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Prospective Elementary Mathematics and Prospective Classoom Teachers' Beliefs Towards Mathematics*

Research Article

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ABSTRACT

Beliefs have important place in teaching mathematics. Students especially build the basis of their beliefs in elementary schools. The aim of this quantitative research design is to determine prospective elementary mathematics and classroom teachers' beliefs towards mathematics. For that aim prospective elementarymathematics and classroom teachers' beliefs towards mathematics were comparedin terms of gender, department, university and grade level variables. Data of the study were collected by using "Mathematical Belief Scale" adapted into Turkish by Hacıömeroğlu (2012).The study was conducted during 2015-2016 academic year. The scale consists of four factors named 'beliefs about constructing students' mathematics knowledge', 'beliefs about teaching mathematical concepts', 'beliefs about teaching mathematical skill', 'beliefs about designing instruction according to students' mathematical development', and 'beliefs about the developments ofstudents' mathematical skills. Study group includes prospective mathematics andclassroom teachers enrolled at Education Faculties of Fırat, Kastamonu, Erciyes, Cumhuriyet and Ağrı İbrahim Çeçen Universities. No specific sample was chosen as the whole participants were included in the study. Independent groups t test wasused to see if there were any statistically significant differences among prospective teachers' views based on gender, grade level and department variables. The non-parametric statistical technique Mann-Whitney U was used instead of Independent groups t test when the distribution of the data was found to be non-normal. One way ANOVA was used to determine the differences among prospective teachers' views based on university variable. Findings of the study showed statistically significant differences among the views of prospective Classroom and Mathematics teachers. Several recommendations are offered based on the study results.

Keywords:
Prospective mathematics teacher, prospective classroom teacher, belief about mathematics

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Introduction

Mathematics has been an alphabet for all sciences since history. From the past to the present day it is possible to see that mathematics is always present in the sources that tell us about human, science and history and it is of great importance for all living and inanimate beings. So much so that when man tried to understand and make sense of nature, he found mathematics and as a result he formed the basis of his own education system. Education systems, which are still in constant change and transformation, are developing with the light shed by science and technology and directing societies.

In recent years, innovations in mathematics teaching in education systems continue to accelerate. In fact, many developed countries have made changes in curriculum and standards to improve mathematics teaching (NCTM, 1989, 1991, 2000; AAMT, 2002). In this direction, the new program aims to gain students' problem solving skills, self-confidence in mathematics, positive attitude towards mathematics. Many factors are effective in establishing these objectives. Many factors are effective in establishing these objectives. One of the most important factors is undoubtedly the beliefs of students and teachers about the nature and teaching of mathematics (Underhill, 1988; Frank, 1990; Carter and Norwood, 1997).

Although there is not a common definition of belief concept, Sigel defines belief as mental structures of experiences (Sigel, 1985), while Raymond (1997) defines faith as personal value judgments formed from past mathematical experiences of an individual. Ernest, on the other hand, defined mathematical belief as 'individuals' concepts, ideologies, values, philosophies about life and mathematics' (Ernest, 1989). Looking at the definitions made on faith from past to present; it can be said that beliefs are judgments carried forward to the future from past experiences shaped by the accumulation of ongoing experiences. In this respect, it is an undeniable reality that mathematical beliefs in the primary school age, which are the periods in which individuals begin to gain their mathematical skills systematically, are of great importance for later periods. Some of these results are; beliefs occur at a very young age, belief structures have a filtering, and in later periods, it filters thinking, information retrieval process, distort, define and shape again, some beliefs are more difficult to be changed according to their structure and acquisition, it is more difficult to change the beliefs thst are new to the belief system than to change the beliefs that have been newly formed, and that newly formed beliefs are more open to change, adults are more resistant to change their beliefs, they do not easily change their beliefs and individuals are very powerful in influencing their behaviors.

Primary school age is the period in which mathematics skills are first introduced to children. During this period, children meet mathematics and form their first belief in mathematics. So much so that in mathematics education, an individual's belief in learning mathematics is as important as learning mathematics field knowledge. In this direction, a large part of individuals' beliefs about mathematics, including the judgments they have about the nature, importance and teaching of mathematics, are formed and shaped during the education process (Schoenfeld, 1992; Thompson, 1992). Pajares (1992), reached some conclusions in the research compiled from studies on beliefs.

