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Investigation of Prospective Preschool Teachers' Beliefs about Mathematics Teaching and Learning

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Abstract. Preschool teachers' beliefs about mathematics are crucial for qualified mathematical learning environments because children need to develop mathematical concepts based on their level of mathematical knowledge. Therefore, the purpose of this research is to determine prospective preschool teachers' beliefs about mathematics teaching and learning and to examine the effect of different variables on these beliefs. This research involved 884 prospective preschool teachers as the research sample at three state universities in Turkey. A belief Scale on mathematics teaching and learning was used as a data collection tool. The results showed that prospective teachers had positive beliefs about mathematics teaching. Moreover, there was a significant difference on prospective teachers' beliefs in accordance with grade levels. On the other hand, according to the type of prospective teachers' high school graduation, there was a significant difference in favor of prospective teachers who graduated from vocational high schools in the "mathematical learning" and "nature of mathematics" sub-scales of the scale.

Keywords: Preschool, mathematics teaching, mathematics learning, belief in mathematics, prospective preschool teacher

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INTRODUCTION ~ Preschool education covers the childhood years from birth to primary school, provides a rich variety of stimulating environmental opportunities suitable for the individual characteristics and development levels of children in these ages and guides children through each developmental step in line with the cultural values and characteristics of the society (Oğuzkan and Oral, 1997). Besides being the fastest period of development, the preschool period is indicated by the acquisition of the foundations of the concept and knowledge of mathematics for children. The National Council for Teachers of Mathematics (2000) stated that the concepts of mathematics is initially acquired in the first years of life and continue to be gained during preschool, primary education, secondary education, and higher education periods. Therefore, the build-up of love, enthusiasm, and positive attitudes towards mathematics in formal education years starting with primary school years is directly related to preschool mathematics experiences. Preschool years are definitely critical as the period of establishing the foundations of many mathematical concepts (Oktay, 2000).

Since children have different levels of mathematical knowledge, preschool teachers assume important responsibility while providing pupils with qualified informal mathematics education (Güven et al., 2012; Todd-Brown, 2003). Preschool teachers assume more important and different missions than teachers practicing at other educational levels due to their role as representatives of their children's parents (Gürkan, 1981). Preschool teachers should prepare qualified teaching programs considering different mathematical knowledge levels in order to develop the necessary mathematical concepts for children. Furthermore, they should offer such programs to children at different times through a variety of activities (Wortham, 2006).

Helping children develop mathematical concepts constituting a spiral pattern of knowledge extending to every stage of life may seem quite complicated. Preschool teachers should realize that children's mathematical beliefs develop as a process (Baki and Hacısalihoğlu-Karadeniz, 2013; Tarım and Bulut, 2006). During such processes, the beliefs of teachers and the learning environments built by teachers based on such beliefs develop students' beliefs about mathematics (Carter and Norwood, 1997; Ernest, 1989; Pajares, 1992; Thompson, 1992).

Mathematical beliefs constitute the person's approach to mathematics and mathematical tasks (Schoenfeld, 1989). Raymond (1997) defined mathematical beliefs as personal judgments about mathematics and argued that such beliefs, including the beliefs about learning, teaching, and the nature of mathematics are shaped by mathematical experiences. According to McLeod (1992), mathematical beliefs can be examined in four dimensions: beliefs about the nature of mathematics, beliefs about learning mathematics, beliefs about teachers' roles in learning mathematics, and beliefs in the social context. Ernest (1989) developed a model about mathematical beliefs and described mathematical beliefs as the individual's insights, values, ideology, and tendencies toward mathematics. The Ernest model consists of three following conceptions, including instrumentalist, Platonist, and problem-solving views. Teachers having instrumental beliefs see mathematics as a compilation of unrelated rules and facts. Teachers with a Platonist belief consider mathematics as an unchanging set of information based on related structures and facts. The Platonist view considers that mathematical information is not created but rather the existing information is discovered. According to the teacher with the problem-solving view, mathematics is a constantly expanding, dynamic, and problem-based knowledge generation process (Kul, 2017). Ernest (1982) argues that such beliefs are systematic with a mechanism of operation starting from the instrumental belief to the problem-solving view. In this context, the instrumental belief lies at the lowest hierarchical level, whereas the problem-solving belief stands at the highest level (Dede and Karakuş, 2014).

Many studies focused on the mathematical beliefs of either teachers (Barkatsas-Tasos and Malone, 2005; Karakuş, 2015; Yu, 2008) or prospective teachers (Ambrose et al., 2004; Cady and Rearden, 2007; Dede and Karakuş, 2014; Duru and Göl, 2016; Kayan et al., 2013; Swars et

al., 2007). In addition, a few studies address the mathematical beliefs of preschool teachers or prospective preschool teachers who do or will assume one of the most critical roles in developing students' beliefs about mathematics (Ginsburg et al., 2008; Güven et al., 2012; Kilpatrick et al., 2001; Lee and Gingsburg, 2007). The review of the studies in the literature shows that prospective preschool teachers fail to build up positive attitudes toward mathematics and acquire sufficient knowledge of mathematics teaching during their student years (Kilpatrick et al., 2001). Furthermore, preschool teachers are reported to have low levels of mathematics knowledge and are afraid to teach mathematics (Ginsburg et al., 2008). From this point forth. it is important to identify the beliefs of prospective preschool teachers who are the future implementers of the program in mathematics education. Hence, the research aims at investigating prospective preschool teachers' beliefs about mathematics education.

