A Research on the Beliefs about Mathematics Learning and Teacher Efficacy of Prospective Teachers in Turkey

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Abstract

The aim of this study is to measure the consistency of beliefs about mathematics teaching and learning, and the perception of the effectiveness of prospective teachers. A total of 554 prospective teachers studying in the Kocaeli University, including 306 mathematics and 248 elementary prospective teachers participated in the research. Mathematics Beliefs Instrument was applied to the mathematics and elementary prospective teachers. In conclusion, it has been understood that majority of the prospective teachers have positive beliefs about mathematics. Mathematical beliefs of freshmen and sophomores or juniors change significantly. Similarly, Significant differences appeared in the belief average points of female and male prospective teachers.

Keywords: *Beliefs; Beliefs about Mathematics; Gender; Grade; Prospective teachers*

1. Introduction

Research performed over the affective variables that are based on pedagogic and psychology began more than 30 years ago with the research about mathematical beliefs. The research provided a view point about learning of mathematics (Gainsburg, 2007). Intellectual and emotive processes are important parts of learning and they have related to each other interactively. Therefore, emotive and expectations have effect on the learned information, in a sense, on what has been learned (Caine & Caine, 1991). The importance of affect is expressed in the studies of reform in mathematics and a special importance is emphasized for this issue. It has been explained that affective variables and strategies have rather important role for learning and teaching of mathematics in different researches (McLeod, 1992: 575). Affective behaviors, which are related to effort, have effect on learning of individuals and problem solving as well as cognitive behaviors (Op't Eynde & De Corte, 2003). For instance, the affective field has been placed at the centre in reorganization of academic program and evaluation works that had been carried out and understanding of the value of mathematics by individuals and development of confidence against mathematics by individuals were two of the objectives that had been the objectives of that study by National Council of Teachers of Mathematics (NCTM-1989). Theoretical analysis and practical applications of Mandler in mathematics classes have revealed that the three most important components for researches that would be performed about affective values in mathematics education are *beliefs, beliefs, emotive (excitement and enthusiasm)* (McLeod, 1992: 578). As one of the affective variables, mathematical beliefs have been examined as one of the affective variables in mathematics education in this research.

Mathematical beliefs are the values of judgment, which are formed by past experiences of individuals (Raymond, 1997). Values, ideologies, judgments, world-view and opinions about the mathematics that the individual has are thought as the beliefs of the individual (Kayaaslan, 2006).

Beliefs, which are very important in education, are referred to the cognition in principle and develop slowly and in comparative way (McLeod, 1992). It is formed when it is with the same opinion as expectations and intellectual mechanism. All of the key factors like; teaching methods of the teacher, evaluation of subject told by the teacher, objectives of the teacher that are really believed to be achieved, the role that has been self casted for education and

decision of the teacher about the issue of how acceptable is the situation that had been achieved at end of the education are parts of the beliefs with regards to the mathematics education in fact (Baydar & Bulut 2002). Very serious part of the beliefs that is related with mathematics is formed during the school life.

Beliefs about mathematics is a notion, which effects learning and teaching of students and thereby effects on the success of them directly or indirectly as having importance in mathematics teaching and learning process (Cobb, 1986; Kloosterman, 1991; Kloosterman & Cougan, 1994; Kloosterman & Stage, 1992; Schoenfeld, 1989; Thompson, 1984). It is helpful to develop positive belief about mathematics and make sense of what has been learned about mathematics subjects in mathematics teaching (Cobb, 1986; Raymond, 1997; Thompson, 1992). Mathematical beliefs of students, which also determine the perspectives of students with regards to the mathematical world, have great importance for the mathematic applications as well. For example, if students believe that all of the mathematical problems would be solved within five minutes, then this situation has serious amount effect on the time they would allocate for a problem (Schoenfeld, 1992). Many researches that have been performed (Kloosterman, 1991; Kloosterman & Cougan, 1994; Thompson, 1984) have also put forward that the beliefs of students with regards to nature and education of mathematics have effect on their abilities of learning of the mathematics and their mathematics education. Nevertheless, beliefs about mathematics could affect negative mathematics learning and success because they effect on how students have been learned and used. Especially, unsuccessful students may not be aware of the negative beliefs they have against mathematics and these beliefs could also have negative effect on their learning and success (Collison, 1992; Mason, 2003). This situation makes students frightened and discouraged (Boaler, 1997; Burton, 1999). Because of these negative beliefs, students think negative about the necessity of mathematics learning (Clewell, Anderson, & Thorpe, 1992). Besides, negative beliefs could create an impassable obstacle for the effective learning of mathematics since these have great influence on how the mathematics is learned and how it is used (Pehkonen & Törner, 1999; cited in Kayaaslan, 2006). Therefore, development of beliefs about mathematics of students is rather important. Because of that, beliefs should first be determined and then sufficient activities should be planned and introduced in the classroom in order to change insufficient beliefs gradually. Hence, changes in the beliefs could effect the motivation for the mathematics in the positive way (Mason, 2003). It could be possible to provide for students to develop their positive beliefs and beliefs with regards to mathematics through carefully designed lessons (Kayaaslan, 2006). Thus, teachers play an important role in the exchange and development of negative beliefs about mathematics of students. Therefore it could also be said that beliefs of prospective teachers about mathematics could have an effect on the learning environment that they would create in the future as teachers and on the success of the student. Besides, although the belief of teacher and the knowledge of field have important place for training of the teachers, this issue had not been approached adequately in researches, which had focused on training of the prospective teachers (Enochs, Smith, & Huinker, 2000). Hence, it is important that the beliefs of prospective teachers about mathematics should be identified.

