What Are the Beliefs of Primary and Primary Mathematics Teacher Candidates about Mathematics?

(Sınıf ve İlköğretim Matematik Öğretmen Adaylarının Matematik Hakkında İnanışları Nedir?)

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Abstract

It is stated that beliefs of teachers about mathematics is one of the important factors affecting teaching practices. It is thought that being informed about these beliefs of teachers could help teachers to explain their perspectives about teaching practices. In this study, survey method, one of quantitave research methods, was used. 429 teacher candidates educating at the Department of Primary and Primary Mathematics Teacher Education were the participants of the study. Data about the beliefs of the teacher candidates related to the nature, learning and teaching was collected by the Mathematics Related Beliefs Scale. Obtained data was categorized under two categories as constructivist and traditioanal beliefs and analyzed in terms grade level, gender and department.

Keywords: primary teacher candidates, primary mathematics teacher candidates, beliefs about mathematics

Özet

Matematik öğretim uygulamalarını etkiyen önemli faktörlerden birisinin de öğretmenlerin matematiğe karşı sahip olunan inanç olduğu ifade edilmektedir. Öğretmenlerin mesleki bilgilerini eğitim ortamlarında anlamdırabilmesinde bu inançların etkin görev aldıkları düşünülmektedir. Bu çalışmada nicel yöntemlerden tarama araştırması kullanılmış ve çalışmaya bir devlet üniversitesinin eğitim fakültesinin sınıf öğretmenliği ve ilköğretim matematik öğretmenliği bölümünde öğrenim gören 429 öğretmen adayı katılmıştır. Öğretmen adaylarının matematiğin doğası, öğretimi ve öğrenimi hakkındaki inanışları ile ilgili veriler "Matematik Hakkında İnanışlar Ölçeği" ile toplanmıştır. Elde edilen inanış verileri geleneksel ve yapılandırmacı kategoriler altında bölüm, cinsiyet ve öğrenim görülen sınıf durumlarına göre değerlendirilmelerde bulunulmuştur.

Anahtar Kelimeler: Sınıf öğretmen adayı, ilköğretim matematik öğretmen adayı, matematik hakkında inanç.

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Introduction

Several factors exist that affect students' mathematics achievement and perspectives of mathematics. It has been stated in many researches that factors as self-confidence and self-efficacy affect mathematics achievement (Eccles, Wigfield, Harold & Blumenfeld, 1993; Felson & Trudeau, 1991; O'brien, Martinez-Pons & Kopala, 1999; Preckel, Goez, Pekrun & Kleine, 2008). Moreover, Jewett (1996) stated that classroom environment and teachers' attitudes towards students also affect students' mathematics achievement and perspectives of mathematics (as cited Grassi & Heriques, 2004). Together with this, teachers' beliefs about mathematics can be considered as an important factor. Because, it is stated that teachers' beliefs about mathematics affect their teaching styles and as so students' learning, perspectives and beliefs of mathematics (Thompson, 1984).

It is seen in the literature that many definitions exist related to the concept of belief (Richardson, 1996; Sigel, 1985). These definitions reveal that there is a lack of agreed definition about the concept. Beliefs have an important role in the occurrence of behaviors due to being effective in the formation of attitudes (Bandura, 1982). Therefore, it is seen significant that understanding of what the concept is, before the variables related to the concept are examined. According to Sigel (1985), beliefs are "mental constructions of experience" (p.351). Richardson (1996), however, defines beliefs as "psychologically held understandings, premises, or propositions about the world that are felt to be true" (p. 103).