Preschool Teachers' Mathematics Education in Turkey

The preschool teacher program in Turkey is started by choosing candidates who are graduates from any type of high school such as regular high school, Gymnasium (Anatolian high school), or a vocational high school (Anatolian teacher training high school or Child Development and Education Departments of vocational high schools). Then, the candidates should get an exam for entering a university.

Early Childhood Teacher Education is a four-year undergraduate program. There are three different types of courses which are content course (i.e., introduction to early childhood education, special teaching methods), teaching profession courses (i.e., school experiences, material development), and general education courses (i.e., educational philosophy, educational psychology) in the early childhood teacher education curriculum. In the content courses, prospective teachers take some courses about teaching in early childhood, drama in early childhood education or instructional technologies and material design, etc. One of the courses in the content is mathematics education in early childhood. Prospective teachers take this course in the fall term. The learning outcomes of this course are able to explain mathematical thinking in preschool education, recognize the importance of mathematics education in preschool, explain the development of mathematical concepts in preschool, explain how to design activities in preschool education, determine the roles of teachers in preschool education and investigate mathematics program in preschool education.

Since prospective teachers' beliefs about mathematics are affected by the courses in teacher education programs (Chai et al., 2009; Zakaria & Musiran, 2010), the determination of the effects of these courses on their beliefs about mathematics education should be investigated. Furthermore, Raymond (1997) argues that the types of school of prospective preschool teachers are major variables because beliefs about mathematics are shaped through the individual's previous school experiences including the impact of teachers. Moreover, the types of schools that preschool prospective teachers will also be an important variable. This research

aims at examining the effects of the different variables on preschool prospective teachers' beliefs regarding teaching and learning mathematics.

Based on the literature review, a limited number of studies have been found examining the beliefs of pre-service/in-service preschool teachers on mathematics. For example, Zacharos et al. (2007) found that most of the Greek pre-service early childhood teachers interviewed had negative attitudes towards mathematics throughout their own school life. Moreover, Lee and Ginsburg (2007) explored teachers' beliefs about mathematics education for low-and middle-socioeconomic status children. While the teachers from a low-socioeconomic level determined that preschool mathematics was necessary and important to teach, the teachers of middle-socioeconomic level thought mathematics education was an important socialization tool in the preschool years. In the study of Anders and Rossbach (2015), 221 preschool teachers did not show negative attitudes towards mathematics and they showed some sensitivity to mathematics. Karataş et al. (2017) revealed that experienced preschool teachers tended to have positive views about mathematics teaching. Along with these studies, this research, which examines the effects of different variables on the beliefs of prospective preschool teachers, is believed to be able to contribute to the literature.

The problems of this study are presented:

1-What are the prospective pre-service teachers' beliefs about mathematics teaching and learning?

2. Does teacher education program have an effect on preschool prospective teachers' beliefs about mathematics teaching and learning?

3. Does the type of high school graduation have an effect on preschool prospective teachers' beliefs about mathematics teaching and learning?

METHOD

Research Design

The methodology of this research was a survey on the beliefs of prospective preschool teachers about mathematical teaching and learning. The survey includes asking a written questionnaire or a test of a large group to obtain data in order to determine specific characteristics of a group (Fraenkel et al., 2012). Surveys are used frequently in educational research to determine attitudes, beliefs or opinions of a group of people.

Sample

Data were collected from the 884 preschool prospective teachers at the end of the spring semester of the 2017-2018 academic year, in 3 weeks. To determine the preschool prospective teachers' beliefs about mathematics teaching and learning, prospective teachers in three state universities in the Aegean Region, Central Anatolia Region, and Black Sea Region in Turkey were selected. The aim of selecting prospective teachers from different regions was to ensure maximum diversity. Demographic characteristics of 884 preschool prospective teachers were presented in Table 1.

Table 1. Demographic characteristics of preschool prospective teachers

Regions	Grade Levels				Total(N)
	Freshman (N)	Sophomore(N)	Junior (N)	Senior (N)	
Aegean Region	101	43	65	73	282
Central Anatolia Region	63	61	61	75	260
Black Sea Region	84	78	90	90	342
TOTAL	248	182	216	238	884

The aim of selecting prospective teachers from four different levels is to determine the effects of the teacher education program on the prospective teachers' beliefs regarding mathematics teaching and learning.

Data Collection Tool

Data were collected by the "Mathematics, Education, Learning and Beliefs Scale (MELBS)", which was created in a national project [TUBITAK (Scientific and Technological Research Council of Turkey), project number is 110K249] and it was developed by Güven et al. (2013). This scale aims at examining beliefs of preschool teachers and prospective preschool teachers related to mathematics education and learning of mathematics. The scale, consisting of 32 items with six subscales, namely talent development and age-appropriateness of mathematical learning, learning mathematically, the nature of mathematics, teaching program, teaching and teachers' role, and teachers' qualification. The reliability coefficient of the scale for this study was .89. If Cronbach Alpha (α) value, which is the reliability coefficient is $0.80 \leq \alpha \leq 1.00$, the scale is highly reliable and accepted (Tavşancıl, 2006). However, the research on the validity of the scale was carried out by the researchers who developed the scale.