In the light of these findings, students' beliefs about early mathematics have a significant effect on mathematics education. Changing these negative beliefs about mathematics developed at an early age will be more difficult in the future education and training periods and these beliefs will turn into fears and affect academic achievement towards mathematics. Because students' beliefs and fears about mathematics are important factors that affect mathematics achievement (House, 2006; Kayaarsalan, 2006; McLeod and McLeod, 2002; Mert, 2004; Schoenfeld, 1989; Schommer-Aikins Duell and Hutter, 2005). Considering all these situations, it is seen how important the development of students' beliefs towards mathematics is. In this development, the elementary process in which children form the basis of their mathematical beliefs and the beliefs of their

teachers with whom tey share this process have great importance in alleviating children's fears or reinforcing their success (Carter and Norwood, 1997). In addition to gaining academic success and competence in mathematics, teachers should reinforce their positive thoughts about mathematics and demolish the walls of negative thoughts. In this respect, considering the place of beliefs on the academic achievement of individuals in mathematics teaching, teachers have great responsibilities and duties. Otherwise, mathematical thinking, academic success and mathematical beliefs that will occur among the students in the long run will be confronted with walls that need to be overcome (Gürsoy, 2010). Thus, Swars, Hart, Smith, Smith, Tolar, (2007) 's view that there is a strong relationshpp between teachers' beliefs, perceptions, self-efficacy and their ability to teach mathematics effectively. Moreover, the knowledge and beliefs of the teacher, who has the task of understanding, interpreting and reflecting the solutions and thoughts he/she has produced during the course, is another factor that plays an important role in the mathematics teaching process (Peterson, Fennema, Carpenter, and Loef, 1989). This relationship between belief and competence in mathematics education directly affects teachers' mathematical competence and mathematics teaching (Briley, 2012). As a result, beliefs about mathematics education have a statistically significant effect on mathematics teaching and mathematical competence.

In order to start and develop mathematical beliefs that will be built in the early ages of the individuals' teaching life, prospective teachers should have sufficient equipment and graduate from the university with this qualification. In this period, prospective teachers' beliefs towards mathematics affect mathematics teaching. Swars, Daane, and Giesen (2006) state that prospective teachers should have more self-efficacy and experience to develop their own classroom environments in the context of mathematics teaching classes in order to have sufficient self-efficacy beliefs. In this way, it will be easier for prospective teachers who have discovered the nature of mathematics and can apply various methods in teaching, to teach mathematical thinking and basic concepts of mathematics to children, or even to love mathematics. Therefore, it is important to know the beliefs of prospective elementary mathematics and prospective classroom teachers about mathematics. The aim of this study, which is organized with this importance, is to determine the mathematics beliefs of prospective elementary mathemtaics and prospective classroom teachers and to reach their opinions on this subject. In this respect, prospective teachers' opinions on mathematics beliefs were compared in terms of gender, department, university and grade level variables. The sub-aims determined for this purpose are as follows:

- What are the prospective teachers' views on the formation of mathematical knowledge and do they change according to the variables of department, gender, class and university?
- What are their views on teaching mathematics concepts and do they change according to department, gender, class and university variables?
- What are their views on the regulation of teaching according to prospective teachers' mathematics development and do they change according to the variables of department, gender, class and university?
- What are the prospective teachers' views on the development of mathematics skills and do they differ according to the variables of department, gender, class and university?

Method

In this section, information about the research model, sample group and data analysis has been mentioned.

Research Model

The aim of this quantitative study was to determine the mathematics beliefs of prospective classrom teachers and elementary mathematics teachers. Within this context, the opinions of prospective teachers about their mathematics beliefs were compared in terms of gender, department, university and grade level variables. Mathematics Belief Scale" which was adapted into Turkish by Hacıömeroğlu (2012) was used as the data collection tool. The research was conducted in 2015-2016 academic year. The scale consists of four factors: "Beliefs about Forming Students' Mathematical Knowledge", "Beliefs about Teaching Mathematics Concepts", "Beliefs Regulating Teaching According to Students' Mathematical Development" and "Beliefs Related to Developing Students' Mathematical Skills".

Study Group

The study group of the research consists of 1st and 4th grade students of Classroom Teaching and Elementary Mathematics departments at Faculty of Education of Fırat, Kastamonu, Erciyes, Cumhuriyet and Ağrı İbrahim Çeçen Universities. The whole population was considered as a sample. Therefore, no sample selection was made. Data were analyzed using a licenced SPSS software.

Data Analysis

Data were analyzed using a licenced SPSS sofware. In order to evaluate the data according to gender, department and grade level variables, Levene test was performed and homogeneity of variances was tested. The independent groups t test was used to determine whether there was a difference according to gender, department and grade level variables to determine prospective teachers' mathematics beliefs and Mann Whitney U test was used in cases where the distribution was not normal. In order to determine whether there is a significant difference according to university variable, variance analysis was performed.