When researches that had been performed nationally and internationally has been studied, it has been seen that researchers, which had examined the beliefs of prospective teachers, (Azar, 2010; Baydar & Bulut, 2002; Delice, Ertekin, Aydın, & Dilmaç, 2009; Hacıömeroğlu & Şahin-Taşkın 2010; Hart, 2002; Işıksal, Kurt, Doğan, & Çakıroğlu, 2007; Kayan & Çakıroğlu, 2008; Yalçın & Öçal, 2010; Yılmaz & Delice, 2007; Wilkins & Brand, 2004; Zollman & Mason, 1992) were available.

It has been understood from the studies performed that some parts of these researchers (Hacıömeroğlu & Şahin-Taşkın, 2010; Hart, 2002; Yalçın & Öçal, 2010; Wilkins & Brand, 2004) performed on beliefs about mathematics were carried out with elementary school prospective teachers and some parts of them (Azar, 2010; Baydar & Bulut, 2002; Delice, Ertekin, Aydın, & Dilmaç, 2009; Işıksal, Kurt, Doğan & Çakıroğlu, 2007; Kayan & Çakıroğlu, 2008; Yılmaz & Delice, 2007) with mathematics prospective teachers. It has been seen as the results of the studies performed with regards to the type of the beliefs performed that different types of beliefs about mathematics like; the beliefs of prospective teachers about solving of mathematical problems, their self efficacy beliefs about being a teacher, their sufficiency or self efficacy beliefs about teaching of the mathematics have been discussed. Besides, it has been understood from some researches (Karakuş & Akbulut, 2010; Zollman & Mason, 1992) that evaluations have also been performed with regards to the mathematics teaching programs and the beliefs.

Amongst these researches, self efficacy beliefs of prospective teachers about learning of the mathematics have been studied in researches that have been performed by Aksu (2008), Baydar and Bulut (2002), Hacıömeroğlu and Şahin-Taşkın (2010) and Yalçın and Öçal (2010). In the research that has been performed by Aksu (2008), whether self efficacy beliefs of secondary school, science and preschool prospective teachers show any differences as to their gender, as to the field of graduation from the high school and as to the departments they study or not, has been studied. It has been seen as the result of the research that the prospective teachers had high inclinations with respect

to the self efficacy beliefs about mathematics and it has also been seen that there was not any meaningful differences with regards to their gender, the field of graduation from the high school and to the departments they study in. The research, which has been performed by Hacıömeroğlu and Şahin-Taşkın (2010), has been carried out in order to determine the efficiency beliefs of secondary school prospective teachers about mathematics teaching and it has been concluded that the sufficiency beliefs of prospective teachers has not shown any differences with regards to their gender, level of education and final grades but the *factor of role of the teacher for effective education* had differed in favor of female prospective teachers.

In the research, which has been performed by Azar (2010), self efficacy beliefs of science and mathematics prospective teachers about being a teacher has been studied and the variation of these self efficacy beliefs of prospective teachers in relation to the demographic features (gender, graduated university and the branch) has been researched. It has been understood from the conclusion of the research that while the self efficacy beliefs of prospective teachers about being a teacher do not vary in relation to the universities, their self efficacy about being a teacher and their academic successes have varied in great deal according to their branches.

In some other researches (Işıksal, Kurt, Doğan, & Çakıroglu, 2007; Yılmaz & Delice, 2007), epistemic beliefs of prospective teachers about mathematics have been studied. Amongst these researches, epistemological comprehension of elementary mathematics prospective teachers about mathematics have been studied in the research performed by Işıksal, Kurt, Doğan and Çakıroğlu (2007) with respect to the variations as the university and the level of education. It has been understood from the conclusion of the research that the epistemological comprehension of prospective teachers about mathematics was high and that the prospective teachers have seen mathematics as a field, which is constituted from notions that vary continuously and that are related to each other and from generalizations. It has also been understood that the epistemological beliefs of prospective teachers about mathematics have differed according to the university they study and according to the class level. In the research performed by Yılmaz and Delice (2007), the effect of epistemological beliefs of mathematics prospective teachers on the problem solving process have been studied. It has been concluded in the research that prospective teachers have beliefs, which have effect on the problem solving processes and these beliefs of them have negative effect on their performances. Some of different kinds of beliefs of prospective teachers about mathematics have been dealt together in this research, as being different from other researches performed and have been evaluated together for different teaching fields. It is aimed to measure the consistency of prospective teachers' beliefs about mathematics teaching and learning with the NCTM Curriculum and Evaluation Standards (1989), beliefs about teaching and learning mathematics within and outside the school setting and perception of the effectiveness of prospective teachers as a mathematics teacher and learner.