Data Analysis

To examine prospective preschool teachers' beliefs about teaching and learning mathematics, both descriptive and inferential statistics were used. Before analyzing the data, the data normality test was conducted. To determine the normal distribution of the data, the coefficients of skewness and kurtosis were examined. If the ratio of the coefficient of skewness (kurtosis) to the coefficient of the standard error of skewness (kurtosis) is staying between -1,96 and +1.96, the distribution of the data is considered normal (Field, 2009). It was determined that all the data were normally disturbed. The scores from each item in the belief scale were firstly analyzed descriptively with frequency and percentage. Moreover, to determine both the effect of preschool teacher education programs and grade levels on beliefs about mathematics teaching and learning, two-way ANOVA was used. Normal distribution and variance homogeneity, which are ANOVA's assumptions were also tested for each variable.

RESULTS

1. *What are the prospective pre-service teachers' beliefs about mathematics education teaching and learning?*

Table 2. Descriptive Analysis of MELBS Instrument

Sub-scales	Articles		1	2	3	4	5	Avg.
Learning mathematically	11. Discoveries of children are crucial in the mathematics learning process.	F	12	8	40	319	505	4.467
		%	1.4	0.9	4.5	36.1	57.1	
	12. It is very important that children are involved in the mathematical problem-solving process in the preschool period.	F	36	69	113	302	364	4.006
		%	4.1	7.8	12.8	34.2	41.2	
	18. In the mathematics learning process, children should share their thoughts with their peers.	F	18	38	80	436	312	4.115
		%	2.0	4.3	9.0	49.3	35.3	
	21. Mathematical learning processes should be based on real life activities of children.	F	13	28	73	390	380	4.240
		%	1.5	3.2	8.3	44.1	43.0	
	TOTAL	F	79	143	306	1447	1561	4.207
		%	2.25	4.05	8.65	40.93	44.15	
Talent development and age appropriateness	6. Mathematics activities are difficult for children in the preschool period.	F	126	67	48	180	463	3.890
		%	14.3	7.6	5.4	20.4	52.4	
		F	66	127	187	335	169	3.468

	13. I am shy about the fact that children can improve their math skills.	%	7.5	14.4	21.2	37.9	19.1	
	14. Children at early ages are not competent enough to be able to understand mathematical patterns.	F	74	160	188	303	159	3.354
		%	8.4	18.1	21.3	34.3	18.0	
	19. Mathematics activities are confusing for preschool children.	F	83	125	154	325	197	3.484
		%	9.4	14.1	17.4	36.8	22.3	
	20. Children in the preschool period should not be expected to develop the concepts of number.	F	79	140	160	291	214	3.476
		%	8.9	15.8	18.1	32.9	24.2	
	22. Contradiction, confusion and astonishment are important parts of mathematics learning.	F	25	97	234	322	206	3.664
		%	2.8	11.0	26.5	36.4	23.3	
	23. If appropriate learning environments are provided, every child learns math.	F	11	25	95	342	411	4.264
		%	1.2	2.8	10.7	38.7	46.5	
	24. Preschool is an appropriate period for learning mathematics.	F	9	39	139	407	290	4.093
		%	1.0	4.4	15.7	46.0	32.9	
	25. Children in the preschool period should not be expected to develop the concepts of measurement.	F	68	187	259	248	122	3.191
		%	7.7	21.2	29.3	28.1	13.8	
	TOTAL	F	541	967	1464	2753	2231	3.654
		%	6.8	12.07	18.4	34.61	28.06	
The nature of mathematics	26. Mathematics makes everyday life easier.	F	11	31	104	394	344	4.164
		%	1.2	3.5	11.8	44.6	38.9	
	27. Mathematics is useful for people.	F	19	38	93	409	325	4.112
		%	2.1	4.3	10.5	46.3	36.8	
	TOTAL	F	30	69	197	803	669	4.138
		%	1.65	3.9	11.15	45.45	37.85	
Teaching program		F	127	60	49	200	448	3.885

	3. Math activities in the preschool period are unnecessary.	%	14.4	6.8	5.5	22.6	50.7	
	4. In the preschool curriculum, there should only be counting towards mathematics.	F	76	136	145	259	268	3.574
		%	8.6	15.4	16.4	29.3	30.3	
	7. Mathematics is an important part of the preschool curriculum.	F	13	40	83	338	410	4.235
		%	1.5	4.5	9.4	38.2	46.4	
	28. Having mathematics in the preschool curriculum reduces children's self-confidence.	F	95	104	101	290	294	3.661
		%	10.7	11.8	11.4	32.8	33.3	
	29. Preschool math activities constitute a good opportunity to create a social environment before school.	F	17	64	198	373	232	3.836
		%	1.9	7.2	22.4	42.2	26.2	
	30. Problem solving, which in the preschool curriculum is not suitable for the children of this period.	F	91	130	186	287	190	3.402
		%	10.3	14.7	21.0	32.5	21.5	
	TOTAL	F	419	534	762	1747	1842	3.765
		%	7.9	10.07	14.35	32.93	34.73	
Teachers' qualification	1. I have sufficient knowledge to teach math to preschool children.	F	15	42	129	404	294	4.041
		%	1.7	4.8	14.6	45.7	33.3	
	2. I know which mathematical concepts that preschool children will have difficulty in understanding.	F	20	57	179	462	166	3.789
		%	2.3	6.4	20.2	52.3	18.8	
	5. I do not know exactly how I can keep children's interest in mathematics high.	F	43	222	285	275	59	3.096
		%	4.9	25.1	32.2	31.1	6.7	
	8. If a child has difficulty understanding a concept of mathematics, I do not know how I can help him/her understand the concept better.	F	60	151	207	369	97	3.330
		%	6.8	17.1	23.4	41.7	11.0	
	15.I can design many math activities for preschool children.	F	13	39	212	436	184	3.836
		%	1.5	4.4	24.0	49.3	20.8	