Table 1. Demographic Information of Prospective Teachers

Gender	**f**	**%**
Female	471	72,91
Male	175	27,09
Department	**f**	**%**
Elementary Mathematics Teaching	316	48,92
Classroom Teaching	330	51,08
University	**f**	**%**
Cumhuriyet University	122	18,89
Fırat University	184	28,48
Kayseri Erciyes University	147	22,76
Kastamonu University	136	21,05
Ağrı İbrahim Çeçen University	57	8,82
Grade Level	**f**	**%**
Freshman	369	57,12
Senior	277	42,88
Total	**646**	**100.0**

When the demographic information of the prospective teachers is examined in Table 1; 471 of them are female and 175 of them are male and 316 of them are in elementary mathematics teaching department while 330 of them are studying in classroom teaching department. According to the university variable, 122 of the prospective teachers are from Cumhuriyet University, 184 from Fırat University, 147 from Kayseri Erciyes University, 136 from Kastamonu University and 57 from Ağrı İbrahim Çeçen University. Finally, it is seen that 369 prospective teachers are freshmen and 277 prospective teachers are seniors.

Findings and Comments

In this section, findings and interpretations obtained from the mathematics belief scale are presented. The findings obtained by the research are presented in the tables below.

Table 2. Arithmetic mean and standard deviations of prospective teachers' beliefs about students' knowledge of mathematics

NO	Scale Items	$\bar{x}$	sd
7	When making decisions about teaching, the natural development of students' mathematical ideas should be taken into consideration.	4,30	0,79
11	In order to be successful in mathematics, the student has to be a good listener.	4,01	0,96
13	Teachers should allow students to solve problems in their own way.	4,11	0,91
17	The subject sequence in mathematics must be taken into consideration in planning the instruction.	3,98	0,96
18	A teacher should allow students to explore ways of solving the problem before showing how to solve the problem.	4,33	0,82
21	Students learn mathematics best by participating in the teacher's explanations of how to do an activity.	3,96	0,83
22	While teaching mathematics, students should be able to explore the relationships in mathematics on their own.	4,09	0,84
23	Students can find ways to solve math problems without help from anyone.	3,67	1,03
26	Teachers should encourage students to explore their own solutions to solve problems.	4,19	0,88
30	It is important for a student to explore for himself how to solve basic mathematical problems.	4,12	0,86
31	Generally, students can find out how to solve math problems on their own.	3,50	0,99
32	In the decisions taken for teaching, the structure of mathematics is more effective than the natural development of students' ideas.	3,47	1,11
34	It is more appropriate to offer students various problems to solve.	4,20	0,80
Total		4,00	0,47

In Table 2, taking into consideration the natural development of mathematical ideas of students while making decisions about teaching beliefs about students' forming mathematical knowledge ($\bar{x}$=4,30), allowing students to discover ways of solving a problem before showing how to solve the problem ($\bar{x}$=4,33) and that the students should be presented with various problems to solve ($\bar{x}$=4,20) are adopted as 'definitely agree' by the prospective teachers. In addition, in order to be successful in mathematics, prospective teachers should be a good listener ($\bar{x}$=4,01), teachers should allow students to solve problems in their own way ($\bar{x}$=4,11), taking into account the subject sequence in mathematics planning ($\bar{x}$=4,01) and the students' views on how to learn mathematics in the best way ($\bar{x}$=3,96) by participating in the teacher's explanations about how to do an activity are adopted as 'agree'. Similarly, while the students are given mathematics lessons ($\bar{x}$=4,09), that students should find ways to solve their math problems without any help ($\bar{x}$=3,67), and students are asked to explore their own solutions to solve the problems ($\bar{x}$=4,19), the importance of self-discovery of how a student can solve basic math problems ($\bar{x}$=4,12), that students should find out how to solve math problems in general ($\bar{x}$=3,50), that the mathematics structure in the decisions taken for teaching is more effective than the natural development of the students' ideas ($\bar{x}$=3,47) and that it is more appropriate to present various problems for the students to solve ($\bar{x}$=4,20) are adopted as 'I agree'.

Table 3. T-test results according to the department variable of the opinions of the prospective teachers about the beliefs of students about forming mathematical knowledge

Sub Scale	Department				df	Levene		t	P
	Elementary Mathematics Teaching (n:316)		Classroom Teaching (n:330)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
The Beliefs of Students About Forming Mathematical Knowledge	4,00	,471	3,99	,477	644	,214	,644	,340	,734

According to the independent group t test analysis results, there is no statistically significant difference between the opinions of prospective teachers in terms of department variable ($t_{(644)}$=0,340, p=0,734). This situation can be interpreted as there is no difference between beliefs of prospective Elementary Mathematics and Classroom teachers about forming mathematical knowledge of students. In this sub-dimension, both prospective Elementary Mathematics ($\bar{x}$=4,00) and Classroom Teachers ($\bar{x}$=3,99) expressed their opinions at the level of "agree".

Table 4. MWU test results of prospective teachers' opinions about beliefs about forming mathematical knowledge of students according to gender

Sub Scale	Gender	n	Mean Rank	Sum of Ranks	U	P
Beliefs about forming mathematical knowledge of students	Male	175	304,12	53221,00	37821,00	0,107
	Female	471	219,81	48358.00		
Levene : 9,121	p = 0.003					

According to the results of the MWU test of the beliefs of students about forming mathematical knowledge, there is no statistically significant difference between the opinions of the prospective teachers [MWU=37821,000; p=0,107]. According to this, it can be said that the opinions of the groups regarding the sub-dimension of beliefs about forming the mathematical knowledge of the students do not differ.

