 and .84 and values were significant at $p > 0.01$. The scale has a single factor structure. The reliability tests found Cronbach's Alpha of the scale to be .97. In this sample group, the cronbach alpha coefficient was .95. The highest score that teachers can get is 150 points and the lowest score is 30 points in the instrument.

Data Analysis

Preschool teachers' attitudes and efficacies regarding early mathematics education and the relationship between them were examined in the study. The relationship between the identified early mathematics education efficacies and variables was examined, and it was investigated whether there was a relationship between their efficacies and attitudes regarding early mathematics education. To this end, data was collected from 122 teachers by random sampling. According to the normality tests, the teachers' efficacies in early mathematics education and their attitudes towards early mathematics education met the assumptions. The kurtosis and skewness values of the data varied between -1 and +1, and the histograms with distribution fit met the assumptions. So, parametric tests were carried out with the collected data.

FINDINGS

The analyses performed in regard to the research questions are examined in detail under this title. Descriptive analyses for the first research question are presented in the table below (Table 1).

[1]Table 1. Teachers' efficacy in early mathematics education

	N	Min.	X	Max.	sd
Efficacy scores	122	81	120.64	150	17.127

As seen in the table, the teachers' levels of efficacy in early mathematics education referred to a very high score on average (X=120.64). One can argue based on these data that the teachers in the sample group had high efficacy in early mathematics education. The analyses conducted for the second research question (Tables 2, 3, 4, 5 and 6) investigated the teachers' levels of efficacy in early mathematics education by different variables. Accordingly, one-way variance analysis based on the professional experience of the teachers is summarized in Table 2.

[2]Table 2. Teachers' efficacy in early mathematics education by their professional experience

Source of Variance	Sum of Squares	df	Mean of Squares	F	p<
Intergroup	274.968	2	137.484		
Intragroup	35219.849	119	295.965	.465	.630
Total	35494.817	121			

According to the table above, the teachers' years of experience did not exhibit a significant difference by their efficacies in early mathematics education (F=.465; p=.630).

[3]Table 3. Teachers' efficacy in early mathematics education by their participation in in-service training

In-service training	N	X	Sd	df	t	p<
Never participated	83	119.50	16.963	120	-1.067	.288
Participated in 1 or more	39	123.05	17.447			

As seen in Table 3, the teachers' status of participation in in-service trainings related to mathematics education did not differ significantly by their perceived efficacy in early mathematics education (t=-1.067; p=.288). The analyses conducted for adequacy of the materials in the teachers' classrooms are given in Table 4.

Table 4. Teachers' efficacy in early mathematics education by adequacy of the materials in their classrooms

Source of Variance	Sum of Squares	df	Mean of Squares	F	p<	Difference
Intergroup	2551.616	2	1275.808			
Intragroup	32943.200	119	276.834	4.609	.012	Inadequate-adequate
Total	35494.817	121				

As seen in the table, there were significant differences among the groups (F=4.609; p=.012). The Scheffe post-hoc test which was performed to see which groups differed significantly is summarized in the Table 4.

[1] N refers to sample size, X refers to sample mean, sd refers to standart deviation.
[2] For all one-way variance analysis tables, df refers to freedom of degree, p< refers to sig. value
[3] For all t-test tables, N refers to sample size, X refers to sample mean, sd refers to standart deviation, df refers to freedom of degree, p< refers to sig. value

According to Table 4, there was a significant difference between the teachers who thought that the materials in their classrooms were adequate and those who thought that the materials were inadequate. This difference was in favor of the teachers who thought that the materials were adequate. The teachers who thought that the materials in their classrooms were adequate had significantly higher efficacy levels than those who thought that the materials were inadequate. The analysis regarding the financial status of the school is shown in the table below (Table 5).