	16. I can design an active learning environment for preschool children to learn math.	F	7	46	154	508	169	3.889
		%	0.8	5.2	17.4	57.5	19.1	
	17. I do not know how to teach math to preschool children.	F	68	145	179	334	158	3.417
		%	7.7	16.4	20.2	37.8	17.9	
	TOTAL	F	226	702	1345	2788	1127	3.628
		%	3.67	11.34	21.71	45.06	18.23	
Teaching and teachers' role	9. Preschool math activities are not suitable for using materials.	F	102	85	104	296	297	3.680
		%	11.5	9.6	11.8	33.5	33.6	
	10. Teachers should take into account natural and informal experiences during the activities.	F	17	22	75	441	329	4.180
		%	1.9	2.5	8.5	49.9	37.2	
	31. When teaching mathematics, attention should be paid to children's explaining their thoughts.	F	17	35	51	340	441	4.304
		%	1.9	4.0	5.8	38.5	49.9	
	32. Only number teaching is sufficient in the preschool period.	F	93	121	181	254	235	3.472
		%	10.5	13.7	20.5	28.7	26.6	
	TOTAL	F	229	263	411	1331	1302	3.909
		%	6.45	7.45	11.65	37.65	36.83	
	SCALE TOTAL	F	1524	2678	4485	10869	8732	3.800
		%	5.39	9.47	15.85	38.42	30.87	

Table 2 shows that while prospective preschool teachers agreed with the 11th and 21st items in the "learning mathematically" sub-scale, they also agreed with the 12th and 18th items. While prospective teachers agreed with the 23rd item in the sub-scale of "Talent-development and age appropriateness of mathematical learning", they were undecided about the statements in the 14th and 25th items. However, they were found not to agree with the 6th, 13th, 19th, and 20th negative items in the same sub-scale and to agree with the 22nd item. Teacher candidates agreed with the items in the sub-scale of "the nature of mathematics."

In Table 2, prospective preschool teachers agreed with the 7th item in the "teaching program" sub-scale while they did not agree with the other negative items. In the "teachers' qualification" sub-scale, prospective teachers neither agreed or disagreed with their statements regarding the 5th and 8th items. As for the other items of the sub-scale, prospective preschool teachers agreed with the positive statements while they disagreed with the negative ones. Regarding the sub-scale of "teaching and teachers' role" while prospective preschool teachers agreed with the statement in the 31st item, they did not agree with the negative expressions in the 9th and 32nd items of the sub-scale and agree with the statement in the 10th item at a high level.

2. *Do the prospective preschool teachers' beliefs regarding mathematics change significantly depending on the common effect of the class level and the type of school graduated from?*

Table 3a. Descriptive statistical results of prospective teachers' opinions about the scale in accordance with the class level and the type of school graduated from

Scale	Classes	The School Type Graduated from	N	Avg.	sd
Total	First Grade	Anatolian High School	86	3.570	.483
		Regular High School	43	3.598	.567
		Anatolian Teacher High School	61	3.487	.396
		Vocational High School	58	3.508	.448
		Total	248	3.540	.470
	Second Grade	Anatolian High School	37	3.802	.375
		Regular High School	33	3.743	.422
		Anatolian Teacher High School	16	3.830	.426
		Vocational High School	96	4.045	.388
		Total	182	3.922	.414
	Third Grade	Anatolian High School	88	4.042	.521
		Regular High School	51	4.018	.499
		Anatolian Teacher High School	47	4.110	.452
		Vocational High School	30	4.116	.408

		Total	216	4.062	.486
	Fourth Grade	Anatolian High School	84	3.718	.537
		Regular High School	44	3.685	.565
		Anatolian Teacher High School	36	3.799	.589
		Vocational High School	74	3.775	.625
		Total	238	3.742	.576
TOTAL		Anatolian High School	295	3.782	.530
		Regular High School	171	3.774	.544
		Anatolian Teacher High School	160	3.775	.527
		Vocational High School	258	3.855	.530
		Total	884	3.800	.532

Table 3b. Two-factor analysis of variance results of prospective teachers' opinions of the scale regarding the class level and the type of school graduated from

Scale	Source of the Variance	Sum of Squares	sd	Average of Squares	F	P	Significant Difference
Total	Class level	30.227	3	10.076	41.465	.000	1-2, 1-3,1-4, 2-3, 2-4, 3-4
	The School Type Graduated from	1.121	3	.374	1.537	.203	
	SD*MOOT	3.011	9	.335	1.377	.194	
	Error	210.915	868	.243			
	Total	13018.290	884				

Table 3b shows that the effect of the type of school graduated from at the level of first grade was not different from its effect at other class levels [F (9, 868) = 1.377; (p > .05)]. In addition, whereas the scores obtained did not differ significantly in accordance with the type of school graduated from [F (3, 868) = 1.537; (p > .05)]; the difference obtained in terms of class level was significant [F (3, 868) = 41.465; (p < .05)]. Therefore, when the average scores obtained from the

scale were compared with prospective first-grade teachers, they were in favor of the prospective second, third, and fourth-grade teachers. Compared to prospective second-grade teachers, the average scores were in favor of prospective third-grade teachers and against prospective fourth-grade teachers. When the average scores of prospective third and fourth-grade teachers were compared, the difference was in favor of prospective teachers studying in the third grade.