Table 5. T-test results according to class variable related to students' forming their beliefs about their mathematical knowledge

Sub Scale	Class				df	Levene		t	P
	Junior (n:369)		Senior (n:277)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Students' forming their beliefs about their mathematical knowledge	3,96	,469	4,05	,476	644	,551	,458	-2,497*	,013

*p<0,05

According to the independent groups t test analysis results, there is a statistically significant difference between the opinions of prospective teachers based on grade level variable ($t_{(644)}$=-2,497, p=0.013). This

situation can be interpreted as the beliefs of the seniors ($\bar{x}$=4,76) about the students in forming mathematical knowledge are higher than the juniors ($\bar{x}$=4,69).

Table 6. The results of the analysis of variance about the opinions of prospective teachers about the beliefs of students' forming mathematics knowledge according to university variable

Sub Scale	University	n	$\bar{x}$	sd	Source of Variance	Sum of Ranks	df	Mean Rank	F	p	Scheffe
Teachers about the beliefs of students' forming mathematics knowledge	Cumhuriyet Uni.	122	3,99	0,481	Between groups	3,214	4	0,803	3,634	,006	4-5
	Fırat Uni.	184	4,02	0,483							
	Erciyes Uni.	147	3,95	0,445	Within Groups	141,699	641	0,221			
	Kastamonu Uni.	136	4,09	0,418							
	Ağrı İ. Çeçen Uni.	57	3,83	0,573							
	Total	646	4,00	0,474	Total	144,913	645				
	Levene = 1,381		p = 0,239								

According to ANOVA test analysis results, there is a statistically significant difference between the views of prospective teachers according to the university variable ($F_{(4-641)}$=3,634, p=0,006). When the differences between universities are examined, it is seen that they are between Kastamonu University ($\bar{x}$=4,09) and Ağrı İbrahim Çeçen University ($\bar{x}$=3,83)

Table 7. Arithmetic mean and standard deviations of prospective teachers' beliefs about teaching mathematics concepts.

NO	Scale Items	$\bar{x}$	sd
1	It is imperative to show the majority of students how to solve problems.	3,97	1,03
2	Students should understand the four processing methods before memorizing.	4,58	0,75
3	The structure of mathematics should determine the sequence of subjects to be taught.	4,39	0,77
4	Students should understand these methods before doing more than four process exercises.	4,37	0,85
5	Teachers should definitely teach the methods to solve problems.	4,31	0,85
6	The order of teaching mathematics subjects should be determined according to the order in which students naturally learn math concepts.	4,28	0,85
9	When choosing the next subject to be taught, what the students know is important.	4,47	0,76
12	The development of students' mathematical ideas should determine the sequence of subjects to be taught.	4,07	0,84
Total		4,30	0,53

In Table 7, prospective teachers' beliefs about teaching mathematics concepts were understood before students memorized four process methods ($\bar{x}$=4,58), the necessity of the structure of mathematics to determine the order of subjects to be taught ($\bar{x}$=4,39), and the students should understand the concepts instead of solving too many exercises. ($\bar{x}$=4,37), teachers should definitely teach the necessary methods to solve the problems ($\bar{x}$=4,31), determining the mathematics subjects' order according to the order of students' learning naturally, ($\bar{x}$=4,28) and considering what the students already know while choosing the next topic to be taught, it is seen that the students adopt the opinions about the competence areas as strongly ***'definitely agree'*** ($\bar{x}$=4,47). In addition, it is seen that prospective teachers should show the majority of students how to solve the problems ($\bar{x}$=3,97) and that the development of the mathematical ideas of the students determine the order of the subjects to be taught ($\bar{x}$=4,07) are adopted as ***'agree'***. Finally, it is seen that the opinions about beliefs about teaching mathematics concepts are at the level of ***'strongly agree'*** ($\bar{x}$=4,30). Accordingly, it can be said that the beliefs of prospective classroom teachers and prospective elementary mathematics teachers about teaching mathematics concepts are very high.

Table 8. T Test Results According to Department Variables of Teachers' Opinions about Beliefs in Teaching Mathematics Concepts

Sub Scale	Department				df	Levene		t	P
	Elementary Mathematics Teaching (n:316)		Classroom Teaching (n:330)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Beliefs in Teaching Mathematics Concepts	4,35	,488	3,26	,458	644	,540	,463	2,333*	,020

*p<0,05

According to the independent groups t test analysis result, there is a statistically significant difference between the opinions of prospective teachers according to the department variable ($t_{(644)}$=2,333, p=0,020) This situation can be interpreted as the beliefs related to the teaching of mathematics concepts are higher in the prospective elementary mathematics teachers ($\bar{x}$=4,35) than the prospective classroom teachers ($\bar{x}$=3,30).