1.1 Research Questions

The present study was designed to emphasize the following questions:

1) What are the beliefs about mathematics teaching and learning within and outside the school setting of the mathematics and elementary prospective teachers?
2) Do the beliefs about mathematics teaching and learning of the mathematics and elementary school prospective teachers show significant difference according to different variables (gender, grades, teaching fields and academic success)?

2. Methodology

2.1 Research Model

This research has been executed by using the general screening model of the descriptive research methods. The screening model is the research approach, which intends to describe a state that was available in the past or in the present time. The event, the individual or an object, which is the subject of the research, is tried to be defined in this model within its own conditions and as it stands and the important issue here is to be able to observe the existing (Karasar, 2005: 77-78).

2.2 Participants

A total of 554 prospective teachers, who were studying in the Education Faculty of Kocaeli University in Turkey during the 2011-2012 academic year fall semester, including 306 mathematics and 248 elementary prospective teachers participated in the research. 403 of the prospective teachers were female and 151 of these

prospective teachers were male.

Table 1: Distribution of prospective teachers according to teaching fields and to grades

	Grades									
Teaching	Freshmen		Sophomores		Juniors		Seniors		Total	
Fields	f	%	f	%	f	%	f	%	f	%
Mathematics	73	13.2	74	13.4	80	14.4	79	14.3	306	55.2
Elementary	63	11.4	55	9.9	74	13.4	56	10.1	248	44.8
Total	136	24.5	129	23.3	154	27.8	135	24.4	554	100.0

2.3 Data Collection Instrument

Data for the research was obtained using the *Mathematics Beliefs Instrument*, which was developed by Hart (2002). The *Mathematics Beliefs Instrument* is a 30-item *Mathematics Beliefs Instrument* including 3 parts and all 30 items were presented on a 4-point Likert scale. The first 16 items (Part A) of the *Mathematics Beliefs Instrument* was a form of the *Standards Belief Instrument*, which measures the consistency of an individual's beliefs about mathematics teaching and learning with the NCTM Curriculum and Evaluation Standards (1989). The *Standards Belief Instrument*, which consists of 16 Likert scale items, was developed by Zollman and Mason (1992). Eight of the items were consistent and eight of them were inconsistent with the NCTM Standards (1989). The construct validity of the 16 items making up the *Standards Belief Instrument* was assessed by 17 experts in mathematics education, who reviewed the items for their consistency with the Standards. Measures of reliability base on internal consistency were found to be adequate (α=.65 for a general population of teachers; α=.79 for a sample of teachers who had taken a course in which the Standards were studied) (Zollman & Mason, 1992). The next 12 items (Part B) of the *Mathematics Beliefs Instrument* was adapted from the Problem-Solving Project (Schoenfeld, 1989) by Hart (2002) and it also measure an individual's beliefs about teaching and learning mathematics within and outside the school setting. These items were not intended to be directly related to the NCTM Standards as with *Standards Belief Instrument*, but to mathematics and mathematics education, in general, although the items in this instrument would also measure consistency with the philosophy of the Standards. Part C of the *Mathematics Beliefs Instrument* consisted of two items on teacher efficacy. These last two items measure an individual's perception of their effectiveness as a mathematics teacher and learner. The first item regarded change in how teachers felt about themselves as learners of mathematics and the second item regarded how teachers felt about themselves as teachers of mathematics (Hart, 2002).

The *Mathematics Beliefs Instrument* was applied to a total of 910 prospective teachers, who were studying in the Education Faculty of Abant Izzet Baysal and Kocaeli Universities in Turkey during the 2011-2012 fall semester, including 475 mathematics and 435 elementary prospective teachers participated in the research. 258 of the prospective teachers were freshmen, 216 of them were sophomores, 224 of them were juniors and 212 of these prospective teachers were seniors for the Turkish adaptation version of the instrument. The content and structure validities of the *Mathematics Beliefs Instrument* were examined for its Turkish form. Exploratory factor analysis was applied in order to study the structure validity of the inventory and the presence of items in three different parts that were included in the original form of the inventory. At the end of the analysis, 10 items (1, 7, 8, 10, 12, 16, 17, 18, 20, 24), which do not correlate with the structure of the instrument or whose total test correlation value for items was below 0.20, have been removed from the instrument that constituted 30 items. It has been determined as the result of the exploratory factor analysis performed that there were 4 factors, whose characteristic value was greater than 1. Items of 15, 13, 19, 11, 3, 2, 4, 9, 14, 22, 6 were placed respectively under the first factor, 21, 5, 23, 25 were placed respectively under the second factor, 29, 30 were placed respectively under the third factor and 27, 26 and 28 were placed respectively under the forth factor. The characteristic values for these four factors are 4.424, 2.022, 1.764 and 1.641 respectively. The first factor explains 22.119% of the total variation on its own and 32.228% of the total variation together with the first and second factors. The other two factors explain 17.025% of the total variation together. These four factors explain 49.253 % of the total variation together. Test specimen/substance correlation and the lower-upper group comparison with 27% were included for substance separation of the instrument. The Pearson product-moment correlation coefficient was determined according to total points of the correlation coefficient for the calculation of the test specimen/substance correlation and the t-test was used for the comparison of the substance points of the lower-upper group with 27%. The internal consistency and split-half test reliability coefficients have been calculated for reliability studies of the instrument. The internal consistency reliability coefficient of the inventory was determined as 0.826 and the split-half correlation values were calculated as 0.732. Besides, the Spearman-Brown and Guttman split-half test correlations were calculated respectively as 0.846 and 0.844 values.