Table 4a. Descriptive statistical results of prospective teachers' opinions regarding the "learning mathematically" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Classes	The School Type Graduated from	N	Avg.	sd
Learning mathematically	First Grade	Anatolian High School	86	4.093	.627
		Regular High School	43	3.988	.830
		Anatolian Teacher High School	61	4.016	.557
		Vocational High School	58	4.344	.473
		Total	248	4.115	.630
	Second Grade	Anatolian High School	37	4.006	.477
		Regular High School	33	4.129	.586
		Anatolian Teacher High School	16	3.859	.632
		Vocational High School	96	4.325	.569
		Total	182	4.184	.579
	Third Grade	Anatolian High School	88	4.261	.691
		Regular High School	51	4.343	.533
		Anatolian Teacher High School	47	4.255	.569
		Vocational High School	30	4.367	.559
		Total	216	4.294	.610
	Fourth Grade	Anatolian High School	84	4.194	.673
		Regular High School	44	4.233	.620
		Anatolian Teacher High School	36	4.285	.649
		Vocational High School	74	4.280	.696

	Total	238	4.242	.664
TOTAL	Anatolian High School	295	4.161	.646
	Regular High School	171	4.184	.660
	Anatolian Teacher High School	160	4.131	.603
	Vocational High School	258	4.322	.586
	Total	884	4.207	.628

Table 4b. Two-factor analysis of variance results of prospective teachers' opinions regarding the "learning mathematically" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Source of the Variance	Sum of Squares	sd	Average of Squares	F	P	Significant Difference
Learning mathematically	Class level	6.197	3	2.066	5.374	.001	1-3
	The School Type Graduated From	5.811	3	1.937	5.039	.002	AHS-VHS, ATHS-VHS
	SD*MOOT	3.761	9	.418	1.087	.370	
	Error	333.667	868	.384			
	Total	15993.750	884				

Table 4b shows that the effect of the school type graduated from on a class level was not different from its effect on other class levels [F (9, 868) = 1.087; (p > .05)]. In addition, while the scores obtained differed significantly in accordance with the type of school graduated from [F (3, 868) = 5.039; (p < .05)], the difference obtained in terms of class level was also significant [F (3, 868) = 5.374; (p < .05)]. Therefore, the average scores of the prospective teachers in the third grade were significantly higher than those of prospective teachers in the first grade. Compared to Anatolian High School and Anatolian Teacher High School graduate prospective teachers, the scores of prospective teachers who graduated from vocational high school were significantly higher.

Table 5a. Descriptive statistical results of prospective teachers' opinions regarding the sub-scale of "talent development and age appropriateness of mathematical learning" in accordance with the class level and the type of school graduated from

Sub-scale	Classes	The School Type Graduated from	N	Avg.	sd
Talent development and age appropriateness of mathematical learning	First Grade	Anatolian High School	86	3.382	.676
		Regular High School	43	3.478	.689
		Anatolian Teacher High School	61	3.317	.567
		Vocational High School	58	3.190	.640
		Total	248	3.338	.648
	Second Grade	Anatolian High School	37	3.700	.489
		Regular High School	33	3.620	.489
		Anatolian Teacher High School	16	3.799	.463
		Vocational High School	96	3.924	.482
		Total	182	3.812	.495
	Third Grade	Anatolian High School	88	3.976	.719
		Regular High School	51	3.937	.565
		Anatolian Teacher High School	47	4.076	.529
		Vocational High School	30	4.011	.520
		Total	216	3.993	.618
	Fourth Grade	Anatolian High School	84	3.482	.770
		Regular High School	44	3.482	737
		Anatolian Teacher High School	36	3.614	.771
		Vocational High School	74	3.650	.804
		Total	238	3.554	.774
TOTAL		Anatolian High School	295	3.628	.736
		Regular High School	171	3.643	.658
		Anatolian Teacher High School	160	3.655	.672

	Vocational High School	258	3.690	.693
	Total	884	3.654	.697

Table 5b. Two-factor analysis of variance results of prospective teachers' opinions regarding the sub-scale of "talent development and age appropriateness of mathematical learning" in accordance with the class level and the type of school graduated from

Sub-scale	Source of the Variance	Sum of Squares	sd	Average of Squares	F	P	Significant Difference
Talent development and age appropriateness of mathematical learning	Class level	48.182	3	16.061	38.182	.000	1-2, 1-3,1-4, 2-3, 2-4, 3-4
	The School Type Graduated from	.777	3	.259	.616	.605	
	SD*MOOT	6.218	9	.691	1.642	.099	
	Error	365.112	868	.421			
	Total	12230.815	884				

Table 5b shows that the effect of the type of school graduated from on one class level was not different from its effect on other class levels [F (9, 868) = 1.642; (p > .05)]. Besides, whereas the scores obtained did not differ significantly according to the type of school graduated from [F (3, 868) = 0.616; (p > .05)], the difference obtained in terms of class level is significant [F (3, 868) = 38.182; (p < .05)]. Therefore, when the average scores obtained from the scale were compared with prospective first-grade teachers, they were in favor of the prospective second, third, and fourth-grade teachers. Compared to the senior prospective teachers, the average scores were in favor of the prospective second-grade teachers. When the average scores of prospective third and fourth-grade teachers were compared, the difference was in favor of prospective teachers studying in the third grade.