Table 9. MWU test results of prospective teachers' beliefs about teaching mathematics concepts according to gender variable

Sub Scale	Gender	n	Mean Rank	Sum of Ranks	U	P
Beliefs about teaching mathematics concepts	Male	175	284,82	49843,50	34443,50	0,001
	Female	471	337,87	159137,50		
Levene : 6,426	p = 0.011					

According to the results of the MWU test of beliefs about teaching mathematics concepts, there is a statistically significant difference between the views of prospective teachers according to gender variable [MWU=3443,500; p=0,001]. This situation can be interpreted as female prospective teachers have higher beliefs about teaching mathematics concepts than male prospective teachers.

Table 10. T-test results of prospective teachers' beliefs about teaching mathematics concepts according to grade level variable

Sub Scale	Grade level				df	Levene		t	P
	Junior (n:369)		Senior (n:277)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Beliefs about teaching mathematics concepts	4,36	,525	4,24	,522	644	,049	,826	2,857*	,004

*p<0,05

According to the independent groups t test analysis results, there is a statistically significant difference between the views of prospective teachers according to class variable ($t_{(644)}$=2,857, p=0,004). This finding can be interpreted as the fact that seniors ($\bar{x}$=4,24) have higher beliefs about teaching mathematics concepts than the juniors ($\bar{x}$=4,36).

Table 11. The results of the analysis of variance of the beliefs of prospective teachers about teaching mathematics concepts according to university variable

Sub Scale	University	n	$\bar{x}$	sd	Source of Variance	Sum of Ranks	df	Mean Rank	F	p	Scheffe
Beliefs about teaching mathematics concepts	Cumhuriyet Uni.	122	4,31	0,559	Between Groups	1,443	4	0,361	1,302	0,268	-
	Fırat Uni.	184	4,32	0,532							
	Erciyes Uni.	147	4,33	0,552	Within Groups	177,596	641	0,277			
	Kastamonu Uni.	136	4,32	0,421							
	Ağrı İ. Çeçen Uni.	57	4,15	0,591							
	Total	646	4,30	0,527	Total	179,039	645				
	Levene = 2,060		p = 0,084								

According to ANOVA test results of the sub-dimension of beliefs about teaching of mathematics concepts, it is seen that there is no statistically significant difference between the views of prospective teachers according to university variable ($F_{(4-641)}$=1,302, p=0,268).

Table 12. Arithmetic mean and standard deviations of the answers of prospective teachers' beliefs about the regulation of teaching according to students' mathematics development

NO	Scale Items	$\bar{x}$	sd
8	Students learn mathematics from the representation and explanation of the best teachers.	3,79	1,03
14	Students should be told to solve problems as instructed by the teacher.	2,59	1,16
16	The best way to teach problem solving is to show students how to solve one type of problem at a time.	3,43	1,14
20	The order of teaching mathematics subjects should be determined according to the formal order of mathematics, not depending on the natural development of students' mathematical ideas.	3,06	1,22
25	Teaching in mathematical order is more important than teaching according to the conceptual development of children.	3,00	1,23
27	Teachers should tell students who have difficulty solving problems how to solve the problem.	3,87	1,06
33	Before allowing students to solve basic problems, a teacher should show them how to solve them.	4,12	0,87
Total		3,33	0,69

In Table 12, it was observed that the prospective teachers' beliefs about the regulation of teaching according to the mathematical development of the students would learn best from the representations and explanations of the students ($\bar{x}$=3,79), and the best way to solve the problem was to show the students how to solve one type of problem at a time ($\bar{x}$=3,43), Teachers should help students who have difficulty in solving problems ($\bar{x}$=3,87), and a teacher should show them how to solve these problems before they allow them to solve basic problems ($\bar{x}$=4,12) are adopted as ***"agree".*** In addition, prospective teachers should instructed to make students solve the problems as taught by the teacher ($\bar{x}$=2,59), the order of teaching of mathematics subjects being determined according to the formal order of mathematics, not depending on the natural development of students' mathematical ideas, ($\bar{x}$=3,06) and mathematical ranking an the fact that the teacher is more important than teaching according to the conceptual development of children, ($\bar{x}$=3,00) are adopted as ***"not certain"***. Finally, it is seen that the opinions about beliefs about the regulation of teaching according to the mathematical development of students are at the level of ***"not certain"*** ($\bar{x}$=3,33). Accordingly, it can be said

that classroom and prospective mathematics teachers have low beliefs about the regulation of teaching according to students' mathematics development.