2.4 Data Collection and Analysis

The mathematics and elementary prospective teachers took 20 minutes to complete the *Mathematics Beliefs Instrument*. Written as a 4-point Likert scale, responses for the items were coded as *1=strongly disagree, 2=disagree, 3=agree and 4=strongly agree* for items exhibiting positive agreement and reverse coded for items exhibiting negative agreement. The highest point value that could be obtained for this inventory is 80 and the lowest point is 20. The group interval coefficient value was calculated by dividing the difference between the greatest value and the smallest value of the progression of the measurement results by the determined number of groups in the study (Kan, 2009: 407). Therefore, the average arithmetical reference interval, which was calculated as being related to the responses provided by prospective teachers, was calculated as to be (4-1)/4=0.75 in the study. Higher scores on the instrument, which contains 8 negative and 12 positive items, show positive level of mathematical beliefs. The beliefs of the prospective teachers could be found by dividing the total points obtained from the inventory to the number of the items. Descriptive statistics methods, independent two samples t-test, One-way ANOVA and Tukey test applied for the analysis of data. For all of the statistical decoding, .05 significant level has been taken as the base. Cronbach Alpha coefficient related to the inventory has been calculated as 0.73 for the data that has been obtained from this research. The data were analyzed using the SPSS 14.0 program.

3. Findings

In this section, we report the results of the statistical analysis that have been performed to measure the beliefs about teaching and learning mathematics and perception of the effectiveness of mathematics and elementary prospective teachers. Descriptive statistical results about the average points, where prospective teachers have obtained from their responses for the items included within the *Mathematics Belief Instrument,* have been included in Table 2.

Table 2: Descriptive analysis results of prospective teachers about belief average points

Teaching Fields	N	Minimum	Maximum	$\overline{x}$	S
Mathematics	306	1.60	3.80	3.136	.292
Elementary	248	1.55	3.95	3.101	.343
Total	554	1.55	3.95	3.120	.316

According to the descriptive statistical results about the average points, where prospective teachers have obtained from their responses for the items included within the *Mathematics Belief Instrument,* it has been understood that average points of mathematics and elementary prospective teachers for their *beliefs about mathematics* are between 1.55 and 3.95 points. This situation shows that some of the prospective teachers have negative beliefs and some of them have positive beliefs. Besides, percentage and frequency values have been calculated as the result of the descriptive statistics that were applied in order to determine beliefs of mathematics and elementary prospective teachers towards mathematics. The results are included in Table 3 and Figure 1.

Table 3: Percentage and frequency values related to belief average points of prospective teachers

Average Points of Prospective Teachers							
Between 1.00-1.75 points		Between 1.76-2.50 points		Between 2.51-3.25 points		Between 3.26-4.00 points	
f	%	f	%	f	%	f	%
2	0.4	20	3.6	364	65.7	168	30.3

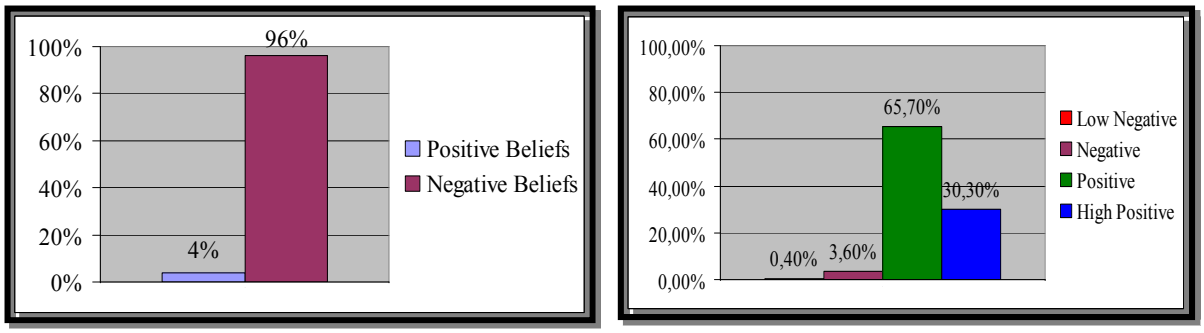


Figure 1: Percentage values about mathematical beliefs of prospective teachers

It has been understood from the surveys performed that majority of prospective teachers (96%) have obtained points of 2.51 and above, which corresponds to choices of *agree* and *strongly agree*. This situation shows that majority of prospective teachers have positive of beliefs about mathematics. Besides, a significant part of prospective teachers (30.3%) have obtained points of 3.26 and above, which corresponds to choice of *strongly agree* and most of the prospective teachers (65.7%) have obtained points between 2.51 and 3.25 points, which corresponds to choice of *agree*.