Table 6a. Descriptive statistical results of prospective teachers' opinions regarding the "the nature of mathematics" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Classes	The School Type Graduated from	N	Avg.	sd
The nature of [illegible]		Anatolian High School	86	3.983	.865

	First Grade	Regular High School	43	4.081	1.029
		Anatolian Teacher High School	61	3.746	.859
		Vocational High School	58	4.259	.572
		Total	248	4.006	.852
	Second Grade	Anatolian High School	37	3.878	.711
		Regular High School	33	3.833	.949
		Anatolian Teacher High School	16	4.125	.646
		Vocational High School	96	4.323	.641
		Total	182	4.126	.747
	Third Grade	Anatolian High School	88	4.148	.814
		Regular High School	51	4.177	.786
		Anatolian Teacher High School	47	4.223	.800
		Vocational High School	30	4.267	1.023
		Total	216	4.188	.832
	Fourth Grade	Anatolian High School	84	4.286	.749
		Regular High School	44	4.171	.655
		Anatolian Teacher High School	36	4.347	.664
		Vocational High School	74	4.176	.846
		Total	238	4.240	.752
TOTAL		Anatolian High School	295	4.105	.809
		Regular High School	171	4.085	.859
		Anatolian Teacher High School	160	4.059	.815
		Vocational High School	258	4.260	.741
		Total	884	4.138	.804

Table 6b. Two-factor analysis of variance results of prospective teachers' opinions regarding the "the nature of mathematics" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Source of the Variance	Sum of Squares	sd	Average of Squares	F	P	Significant Difference
The nature of mathematics	Class level	7.760	3	2.587	4.124	.006	1-4
	The School Type Graduated from	4.973	3	1.658	2.643	.048	AHS-VHS, RHS-VHS, ATHS-VHS
	SD*MOOT	12.507	9	1.390	2.216	.019	
	Error	544.399	868	.627			
	Total	15707.000	884				

Table 6b shows the effect of the type of school graduated from on a class level was different from its effect on other class levels [F (9, 868) = 2.216; (p < .05)]. In addition, while the scores obtained differed significantly in accordance with the type of school graduated from [F (3, 868) = 2,643; (p < .05)], the difference obtained in terms of class level was also significant [F (3, 868) = 4,124; (p < .05)]. Therefore, the average scores of the prospective teachers in the fourth grade were significantly higher than those of prospective teachers in the first grade. Compared to Anatolian High School and Anatolian Teacher High School graduate prospective teachers, the scores of prospective teachers who graduated from vocational high school were significantly higher.

Table 7a. Descriptive statistical results of prospective teachers' opinions regarding the "teaching program" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Classes	The School Type Graduated from	N	Avg.	sd
Teaching program	First Grade	Anatolian High School	86	3.374	.778
		Regular High School	43	3.442	.739
		Anatolian Teacher High School	61	3.336	.656
		Vocational High School	58	3.152	.732
		Total	248	3.325	.735
	Second Grade	Anatolian High School	37	3.842	.551
		Regular High School	33	3.838	.692
		Anatolian Teacher High School	16	3.927	.683
		Vocational High School	96	4.179	.540

		Total	182	4.027	.603
	Third Grade	Anatolian High School	88	4.189	.683
		Regular High School	51	4.105	.659
		Anatolian Teacher High School	47	4.188	.647
		Vocational High School	30	4.317	.488
		Total	216	4.187	.645
	Fourth Grade	Anatolian High School	84	3.653	.825
		Regular High School	44	3.583	.895
		Anatolian Teacher High School	36	3.644	.918
		Vocational High School	74	3.664	.920
		Total	238	3.642	.877
TOTAL		Anatolian High School	295	3.755	.804
		Regular High School	171	3.752	.791
		Anatolian Teacher High School	160	3.715	.800
		Vocational High School	258	3.817	.824
		Total	884	3.765	.806

Table 7b. Two-factor analysis of variance results of prospective teachers' opinions regarding the "teaching program" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Source of the Variance	Sum of Squares	sd	Average of Squares	F	P	Significant Difference
Teaching program	Class level	86.965	3	28.988	54.387	.000	1-2, 1-3,1-4, 2-3, 2-4, 3-4
	The School Type Graduated From	.801	3	.267	.501	.682	
	SD*MOOT	7.566	9	.841	1.577	.118	
	Error	462.650	868	.533			
	Total	13106.306	884				

Table 7b shows that the effect of the school type graduated from on a class level was not different from its effect on other class levels [F (9, 868) = 1.577; (p >.05)]. Besides, whereas the scores obtained did not differ significantly in accordance with the type of school graduated from [F (3, 868) = 0.501; (p > .05)], the difference obtained in terms of class level was significant [F (3, 868) = 54.387; (p < .05)]. Therefore, when the average scores obtained from the scale were compared with prospective first-grade teachers, they were in favor of the prospective second, third and fourth-grade teachers. Compared with the senior teacher candidates, the average scores were in favor of prospective preschool teachers studying in the 2nd and 3rd grades in this sub-scale.