Table 13. T-test results according to the department variable of the prospective teachers' beliefs about the regulation of teaching according to students' mathematics development

Sub Scale	Department				df	Levene		t	P
	Elementary Mathematics Teaching (n:316)		Classroom Teaching (n:330)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Beliefs about the regulation of teaching according to students' mathematics development	3,31	,670	3,24	,704	644	,983	,322	-0,580	,562

According to the results of the independent groups t-test analysis, there is no statistically significant difference between the views of prospective teachers according to department variable ($t_{(644)}$=-0,580, p=0,562). This situation can be interpreted as there is no difference between prospective elementary mathematics ($\bar{x}$=3,31) and classroom teachers' beliefs ($\bar{x}$=3,24) about the regulation of teaching according to students' mathematics development.

Table 14. T-test results of prpspective teachers ' beliefs about the regulation of teaching according to students' mathematics development according to gender variable

Sub Scale	Gender				df	Levene		t	P
	Female (n:471)		Male (n:175)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Beliefs about the regulation of teaching according to students' mathematics development	3,27	,670	3,48	,710	644	,733	,392	-3,384*	,001

*p<0,05

According to the independent groups t test analysis results, there is a statistically significant difference between the opinions of prospective teachers according to class variable ($t_{(644)}$=-3,384, p=0,001). It can be interpreted that male prospective teachers ($\bar{x}$=3,48) have higher beliefs about the regulation of teaching according to students' mathematics development than female prospective teachers ($\bar{x}$=3,27).

Table 15. MWU Test results of prospective teachers' beliefs about the regulation of teaching according to students' mathematics development according to class variable

Sub Scale	Grade level	n	Mean Rank	Sum of Ranks	U	P
Beliefs about the regulation of teaching according to students' mathematics development	Junior	369	334,81	123545,50	46932,50	0,075
	Senior	277	308,43	85435,50		
Levene : 9,240	p = 0.002					

According to the results of the MWU test of beliefs about the arrangement of teaching according to the mathematical development of the students, it is seen that there is no statistically significant difference between the views of the prospective teachers according to the class variable [MWU=46932,500; p=0,075]. This situation can be interpreted as the fact that there is no difference at the class level between the beliefs of freshmen about the arrangement of teaching according to mathematics development of students compared to seniors.

Table 16. The results of the analysis of variance about the opinions of prospective teachers regarding beliefs about the regulation of teaching according to university variable according to students' mathematics development

Sub Scale	University	n	$\bar{x}$	sd	Source of Variance	Sum of Ranks	df	Mean Rank	F	p	Scheffe
Beliefs about the regulation of teaching according to students' mathematics development	Cumhuriyet Uni.	122	3,30	0,657	Between Groups	1,688	4	0,422	0,894	0,467	-
	Fırat Uni.	184	3,34	0,679							
	Erciyes Uni.	147	3,25	0,665	Within Groups	302,695	641	0,472			
	Kastamonu Uni.	136	3,39	0,688							
	Ağrı İ. Çeçen Uni.	57	3,40	0,822							
	Total	646	3,33	0,687	Total	304,383	645				
	Levene = 1,775		p = 0,132								

When the results of ANOVA test analysis regarding the sub-dimension of beliefs related to the regulation of teaching according to the mathematical development of the students are examined, it is seen that there is no statistically significant difference between the opinions of the prospective teachers according to the university variable ($F_{(4-641)}$=0,894, p=0,467).

Table 17. Arithmetic mean and standard deviations of prospective teachers' beliefs about the development of students' mathematical skills

NO	Scale Items	$\bar{x}$	sd
10	Students learn mathematics by solving the best problems on their own.	3,56	1,11
15	It is important for a student to be a good listener to learn mathematics.	4,04	0,93
19	Students must gain experience by solving basic problems before memorizing the multiplication table.	3,75	1,12
24	In the planning of instruction, it is important to know how (naturally) children's mathematical ideas develop.	4,23	0,78
28	Students should understand the meaning of addition and subtraction before memorizing the basic properties of natural numbers.	4,25	0,92
29	Most students will find a solution to basic mathematical problems.	3,84	0,96
Total		3,95	0,52

In Table 17, the student teachers' beliefs about the development of mathematics skills, students' understanding of the meaning of addition and subtraction before memorizing the basic features of natural numbers ($\bar{x}$=4,25) and teacher's knowing how children's mathematical ideas (naturally) develop ($\bar{x}$=4,23) are adopted as ***"completely agree".*** In addition, the fact that prospective teachers must be a good listener for a student to learn mathematics ($\bar{x}$=4,04), that students learn mathematics best by solving the problems on their own ($\bar{x}$=3,56), and that students have experience by solving basic problems before memorizing the multiplication table ($\bar{x}$=3,75) and most of the students should find a solution for basic mathematical problems ($\bar{x}$=3,84) are adopted as ***"agree"***. Finally, it is seen that the students' beliefs about the development of

mathematics skills are at the level of *"agree"* ($\bar{x}$=3,95). Accordingly, it can be said that prospective classroom and mathematics teachers have high beliefs about the development of mathematics skills of students.