Table 5. Teachers' efficacy in early mathematics education by school's financial status

School's financial status	N	X	sd	df	t	p<
Inadequate	85	118.30	16.718	120	-2.324	.022
Adequate	37	126.00	17.069			

According to Table 5, the adequacy of school's financial status as perceived by the teachers created a significant difference on their efficacy in early mathematics education (t=-2.324; p=.022). It is seen that the teachers who thought that the financial status of the school was adequate had higher efficacy levels in early mathematics education than those who thought that it was inadequate.

Table 6. Teachers' attitudes towards early mathematics education

	N	Min.	X	Max.	sd
Attitude scores	122	53	66.23	82	5.829

As seen in Table 6, one can argue that the teachers' attitudes towards early mathematics education were high. The correlation analyses performed to determine whether there was a relationship between teachers' perceived efficacy in early mathematics education and their attitudes towards early mathematics education are shown in Table 7.

Table 7. Correlation between teachers' attitudes towards early mathematics education and their perceived efficacies

N=122	Attitude	Efficacy
Attitude	-	.018
Efficacy		-

According to the table above, the correlation coefficient between teachers' attitudes and efficacies regarding early mathematics education was not significant. The analyses concluded that there was no significant relationship between teachers' attitudes and efficacies regarding early mathematics education for this sample group.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

It is important for teachers to correctly define the mathematics that should be taught in the preschool period, to use it properly and to know what they can teach children about mathematics. Teachers being able to identify proper opportunities and ways for children reinforce children's effective mathematics learning (Fuson, Clements & Sarama, 2015). In this context, this study examined the efficacies of preschool teachers in the mathematics education they provide by different variables and investigated the relationship between their attitudes towards mathematics and their perceived efficacies in mathematics education.

One of the qualities that a teacher should have for an effective mathematics education is their belief in their ability to teach mathematics, their belief in themselves is extremely important (Briley, 2012). This research concluded that both teachers' attitudes towards mathematics education and their efficacies in mathematics education were at high levels. Similarly, Çelik (2017a) examined the efficacies of preschool teachers in early mathematics education and found efficacies at good levels in the sample group. Thiel (2010) stated that the preschool teachers were positive and open-minded about

mathematics. However, according to Todd Brown (2005), although the teachers reported a strong sense of efficacy in their teaching skills, they were yet to reach a consensus on their belief in mathematics as an important content for preschool children. In a qualitative study conducted with preschool teachers, Benz (2012) stated that 35% to 24% of the participants described mathematics as incomprehensible and complex while most of the participants considered mathematics as important and useful. Copley (2004) stated in a study conducted with preschool teachers for five years that the preservice teachers felt very comfortable in activities supporting the language skills but found mathematics activities challenging.

Furthermore, there are research results in the relevant literature that indicate that preschool teachers do not feel competent in teaching mathematics because they think they have insufficient knowledge of mathematics (Doverborg & Pramling Samuelsson, 2009; Lee, 2010; Lee & Ginsburg, 2007; Sheridan, Williams, Sandberg & Vuorien, 2011). In accordance with the results of this research, one can argue that preschool teachers lack knowledge on mathematics and feel uncomfortable (Chen & McCray, 2014). Research has shown that one of the reasons why teachers do not perform mathematical activities in preschool education classes may be the fear of making mistakes (Wigfield & Eccles, 2002). Teachers' self-efficacies or beliefs are very important. Indeed, some studies reveal that teachers' beliefs about mathematics have a weak but significant relationship with learning outcomes of children (Todd Brown, Molfese, & Molfese, 2008).

In this study, it was seen that the efficacies of the teachers in mathematics education did not differ by their professional seniority. In contrast, Todd Brown, Molfese and Molfese (2008) found that teachers' experience affected children's letter recognition or numeracy skills. It was found that the efficacies of the teachers in mathematics education did not differ by their in-service trainings on mathematics. The reason may be the fact that in-service trainings received did not address the need or the mathematics education they provided in the classroom. Moreover, it has been shown by previous research that well-prepared professional development programs can support mathematics teaching practices of preschool teachers (Clements & Sarama, 2008; Rudd, Lambert, Satterwhite & Smith, 2009).