Table 8a. Descriptive statistical results of prospective teachers' opinions regarding the "teachers' qualification" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Classes	The School Type Graduated from	N	Avg.	Sd
Teachers' qualification	First Grade	Anatolian High School	86	3.513	.546
		Regular High School	43	3.449	.607
		Anatolian Teacher High School	61	3.464	.474
		Vocational High School	58	3.535	.500
		Total	248	3.495	.527
	Second Grade	Anatolian High School	37	3.645	.428
		Regular High School	33	3.489	.624
		Anatolian Teacher High School	16	3.589	.472
		Vocational High School	96	3.694	.581
		Total	182	3.637	.554
	Third Grade	Anatolian High School	88	3.774	.534
		Regular High School	51	3.796	.649
		Anatolian Teacher High School	47	3.930	.455
		Vocational High School	30	3.791	.440
		Total	216	3.816	.536
		Anatolian High School	84	3.590	.591

	Fourth Grade	Regular High School	44	3.542	.494
		Anatolian Teacher High School	36	3.650	.572
		Vocational High School	74	3.591	.629
		Total	238	3.591	.581
	TOTAL	Anatolian High School	295	3.630	.550
		Regular High School	171	3.584	.608
		Anatolian Teacher High School	160	3.655	.524
		Vocational High School	258	3.640	.567
		Total	884	3.628	.562

Table 8b. Two-factor analysis of variance results of prospective teachers' opinions regarding the "Teachers' qualification" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Source of the Variance	Sum of Squares	sd	Average of Squares	F	P	Significant Difference
Teachers' qualification	Class level	11.800	3	3.933	12.940	.000	1-3, 2-3, 3-4
	The School Type Graduated from	.828	3	.276	.908	.437	
	SD*MOOT	1.427	9	.159	.522	.859	
	Error	263.853	868	.304			
	Total	11916.122	884				

Table 8b shows the effect of the type of school graduated from on a class level was not different from its effect on other class levels [F (9, 868) = 0.522; (p >.05)]. Besides, whereas the scores obtained did not differ significantly in accordance with the type of school graduated from [F (3, 868) = 0.908; (p > .05)], the difference obtained in terms of class level was significant [F (3, 868) = 12.940; (p < .05)]. Therefore, when the average scores obtained from the scale were compared with prospective first-grade teachers, they were in favor of the prospective second and third-grade teachers. Compared with the senior teacher prospective teachers,

the average scores were in favor of prospective preschool teachers studying in the 3rd grade in this sub-scale.

Table 9a. Descriptive statistical results of prospective teachers' opinions regarding the "teaching and teachers' role" sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Classes	The School Type Graduated From	N	Avg.	sd
Teaching and teachers' role	First Grade	Anatolian High School	86	3.654	.668
		Regular High School	43	3.733	.676
		Anatolian Teacher High School	61	3.475	.653
		Vocational High School	58	3.500	.585
		Total	248	3.588	.651
	Second Grade	Anatolian High School	37	4.000	.471
		Regular High School	33	3.894	.685
		Anatolian Teacher High School	16	4.000	.764
		Vocational High School	96	4.315	.535
		Total	182	4.147	.599
	Third Grade	Anatolian High School	88	4.165	.742
		Regular High School	51	4.059	.699
		Anatolian Teacher High School	47	4.186	.660
		Vocational High School	30	4.292	.573
		Total	216	4.162	.692
	Fourth Grade	Anatolian High School	84	3.813	.718
		Regular High School	44	3.756	.852
		Anatolian Teacher High School	36	3.951	.707
		Vocational High School	74	3.841	.790
		Total	238	3.832	.762
TOTAL		Anatolian High School	295	3.895	.712
		Regular High School	171	3.867	.740

	Anatolian Teacher High School	160	3.844	.737
	Vocational High School	258	3.993	.711
	Total	884	3.909	.723

Table 9b. Two-factor analysis of variance results of prospective teachers' opinions regarding the "teaching and teachers' role " sub-scale in accordance with the class level and the school type graduated from

Sub-scale	Source of the Variance	Sum of Squares	sd	Average of Squares	F	P	Significant Difference
Teaching and teachers' role	Class level	39.858	3	13.286	28.837	.000	1-2, 1-3,1-4, 2-3, 2-4, 3-4
	The School Type Graduated from	1.632	3	.544	1.181	.316	
	SD*MOOT	8.528	9	.948	2.057	.031	
	Error	399.916	868	.461			
	Total	13968.750	884				

Table 9b shows that the effect of the school graduated from on a class level differed from its effect on other class levels [F(9, 868) = 2.057; (p < .05)]. Besides, while the scores obtained did not differ significantly in accordance with the type of school graduated from [F (3, 868) = 1.181; (p > .05)], the difference obtained in terms of class level was significant [F (3, 868) = 54,387; (p < .05)]. Therefore, when the average scores were compared with prospective first-grade teachers, they were in favor of the prospective second, third and fourth-grade teachers. When compared with senior prospective teachers, the average scores were in favor of prospective preschool teachers studying in second and third grades.