Mathematical belief, on the other hand, is defined as "personal judgments about mathematics formulated from experiences in mathematics, including beliefs about the nature of mathematics, learning mathematics and teaching mathematics" (Raymond, 1997, p. 552). It can be said based on the definition of mathematical belief that mathematical belief of a person is formed according to his/her mathematical experiences. Therefore, for changing mathematical beliefs of students in positive direction, it is required to be regulated their experiences related to mathematics which means organising classroom environment. This can be possible with changing the beliefs of teachers about mathematics. As a matter of fact, it was found that the beliefs of teachers have affected their ways of teaching (Thompson, 1984). Stipek, Givvin, Salmon and MacGyvers (2001) found that teachers having traditional beliefs teach mathematics parallel to their beliefs. In the research it was also found that teachers with traditional beliefs give more importance on getting correct answers and high scores, and it is also more important for these teachers that being able to calculate quickly than learning and understanding. By taking the nature of traditional teaching into account, it can be said that teaching in such classrooms is teacher-controlled. In contrast, it is stated that teachers with constructivist beliefs give more freedom to their students and they believe that teaching should be student-centered (Boz, 2008). In such an environment, the role of teacher is to guide students and create discussion environment which is seen as an important factor for learning.

Based on the researches conducted about teachers' beliefs about mathematics, it can be asserted that teachers with different beliefs give different messages to their students about mathematics. A student whose teacher has traditional beliefs can think that mathematics is reaching correct answer as soon as possible while a student whose teacher has constructivist beliefs can give more importance to discussion, process instead of product, participating actively and explaining ideas. Because childhood years and school environment are the

periods through which beliefs about mathematics are formed (Pajares, 1992) and teachers have very important role through these periods.

Although there are some researches found that teachers' beliefs about mathematics affect their teaching style, other studies state that inconsistencies exist between the beliefs teachers have and their teaching methods (Boz, 2008; Raymond, 1997). In these studies, it was found that techers have constructivist beliefs about mathematics however they use traditional approach while they are teaching. It can be said that classroom environment can cause this inconsistency because of the fact that classroom environment can affect the practice of what teachers believe (Beswick, 2005). It is even stated that new teachers use traditional approach as teaching method although they have constructivist beliefs (Raymond, 1997).

It is seen in some studies that mathematical beliefs of teachers or teacher candidates were also examined in terms of gender (Duatepe Paksu, 2008; Kayan, Haser & Işıksal-Bostan, 2013). In the study of Kayan, Haser and Işıksal-Bostan (2013), it was found that both traditional and constructivist beliefs of the teacher candidates differed significantly in terms of gender since females had higher mean scores than males. However, Duatepe Paksu (2008) stated that there were no significant gender differences in beliefs of teachers about mathematics. Therefore, it can be said that various researchers found different results in terms of gender which makes gender an important variable to examine beliefs of teachers or teacher candidates about mathematics.

According to the studies examined, it is understood that beliefs of teachers about mathematics affect the way that they teach mathematics and therefore the way that students understand mathematics. Republic of Turkey Ministry of National Education has adopted a constructivist approach mostly after the revision the mathematics curriculum in 2005 (Ministry of National Education [MoNE], 2005). When it is taken into consideration that beliefs affect teaching styles, it is expected that teachers have constructivist beliefs. The determination of beliefs of teachers can be useful in such a situation (Haser & Doğan, 2012). Since the determination of the beliefs will determine the way of education. Therefore, the aim of this study is to determine the beliefs of primary and primary mathematics teacher candidates about the nature, learning and teaching of mathematics and to compare these beliefs in terms of the factors of gender, grade level and department.

Method

Research Design

In this study, survey method was used due fact that the beliefs of the primary and primary mathematics teacher candidates about nature, teaching and learning of mathematics were examined. In order to examine the differences between the beliefs of the teacher candidates according to gender, grade level and department, causal comperative design, comparing different groups, was used (Fraenkel & Wallen, 2006).

Participants

In this study, purposive sampling method was used. Maximum variation sampling, one of purposive sampling methods, was the sampling method of the study. The study was conducted with 1st, 2nd, 3rd and 4th grade teacher candidates educating at the departments of Primary Teacher Education and Primary Mathematics

Teacher Education of a state university at the end of the spring semester of the academic years of 2013-2014. It is seen in Table 1 that information about 429 teacher candidates participating the study.