Table 18. T-test results of prospective teachers' beliefs about the development of students' mathematics skills according to department variable

Sub Scale	Department				df	Levene		t	p
	Elementary Mathematics Teaching (n:316)		Classroom Teaching (n:330)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Beliefs about the development of students' mathematics skills	3,94	,523	3,95	,524	644	,006	,940	-,409	,683

According to the results of independent groups t test analysis, there is no statistically significant difference between the views of prospective teachers according to department variable ($t_{(644)}$=-0,409, p=0,683). This finding shows that the beliefs of both prospective elementary mathematics teachers ($\bar{x}$=3,94) and prospective classroom teachers ($\bar{x}$=3,95) do not differ about the development of students' mathematical skills.

Table 19. T-test results of prospective teachers 'beliefs related to the development of students' mathematics skills according to gender variable

Sub Scale	Gender				df	Levene		t	p
	Female (n:471)		Male (n:175)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Beliefs about the development of students' mathematics skills	3,99	,507	3,83	,549	644	,420	,517	3,344*	,001

*p<0,05

According to the independent groups t test analysis results, there is a statistically significant difference between the views of prospective teachers according to gender variable ($t_{(644)}$=3,344, p=0,001). This can be interpreted as that the female teachers ($\bar{x}$=3,99) have higher beliefs about the development of mathematics skills than the male prospective teachers ($\bar{x}$=3,83).

Table 20. T-test results of student teachers' beliefs about the development of mathematics skills according to class variable

Sub Scale	Grade level				df	Levene		t	p
	Freshman (n:369)		Senior (n:277)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	P		
Beliefs about the development of students' mathematics skills	3,91	,528	4,00	,512	644	,184	,668	-2,158*	,031

*p<0,05

According to the independent groups t test analysis results, there is a statistically significant difference between the views of prospective teachers according to the class variable ($t_{(644)}$=-2,158, p=0,031). This situation can be interpreted as the beliefs of the students about the development of mathematics skills are higher than the grade 4 teacher candidates ($\bar{x}$=4,00) than the grade 1 teacher teachers ($\bar{x}$=3,91).

Table 21. The results of the analysis of variance about the opinions of prospective teachers about the beliefs related to the development of mathematics skills of the students according to the university variable

Sub Scale	University	n	$\bar{x}$	sd	Source of Variance	Sum of Ranks	df	Mean Rank	F	p	Scheffe
Beliefs about the development of students' mathematics skills	Cumhuriyet Uni.	122	3,94	,509	Between Groups	2,022	4	0,506	1,859	0,116	-
	Fırat Uni.	184	3,95	,542							
	Erciyes Uni.	147	3,93	,501	Within Groups	174,302	641	0,272			
	Kastamonu Uni.	136	4,02	,514							
	Ağrı İ. Çeçen Uni.	57	3,80	,549							
	Total	646	3,95	,523	Total	176,344	645				
	Levene = 0,498		p = 0,737								

When the results of ANOVA test analysis regarding the sub-dimension of beliefs related to the development of mathematics skills of the students are examined, it is seen that there is no statistically significant difference between the opinions of the prospective teachers according to the university variable ($F_{(4-641)}$=1,859, p=0,116).

Table 22. T test results according to department variable related to mathematics beliefs of prospective teachers

Sub Scale	Department				df	Levene		t	p
	Elementary Mathematics Teaching (n:316)		Classroom Teaching (n:330)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Mathematics Beliefs	3,93	,382	3,91	,402	644	,073	,787	0,587	,558

According to the results of independent groups t-test analysis, there is no statistically significant difference between the views of prospective teachers according to department variable ($t_{(644)}$=0,587, p=0,558). This situation can be interpreted as there is no difference between prospective elementary mathematics ($\bar{x}$=3,93) and prospective classroom teachers' beliefs ($\bar{x}$=3,91) about forming mathematical knowledge of students.

Table 23. MWU test results of prospective teachers' views on mathematics beliefs according to gender

Sub Scale	Gender	n	Mean Rank	Sum of Ranks	U	p
Mathematics Beliefs	Male	175	308,79	54038,50	38638,5	0,222
	Female	471	328,96	154942,50		
Levene: 13,037	p = 0.000					

According to the results of the MWU test regarding the mathematics beliefs of the prospective teachers, there is no statistically significant difference between the opinions of the prospective teachers according to gender variable [MWU=38638,500; p=0,222].

Table 24. T-test results according to class variable related to mathematics beliefs of prospective teachers

Sub Scale	Grade level				df	Levene		t	p
	Freshman (n:369)		Senior (n:277)						
	$\bar{x}$	sd	$\bar{x}$	sd		F	p		
Mathematics Beliefs	3,92	,385	3,92	,402	644	,612	,434	-,154	,878

According to independent group t test analysis results, there is no statistically significant difference between the views of prospective teachers according to class variable ($t_{(644)}$=-0,154, p=0,878). This situation can be interpreted as there is no difference between the mathematics beliefs of the first grade ($\bar{x}$=3,92) and fourth grade ($\bar{x}$=3,92) prospective teachers.