It was found that the teachers who thought that there were adequate materials in their classrooms had higher levels of efficacy in mathematics education. Uyanık and Kandır (2010) stated that there should be a wide variety of materials in mathematics centers and that mathematics skills should be supported by teachers presenting these materials to children in an interesting way. In addition to the materials used in the classroom, it is thought that teachers' frequent use of mathematical expressions in the classroom setting contributes to children's positive perception of mathematics (Şahin, 2013). For children to use their informal knowledge, they need to be provided with an appropriate environment and materials (Aydın, 2009; Cooke & Buchholz, 2005). In this context, teachers who find the classroom environments adequate feel competent in bringing the mathematical skills to children.

The natural mathematical inputs provided by preschool teachers to the children in the classroom offer rich experiences for children. Teachers being able to identify proper opportunities and ways for children reinforce children's effective mathematics learning (Fuson, Clements & Sarama, 2015). The child being able to acquire mathematical skills depends on proper planning. Systematic planning enables children to acquire new experiences, express themselves in different ways and learn mathematics correctly (Erdoğan & Baran, 2003; Avcı & Dere, 2002). It is observed that teachers make use of mathematical concepts and expressions in gaming activities, music activities, conversations or when trying to achieve classroom management (Erdoğan & Baran, 2003).

It was found that the teachers who perceived the financial status of their schools as adequate had higher perception of efficacy in early mathematics education. It can be argued that this is directly related to the material adequacy in the classrooms. School's financial inadequacy has an impact on materials or toys in the classroom. Research shows that teachers generally associated lack of materials with financial concerns (Ramazan, Arslan Çiftçi & Tezel, 2018). Varol and Farran (2006) emphasize

some factors in the quality of mathematics education. One of them is the use of mathematical tools that facilitate children's learning. The importance of environmental support (such as providing appropriate environment and materials) for children to use the mathematical information they acquire is stated in the relevant literature (Aydın, 2009; Cooke & Bucholz, 2005). One can accordingly say that the current research result coincides with the results of the relevant studies.

The teachers' attitudes towards mathematics education were found to be at high levels. Similarly, Çelik (2017b) found high levels of teacher attitudes towards early mathematics education. The present finding is arguably in parallel with the research results (Chen, McCray, Adams, & Leow, 2014; Thiel, 2010) which observed positive attitudes of preschool teachers towards mathematics. Teachers' attitudes towards teaching mathematics have been shown to be an important factor in mathematics teaching which is developmentally appropriate (Lee, 2005). In addition, there are research results showing that the teachers thought mathematics is not fun (Lee & Ginsburg, 2009) and indicating their negative feelings towards mathematics (Benz, 2012). This usually can be due to negative school experiences in mathematics (Anders & Rossbach, 2015).

There was no relationship between teachers' attitudes towards mathematics education and their perceived efficacy in mathematics education. How a teacher can succeed in their profession is affected by several factors such as the facilities of the educational institution and children's and parents' interest in education as well as internal factors such as teacher's attitude towards the profession and their self-efficacy beliefs (Demirtaş, Cömert & Özer, 2011). In a study on the beliefs and efficacies of preschool teachers, Platas (2008) found that mathematics education practices in the preschool education class were greatly influenced by teachers' beliefs. However, Todd Brown (2005) found that teacher efficacy and teacher mathematics beliefs were not significantly related to reflections of early childhood teachers on the mathematics teaching practices.

Some recommendations were made in the light of these study results. The teachers' efficacy in mathematics education were arguably affected by the conditions of the classroom and school. This finding can therefore be examined in different research with quasi-experimental studies. By developing in-service trainings on mathematics education for teachers, how these trainings can affect teachers' attitudes and efficacies regarding preschool mathematics education can be investigated in particular.

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