Table 1.

The Teacher Candidates Participating the Study

Deparment of Primary Education	Gender	1st grade	2nd grade	3rd grade	4th grade
Primary Mathematics Teacher Education (PMTE)	Male	f	f	f	f
		16	15	19	9
	Female	34	29	55	22
Primary Teacher Education (PTE)	Male	18	14	12	11
		47	48	49	31
	Female				

Data Collection Tool

In the study, the Mathematics Related Beliefs Scale (MRBS), developed by Kayan, Haser and Işıksal-Bostan (2013), was used as data collection tool. As a result of implementation of the scale, the Cronbach alfa coefficient of the scale was calculated as α=.82 and therefore, the scale was evaluated as reliable. The scale is a likert-type scale, responses to which ranging from "Strongly disagree" to "Stronly agree". The highest score that can be obtained from the scale is 130 whereas the lowest is 26.

In the development process of MRBS, the scale was applied to 242 primary and primary mathematics teacher candidates in the pilot study. Principal component analysis (PCA) was done by reversing the scores of negative items to determine the construct validity of the scale. According to the results of PCA, the factors whose values were bigger than 1 were determined and it was found that the items in the scale were cumulated under two factors by facilitating from the scree-plot graphic and components matrice. When the factors were investigated, it was found that the first factor was related to beliefs and stratejies about mathematics parallel to constructivist approach and beliefs regarding opportunities provided for students to learn mathematics better, so the factor was named as "Constructivist Beliefs". The second factor was named as "Traditional Beliefs" because of the fact that it was related to beliefs parallel to traditional approach of the nature and teaching of mathematics. After the determination of the factors, it was found that the Cronbach Alpha coefficient was .835 for the factor of "Constructivist Beliefs" and was .734 for the factor of "Traditional Beliefs". The ranges of scores that can be obtained from the factors are as follows: 20-100 for constructivist beliefs, 6-30 for traditional beliefs.

Data Analysis

After the application of MRBS, obtained data was transferred to a statistical program and appropriate statistical analysis were run. The means and standard deviations of the scores that participants obtained from the scale were calculated. In the analysis process of the comparison of the teacher candidates' beliefs in terms of gender, grade level, and the department, one-way variance analysis (ANOVA), mean, standard deviation and t-test were used for each group. Moreover, in addition to these analyses, effect sizes were calculated. Eta

squared (η^2) (Kotrlik & Williams, 2003) was used in the calculation of effect size. According to Cohen (1988) the effect size is small if it is $.01 < \eta^2 < .06$, moderate if it is $.06 \leq \eta^2 < .14$ and large if it is $.14 \leq \eta^2$. Moreover, effect size is calculated to investigate whether the difference between the variables is significant not only for statistical but also in practice.

<div align="center">**Findings**</div>

In the findings part of this study investigating the beliefs of the teacher candidates about the nature, learning and teaching of mathematics, the beliefs of the teacher candidates were compared in terms of gender, grade level and department.

The Beliefs of Primary Mathematics Teacher Candidates

The factor of constructivist beliefs in terms grade level

Means and standard deviations of the scores related to the factor of "Constructivist Beliefs" of primary mathematics teacher candidates at each grade level were calculated to test whether there is a significant difference between constructivist beliefs of the teacher candidates in terms of grade level (See Table 2).

Table 2.

The Scores of the "Constructivist Beliefs" Factor according to Grade Level

Grade Level	n	$\bar{x}$	ss
1	50	81.24	6.79
2	44	83.23	5.58
3	74	81.36	8.92
4	31	82.22	5.41
Total	199	82.21	7.31

When Table 2 is examined, it is seen that 2nd grade teacher candidates' score is the highest (83.23) and 1st grade teacher candidates' score is the lowest (81.24). The mean of the scores of all grade levels, however, was found as 82.21.