Percentage and frequency values about the average points, which have been obtained by the prospective teachers from *mathematics belief instrument* as being related, have been examined in terms of the gender. In additionally, *independent two sample t-test* has been applied to find out whether there is a significant difference between the average points of prospective teachers have obtained from *belief instrument* about mathematics and their genders. The results are included below.

Table 4: Average points related to beliefs of prospective teachers according to gender

	Average Points									
	Between 1.00-1.75 points		Between 1.76-2.50 points		Between 2.51-3.25 points		Between 3.26-4.00 points		Total	
Gender	f	%	f	%	f	%	f	%	f	%
Female	2	0.5	11	2.7	253	62.8	137	34.0	403	100.0
Male	0	0.0	9	6.0	111	73.5	31	20.5	151	100.0

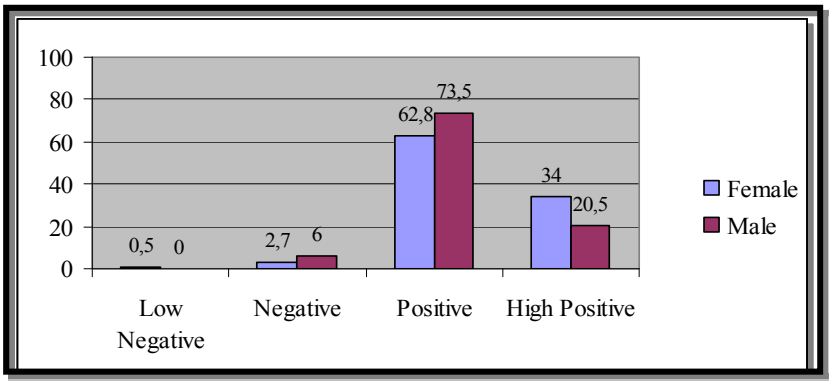


Figure 2: Percentage values about mathematical beliefs of prospective teachers according to gender

When the average points of prospective teachers for their beliefs about mathematics have been examined in terms of the gender, it could be understood that percentage values of female and male prospective teachers, who have gained points within the same point interval, are not rather close to each other. Because of that, the *independent two sample t-test* has been applied for these independent groups for the aim of showing whether there is a significant difference between points in relation to beliefs about mathematics of prospective teachers in terms of the gender or not (Table 5).

Table 5: Results of the independent two sample t-test in relation to variation of beliefs about mathematics according to gender

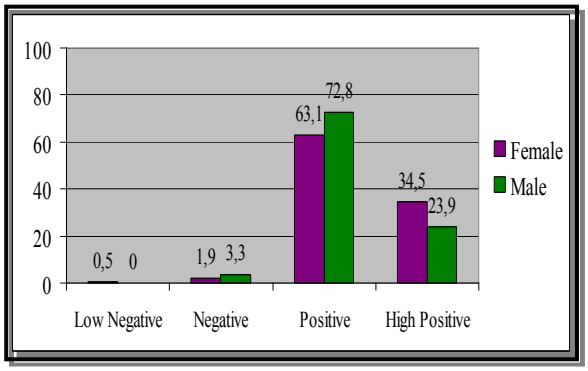
Gender	N	$\bar{x}$	sd	df	t	p
Female	403	3.15	0.3125	552	3.597	.000
Male	151	3.04	0.3134			

It has been determined that there is a significant difference between the belief average points about mathematics of female and male prospective teachers who have participated in this research ($t_{(552)}$=3.597; p<.05). The belief average points of the male prospective teachers ($\bar{x}$=3.04) are higher than the belief average points of the female prospective teachers ($\bar{x}$=3.15).

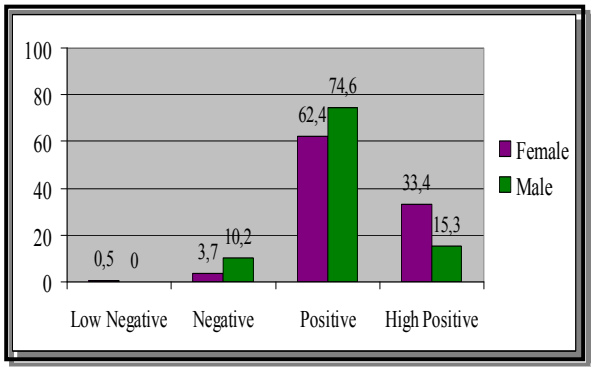
Percentage and frequency values about the average points, which have been obtained by the mathematics and elementary prospective teachers from *mathematics belief instrument* as being related, have been examined in terms of the gender separately. It is aimed to find out whether there has been a significant difference between the average points of mathematics or elementary prospective teachers have obtained from *belief instrument* about mathematics and their genders. The independent two sample t-test has been applied with this aim and the results are included in Table 6 and Figure 3.