DISCUSSION

The research results revealed that the prospective preschool teachers had high levels of positive beliefs on mathematics education based on the average scores of the overall scale and its sub-scales. It may be suggested that their strong beliefs on mathematics education were reflected positively in their future teaching lives. According to Zacharos et al. (2007), teachers holding negative beliefs about mathematics throughout their education lives did not like the process of teaching mathematics. Strong beliefs about mathematics education in prospective preschool teachers showed that, compared to a traditional approach, such

teacher candidates had a constructivist approach in guiding the student through self-learning. This was supported by the scale items such as "discoveries of children are crucial in the mathematics learning process" or "when appropriate learning environments are provided, every child learns mathematics" or "when teaching mathematics, attention should be paid to allow children for explaining their thoughts". Furthermore, the study conducted by Kayan, et al. (2013) revealed that prospective teachers had constructivist beliefs. Considering that a constructivist-based education system has been realized in Turkey since 2005, the obtained results may have occurred as expected.

The results of the two-way ANOVA to examine the average scores from the overall scale reveal that the prospective preschool teachers' beliefs on mathematics education differed significantly in graduation compared to the first year in the school of education. Furthermore, there were also significant differences in the mathematical beliefs of prospective preschool teachers between those in intermediate grade levels and the ones in the fourth grade. Compared to prospective preschool teachers in other grade levels, the average scores of those in the third grade were significantly higher when training about teaching mathematics was received. This finding indicates that the preschool teacher education curriculum acting on prospective preschool teachers' beliefs about mathematics were similar to the results of the studies conducted on prospective primary school mathematics teachers despite the differences in the study samples throughout the study (Ambrose, 2004; Dede and Karakuş, 2014; Kayan et al., 2013; Swars et al., 2009; Wilkins & Brand, 2004).

In this research, the average scores obtained from the "talent development and age-appropriateness of mathematical learning", "teaching program" and "teaching and teachers' role" sub-scales were in favor of prospective preschool teachers in the second, third, and fourth grades compared to the scores obtained by those in the first grade. Furthermore, compared to senior prospective teachers, the average scores were in favor of prospective preschool teachers in the second and third grades. In the "learning mathematically" sub-scale, there was a significant difference in average scores in favor of prospective preschool teachers in the third grade compared to those in the first grade. In the "the nature of mathematics" sub-scale, the average scores were significantly different in favor of the senior prospective preschool teachers compared to those in the first grades. In the "teachers' qualification" sub-scale, there was a significant difference in favor of the average scores of prospective teachers in the third grade compared to those in other grade levels. This finding was likely influenced by prospective preschool teachers taking a mathematics education course and then practicing microteaching in third grade. Certainty, the literature review shows that teaching practices in the curriculum of schools of education were acted on prospective teachers' beliefs about mathematics (Gill et al., 2004; Tatto et al., 2008; Vacc and Bright, 1999).

Another variable thought to act on prospective preschool teachers' beliefs about mathematic education in the research was the type of high school of graduation. Based on the results of the two-way ANOVA, a significant difference in the average scores of prospective preschool teachers was found only in "learning mathematically" and "the nature of mathematics" sub-scales in favor of vocational high school graduates. In other words, the prospective preschool teachers who graduated from vocational high schools had more positive beliefs on the nature of mathematics. The research conducted by Karataş et al. (2017) found that a significant difference was in the average scores of the "the nature of mathematics" sub-scale by the school type of graduation. Moreover; Maasepp and Bobis (2014) also found that university graduate teachers' opinions about mathematics were more positive compared to teachers who graduated from other types of schools. However, those results failed to achieve statistical significance.

This research also found an increase in the average sub-scale scores, excluding the "the nature of mathematics", starting from the first grade to the third grade. However, the scores decreased in the fourth grade. The researchers have assumed that such increases would perpetuate to the senior year. This finding indicates that working through prospective teachers' beliefs was not a possibility but a necessity for teacher training programs (Swars et al., 2009). The decrease in average scores may be related to the negative experiences of prospective teachers in the senior year. Therefore, difficulties, workload, and working conditions experienced in the first year of the occupation might act on teachers' beliefs negatively (Cady, Meier & Lubinski, 2006; Felbrich, Müller & Blömeke, 2008).

Conclusion

In this research, prospective preschool teachers' beliefs about mathematics education and the effects of the grade level and the school type of graduation on such beliefs were investigated. While it is gratifying in the name of training programs that prospective teachers' beliefs about mathematics education are in a positive trend, the research may need to be repeated on different study samples. Furthermore, the effects of various other variables on prospective preschool teachers' beliefs about mathematics education may be examined.

In addition, prospective preschool teachers' beliefs about mathematics education were highly positive. The reflections of the study results on the actual education practices of the study participants may be investigated whether their mathematics teaching practices are parallel to their beliefs. Moreover, the decrease in the average MELBS scores of prospective preschool teachers in the senior year may be examined in depth through qualitative studies.

The research may be repeated with the same participants after graduation. Thus, trends in modifications of prospective teachers' beliefs about mathematics can be found out.

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