One-factor ANOVA was run to test whether there is a significant difference between the scores of "Constructivist Beliefs" factor of the teacher candidates in terms of grade level. Results of one-factor ANOVA were given in Table 3.

Table 3.

Results of one-factor ANOVA of the Scores of "Constructivist Beliefs" Factor according to Grade Levels

	Sum of squares	Sd	Mean squares	F
Between groups	292.358	3	97.453	
Within groups	10301.351	195	52.827	1.845
Total	10593.709	198		

*One-factor ANOVA, $p < 0.05$

When Table 3 is examined, it is seen that "Constructivist Beliefs" factor of the teacher candidates did not differ significantly in terms of grade level ($F_{(3-198)}$ =1.845; p> .05). In other words, it appeared that there was not a significant difference between the scores of the teacher candidates related to the factor of "Constructivist Beliefs" in terms of grade level.

The factor of traditional beliefs in terms grade level

Means and standard deviations of the scores related to the factor of "Traditional Beliefs" of primary mathematics teacher candidates at each grade level were calculated to test whether there is a significant difference between traditional beliefs of the teacher candidates in terms of grade level (See Table 4).

Table 4.

The Scores of the "Traditional Beliefs" Factor according to Grade Level

Grade Levels	n	$\bar{x}$	ss
1	50	22.00	3.85
2	44	20.34	3.44
3	74	17.52	3.81
4	31	18.71	2.62
Total	199	19.45	3.99

When Table 4 is examined, it is seen that 1st grade teacher candidates obtained the highest score (22.00) and 3rd grade teacher candidates obtained the lowest score (17.52). It was also found that the mean score of 4th grade teacher candidates was 18.71. The mean of the scores of all grade levels, however, was found as 19.45.

One-factor ANOVA was run to test whether there is a significant difference between the scores of "Traditional Beliefs" factor of the teacher candidates in terms of grade level. Results of one-factor ANOVA were given in Table 5.

Table 5.

Results of one-factor ANOVA of the Scores of "Traditional Beliefs" Factor according to Grade Levels

	Sum of Squares	Sd	Mean Squares	F	η^2
Between groups	650.668	3	216.889		
Within groups	2508.719	195	12.865	16.859*.	.21
Total	3159.387	198			

* One-factor ANOVA, p < 0.05

When Table 3 is examined, it is seen that "Traditional Beliefs" factor of the teacher candidates differed significantly in terms of grade level ($F_{(3-198)}$ =16.859; p< .05). In other words, it appeared that there

was a significant difference between the scores of the teacher candidates related to the factor of "Traditional Beliefs" in terms of grade level. According to the result of eta squared, it can be said that the size of the difference was large (η^2=.21). Variance homogeneity between groups was examined to determine the source of this difference obtained between grade levels and variance between groups was found to be homogenous. Therefore, LSD test, used when variances are found to be homogenous, was used to determine the source of the difference. The results of LSD test were given in Table 6.

Table 6.

Results of LSD Test

Grade Levels(I)	Grade Levels (J)	Mean Difference (I-J)	Standard Error	p*
1	2	1.65	.74	.026
	3	4.47	.65	.000
	4	3.29	.81	.000
2	3	2.81	.68	.000

*LSD Test, p < 0.05

According to Table 6, it was found that there was a significant difference between 1st grade teacher candidates and other teacher candidates in terms of the scores of the "Traditional Beliefs" factor. However, significant difference was not found between the mean scores of 3rd grade teacher candidates and 4th grade teacher candidates.

The factor of constructivist beliefs in terms gender

Means and standard deviations of the scores related to the factor of "Constructivist Beliefs" of primary mathematics teacher candidates at each grade level were calculated to test whether there is a significant difference between constructivist beliefs of the teacher candidates in terms of gender (See Table 7).

Table 7.