Table 6: Differentiation of average points of mathematics prospective teachers according to gender

		Average Points									
		1.00-1.75 points		1.76-2.50 points		2.51-3.25 points		3.26-4.00 points		Total	
Teaching Fields	**Gender**	f	%	f	%	f	%	f	%	f	%
Mathematics	Female	1	0.5	4	1.9	135	63.1	74	34.5	214	100.0
	Male	0	0.0	3	3.3	67	72.8	22	23.9	92	100.0
	Total	1	0.3	7	2.3	202	66.0	96	31.4	306	100.0
Elementary	Female	1	0.5	7	3.7	118	62.4	63	33.4	189	100.0
	Male	0	0.0	6	10.2	44	74.6	9	15.3	59	100.0
	Total	1	0.4	13	5.2	162	65.3	72	29.0	248	100.0



Mathematics Prospective Teachers



Elementary Prospective Teachers

Figure 3: Differentiation of beliefs percentage values of mathematics and elementary prospective teachers according to gender

When the average points of mathematics prospective teachers for their beliefs about mathematics have been examined in terms of the gender, it could be understood that percentage values of female and male mathematics prospective teachers, who have gained points within the same point interval, are not rather close to each other. The percentage value (34.5%) of female mathematics prospective teachers, who have obtained points of 3.26 and above, has been rather high as compared to the percentage value (23.9%) of male mathematics prospective teachers. Conversely, the percentage value (63.1%) of female mathematics prospective teachers, who have obtained points between 2.51 and 3.25 points, has been rather low as compared to the percentage value (72.8%) of male mathematics

prospective teachers. This situation is the similar for elementary prospective teachers. Because of that, the *independent two sample t-test* has been applied for these independent groups for the aim of showing that there is a significant difference between average points in relation to beliefs about mathematics or elementary of prospective teachers in terms of their gender (Table 7).

Table 7: Results of the independent two sample t-test in relation to variation of beliefs about mathematics according to gender of mathematics and elementary prospective teachers

	Gender	N	$\bar{x}$	sd	df	t	p
Mathematics	Female	214	3.16	0.293	304	2.094	.037
	Male	92	3.08	0.283			
Elementary	Female	189	3.14	0.333	246	3.190	.002
	Male	59	2.98	0.349			

It has been determined that there are significant differences between the average points of beliefs about mathematics of female and male prospective teachers who were studying in mathematics or elementary teaching fields ($t_{(304)}$=2.094; p<.05 and $t_{(246)}$=3.190; p<.05 respectively for mathematics and elementary prospective teachers). The belief average points of the male mathematics or elementary prospective teachers are higher than the belief average points of the female mathematics or elementary prospective teachers.

Descriptive statistics and One-way ANOVA test have been used to test whether there are significant differences among the beliefs and the grades of prospective teachers or not. Percentage and frequency values have been given especially for each of the teaching fields in Table 8 and One-way ANOVA test result in relation to the beliefs and grades has been given in Figure 4 and Table 9.

When the average points of prospective teachers for their beliefs about mathematics have been examined in terms of their grades, it has been understood that the percentage values about belief average points has been 3.26 and above as this corresponds to *strongly agree* choice (17.6% - 31.8% - 35.1% - 36.5% respectively for Freshmen, Sophomores, Juniors and Seniors) have been rather close for sophomores, juniors and seniors. Besides, the percentage value about belief average points has been 3.26 and above was low than the others. Similarly, it has been understood that percentage and frequency values of prospective teachers, whose belief average points are 2.51 and above as this corresponds to *strongly agree* and *agree* choices and their percentages (respectively 91.1% - 98.5% - 97.4% and 97.2%) are very close to each other.

Table 8: Distribution of average points related to beliefs about mathematics of prospective teachers according to grades

	Average Points							
	Between 1.00-1.75 points		Between 1.76-2.50 points		Between 2.51-3.25 points		Between 3.26-4.00 points	
Grades	f	%	f	%	f	%	f	%
Freshmen	0	0.0	12	8.8	100	73.5	24	17.7
Sophomores	0	0.0	2	1.6	86	66.6	41	31.8
Juniors	1	0.6	3	1.9	96	62.3	54	35.2
Seniors	1	0.6	3	2.2	82	60.7	49	36.5

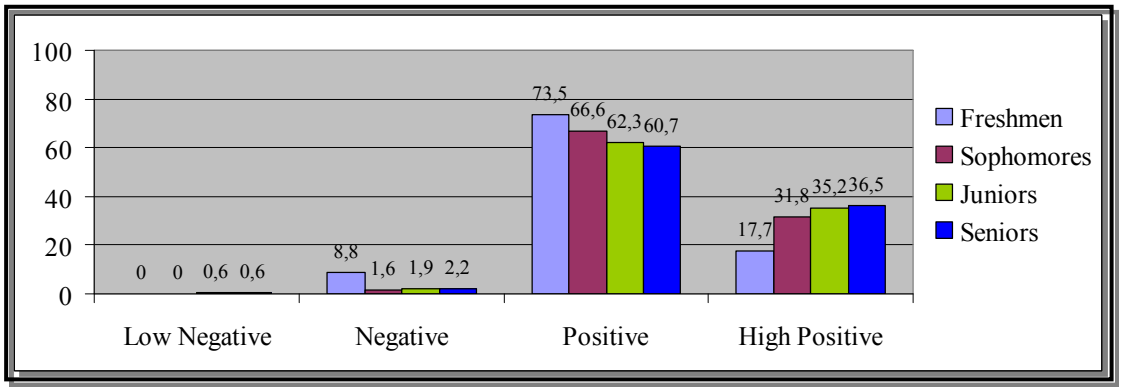


Figure 4: Distribution of percentage values of prospective teachers according to grades