Table 25: KWH test results according to university variable regarding the mathematics belief level

Sub Scale	University	n	Mean Rank	sd	KWH	p	Difference
Mathematics Beliefs	Cumhuriyet Uni.	122	325,01	4	10,305	,036	2-5
	Fırat Uni.	184	334,47				3-4
	Erciyes Uni.	147	305,40				
	Kastamonu Uni.	136	350,83				4-5
	Ağrı İ. Çeçen Uni.	57	266,31				
	Total	646					
	Levene = 2,450	p = 0,45					

According to the KWH test results of prospective teachers 'mathematics belief levels, it is seen that prospective teachers' mathematics belief levels differ between universities ($KWH_{(4)}$=10,305, p=0,036). When the differences between universities are examined, it is seen that there are differences between Fırat University and Ağrı İbrahim Çeçen University, Erciyes University and Kastamonu University and Ağrı İbrahim Çeçen University. It is seen that most of the differences are with Ağrı İbrahim Çeçen University.

Discussion and Results

When the findings obtained with the study were examined, it was seen that the pre-service teachers' beliefs about the formation of mathematics knowledge of the students, their beliefs about teaching mathematics concepts, their beliefs about the arrangement of teaching according to the mathematics development of the students and the beliefs about the development of mathematical skills of the students were generally found to be sufficient. Effective teaching depends on both skills and teachers' approach to their tasks, feelings and beliefs (Zakaria and Musiran, 2010). When the variables examined in this direction were examined, it was seen that the pre-service teachers had differentiation on their beliefs about teaching mathematics concepts according to the department variable. According to the findings, it was found out that primary school mathematics teachers had higher beliefs about teaching mathematics concepts than prospective classroom teachers. This difference can be attributed to the effect of being a teacher of mathematics in the field. When the evaluations according to gender, which is another variable of the study, were examined, it was seen that there were differences in the beliefs of prospective teachers about teaching mathematics concepts, beliefs related to the arrangement of teaching according to students' mathematics development and beliefs related to the development of mathematics skills of students. According to the findings, it was concluded that female teachers' beliefs about teaching mathematics concepts and students' beliefs related to

development of mathematics skills were higher than male prospective teachers, but male teachers' beliefs about teaching mathematics development according to female teachers were higher. When similar studies in the literature were examined, it was found that they support this finding (Ayvaz and Dündar, 2014; Pişkin Tunç and Haser, 2012; Duatepe Paksu, 2008). In addition, when the results obtained by examining the sub-dimensions of mathematics beliefs according to class variable were evaluated, it was found that the beliefs of the prospective teachers about forming mathematical knowledge, the beliefs about teaching mathematics concepts and the beliefs related to the development of mathematics skills of the students were differentiated. From the findings, it can be concluded that seniors have higher beliefs about forming mathematical knowledge of students and their beliefs about students' development of mathematics skills compared to freshmen. The reason for this result can be attributed to the mathematics teaching, teaching practices and guidance courses that are taught depending on the grade level. In this respect, when the similar studies in the literature regarding the effect of class level on beliefs are examined, it is seen that as class level increases, competence and beliefs increase (Yaman, Cansüngü Koray and Altunçeküç, 2004; Pişkin Tunç and Haser, 2012) and similar studies support this result (Kayan, Haser and Işıksalbostan, 2013). It has been determined that mathematics belief levels of prospective teachers vary according to university variable. The difference was found between Fırat University and Ağrı İbrahim Çeçen University, Erciyes University and Kastamonu University, Kastamonu University and Ağrı İbrahim Çeçen University. It was found out that the mathematics beliefs of the prospective teachers at Ağrı İbrahim Çeçen University were lower. This difference can be attributed to the difference in university entrance scores and academic achievement levels of students. When all the findings were evaluated, it was seen that prospective teachers showed differences according to some variables determined on the basis of mathematics belief levels and sub-dimensions. The results obtained are based on research conducted in Turkey and abroad (Southwell, 1999; Gill, Ashton and Algina, 2004; Boz, 2008; Ng and Rao, 2008; Chrysostomoua and Philippou, 2010; Dede and Uysal; 2012; Golafshani; 2015; Nisbet and Warren, 2000) bears similarities and complementary different dimensions.

Suggestions

In the light of the findings following recommendations are offered:

- ✓ In teacher education programs, mathematics and mathematics teaching courses should be emphasized in order to increase prospective teachers' beliefs about mathematics.
- ✓ It should be ensured that prospective teachers gain more and more effective experience in teaching mathematics in teaching practice courses.
- ✓ New and original studies should be carried out that evaluate different dimensions to support the present study.

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