One-Way ANOVA test has been applied to find out whether the differences among the grades of prospective teachers are significant or not and the data with regards to the result is included below.

Table 9: Results of One-Way ANOVA test in relation to variation of the belief average points according to grades

	Sum of Squares	df	Mean Square	F	p	Significant Difference
Inter-Groups	1.963	3	0.654	6.754	.000	Freshmen-Sophomores
WithinGroups	53.295	550	0.097			Freshmen-Juniors
Total	55.258	553				Freshmen-Seniors

The results of the analysis indicate a significant difference has been found among the grades of the prospective teachers and their belief average points ($F_{(3,550)}$=6.754, p<.05). In other words, beliefs of prospective teachers change significantly according to their grades. It has been understood as the result of the Tukey test that has been performed that this significant difference among the grades has taken place among freshmen and other prospective teachers.

One-Way ANOVA test has been applied to find out whether the differences among the grades of *mathematics or elementary prospective teachers* are significant or not. The results are given in Table 10.

Table 10: Results of the One-Way ANOVA test in relation to variation of the belief average points according to their grades of mathematics and elementary prospective teachers

	Teaching Fields	Sum of Squares	df	Mean Square	F	p	Significant Difference
Inter-Groups	Mathematics	0.580	3	0.193	2.298	.078	
WithinGroups		25.417	302	0.084			-
Total		25.997	305				
Inter-Groups	Elementary	1.748	3	0.583	5.197	.002	Freshmen-Sophomores
WithinGroups		27.350	244	0.112			Freshmen-Juniors
Total		29.097	247				

The results of the analysis indicate significant differences among the grades of the elementary prospective teachers and their belief average points ($F_{(3,244)}$=5.197, p<.05). In other words, beliefs of elementary prospective teachers change significantly according to their grades. It has been understood as the result of the Tukey test that has been performed that this significant difference among the grades has taken place among freshmen and sophomores or juniors elementary prospective teachers. Conversely, there is not a significant difference among the grades of the mathematics prospective teachers and their belief average points ($F_{(3,302)}$=2.298, p>.05). The mathematical beliefs of mathematics prospective teachers do not change significantly according to their grades.

Correlation analysis has been performed in order to determine whether there are relationships between the beliefs about mathematics of a total of 459 mathematics and elementary prospective teachers, who gave the information about their grades, and university grade point averages or not. Percentage and frequency values have been given especially for each of the teaching fields Table 11

Table 11: Correlation analysis results of prospective teachers about their grade point averages

Teaching Fields	N	Pearson Correlation	p
Mathematics	289	0.185	.002
Elementary	170	0.048	.531
Total	459	0.126	.007

Results of the analysis show a low level, positive relationship between beliefs of prospective teachers and their university grade point averages (r=0.126, p<0.05). Similarly, results of the analysis about the beliefs of mathematics prospective teachers show a low level, positive relationship between beliefs of mathematics prospective teachers and their university grade point averages (r=0.185, p<0.05). Conversely, there could not be found a positive significant relationship between beliefs of elementary prospective teachers and their grades (r=0.048, p>0.05). In other words, as the grade point averages of prospective teachers increase so too does the mathematical beliefs. Besides, especially as the grade point averages of mathematics prospective teachers increase so too does the mathematical beliefs. After that, descriptive statistics applied to find the differences between the average points about beliefs and teaching fields.

Percentage and frequency values have been given especially for each of the teaching fields below.

Table 12: Distribution of average points about beliefs according to teaching fields

	Average Points							
	Between		Between		Between		Between	
Teaching	1.00-1.75 points		1.76-2.50 points		2.51-3.25 points		3.26-4.00 points	
Fields	f	%	f	%	f	%	f	%
Mathematics	1	0.3	7	2.3	202	66.0	96	31.4
Elementary	1	0.4	13	5.2	162	65.4	72	29.0

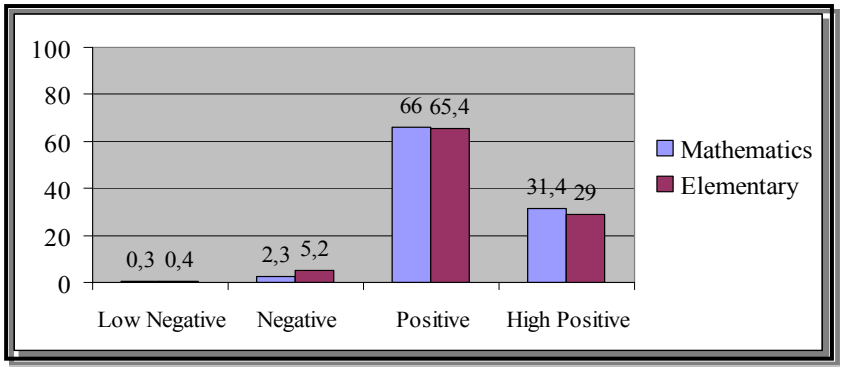


Figure 5: Distribution of percentage values according to teaching fields

The average points of mathematics and elementary prospective teachers about their beliefs have been examined in terms of their teaching field in Table 12 and Figure 5. As a result of the descriptive analysis, the percentage values (respectively 31.4% and 29.0%), who have obtained belief points of 3.26 and above as this corresponds to *strongly agree* choice, of mathematics and elementary prospective teachers are very close to each other. Similarly, the other percentage values of mathematics and elementary prospective teachers, who have obtained belief average points of 3.25 and below as this corresponds to *strongly disagree, disagree and agree* choices, are very close to each other.

The *independent two sample t-test* has been applied for these independent groups for the aim of showing that there is not a significant difference between points in relation to beliefs about mathematics of prospective teachers in terms of the teaching fields (Table 13).

Table 13: Results of the Independent Two Sample t-test in relation to Variation of Beliefs about Mathematics according to Teaching Fields

Teaching Fields	**N**	$\bar{x}$	**sd**	**df**	**t**	**p**
Mathematics	306	3.14	0.292	552	1.282	.200
Elementary	248	3.10	0.343			

It has been determined that there is not a significant difference between the belief average points of mathematics and elementary prospective teachers who participated in this research ($t_{(552)}$=1.282; p>.05). The belief average points of the mathematics and elementary (respectively 3.14 and 3.10 average points) prospective teachers are very close to each other. In other words, beliefs of mathematics and elementary prospective teachers do not change significantly according to teaching fields that they are educated in.

4. Conclusion

Beliefs about mathematics of mathematical and elementary prospective teachers have been determined and examined in this research. It has been explored whether these prospective teachers' beliefs about mathematics have changed with respect to gender, grades, the teaching fields and academic success or not. *Beliefs about Mathematics Instrument* has been applied to a total of 554 mathematics and elementary prospective teachers.

It has been understood from the analysis of the data that majority of the prospective teachers (96%) have positive beliefs about mathematics teaching, learning and teacher efficacy. It is understood from this that prospective teachers have positive inclinations with regards to their beliefs about mathematics as this situation is supported by the research. This situation is supported by the research of Aksu (2008) and Işıksal, Kurt, Doğan and Çakıroğlu

(2007) who had similar findings. However, the percentage value (69.7%), which is related to the prospective teachers have obtained points of 3.25 and below, have shown that a significant part of the prospective teachers' positive beliefs about mathematics need to be developed.

As the results of the examination about prospective teachers' beliefs about mathematics in terms of their gender, it has been understood that there is a significant difference between the belief average points of female and male prospective teachers and their gender. This result does not support the results of the research of Aksu (2008) and Hacıömeroğlu, Şahin-Taşkın (2010). Besides, as the results of the examination about elementary prospective teachers' beliefs about mathematics in terms of their grades, it has been understood that there are significant differences among average points of elementary prospective teachers in relation to their beliefs about mathematics and grades. As a result, we could say that mathematical beliefs of freshmen and sophomores or juniors change significantly. In additionally, it has been understood that there are significant differences among average points of mathematics prospective teachers in relation to their beliefs about mathematics. Similar results were obtained by Işıksal, Kurt, Doğan and Çakıroğlu (2007). In additionally, the results of analysis of the beliefs about mathematics of prospective teachers do not differ significantly according to their teaching field. This situation is supported by the research of Aksu (2008) who had similar findings.

We also understood that university education has a positive effect on their beliefs about mathematics, where this has risen after second year in university, even though this has been in low amounts. At the same time, the results of analysis of the relationship between the mathematical beliefs of prospective teachers and their university grade point averages indicate that there is a low level, positive relationship ($r=0.126$, $p<0.05$) and that this relationship occurs especially for mathematics prospective teachers ($r=0.185$, $p<0.05$). This situation has showed that mathematical beliefs and average grades of mathematics prospective teachers raise as the grade point averages raise. This result supports the results of the research of Azar (2010) and Işıksal, Kurt, Doğan and Çakıroğlu (2007). Besides, the relationship does not occur for elementary prospective teachers ($r=0.048$, $p>0.05$). Similar results are obtained by Hacıömeroğlu, Şahin-Taşkın (2010).

It should be provided for prospective teachers that they should appreciate the importance of the mathematics for the life and its contribution for other sciences and they should also know that mathematics is a universal language. Because of that, it would be appropriate to determine the beliefs about mathematics of prospective teachers, who are studying in different teaching fields, in the researches to be performed. The issue of how the beliefs about mathematics of prospective teachers could be developed, researched and given suggestions for solutions with regards to this matter could be put forward in detail.

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