The Scores of the "Constructivist Beliefs" Factor according to Gender

Gender	n	$\bar{x}$	s	t
Female	140	80.91	10.06	1.197
Male	59	82.51	6.53	

*t-test, p< 0.05

When Table 7 is examined, it is seen that mean score of the males (82.51) is higher than that of girls (80.91). Independent samples t-test was run to test whether there is a significant difference between the scores of "Constructivist Beliefs" factor of the teacher candidates in terms of gender. It was found that the difference was not significant statistically.

The factor of traditional beliefs in terms gender

Means and standard deviations of the scores related to the factor of "Traditional Beliefs" of primary mathematics teacher candidates at each grade level were calculated to test whether there is a significant difference between traditional beliefs of the teacher candidates in terms of gender (See Table 8).

Table 8.

The Scores of the "Traditional Beliefs" Factor according to Gender

Gender	n	$\bar{x}$	s	t
Female	140	20.43	3.65	
				-1.653
Male	59	19.23	4.04	

*t-test, p< 0.05

When Table 8 is examined, it is seen that mean score of the males (19.23) is lower than that of girls (20.43). Independent samples t-test was run to test whether there is a significant difference between the scores of "Traditional Beliefs" factor of the teacher candidates in terms of gender. It was found that the difference was not significant statistically.

The Beliefs of Primary Teacher Candidates

The factor of constructivist beliefs in terms grade level

Means and standard deviations of the scores related to the factor of "Constructivist Beliefs" of primary teacher candidates at each grade level were calculated to test whether there is a significant difference between constructivist beliefs of the teacher candidates in terms of grade level (See Table 9).

Table 9.

The Scores of the "Constructivist Beliefs" Factor according to Grade Level

Grade Levels	n	$\bar{x}$	ss
1	65	82,12	9,33
2	62	83,50	4,20
3	61	81,54	6,92
4	42	82,50	8,77
Total	230	81,16	9,33

When Table 9 is examined, it is seen that 2nd grade teacher candidates' score is the highest (83.5) and 3rd grade teacher candidates' score is the lowest (81.54). Moreover, it was found that 1st grade teacher candidates' mean score was 82.12. The mean of the scores of all grade levels, however, was found as 81.16

One-factor ANOVA was run to test whether there is a significant difference between the scores of "Constructivist Beliefs" factor of the teacher candidates in terms of grade level. Results of one-factor ANOVA were given in Table 10.

Table 10.

Results of one-factor ANOVA of the Scores of "Constructivist Beliefs" Factor according to Grade Levels

	Sum of Squares	Sd	Mean Squares	F
Between groups	2330.225	3	776.742	
Within groups	10986.163	227	84.509	9.191
Total	13316.388	229		

* One-factor ANOVA, p < 0.05

When Table 10 is examined, it is seen that "Constructivist Beliefs" factor of the teacher candidates did not differ significantly in terms of grade level ($F_{(3-229)}$ =9.191; p> .05). In other words, it appeared that there was not a significant difference between the scores of the teacher candidates related to the factor of "Constructivist Beliefs" in terms of grade level.

The factor of traditional beliefs in terms grade level

Means and standard deviations of the scores related to the factor of "Traditional Beliefs" of primary teacher candidates at each grade level were calculated to test whether there is a significant difference between traditional beliefs of the teacher candidates in terms of grade level (See Table 11).

Table 11. *The Scores of the "Traditional Beliefs" Factor according to Grade Level*

Grade Levels	n	$\overline{x}$	ss
1	65	21,81	4,21
2	62	20,25	4,78
3	61	19,54	3,06
4	42	17,50	7,33
Total	230	19,75	4,002

When Table 4 is examined, it is seen that 1st grade teacher candidates obtained the highest score (21.81) and 4th grade teacher candidates obtained the lowest score (17.5). The mean of the scores of all grade levels, however, was found as 19.75.

One-factor ANOVA was run to test whether there is a significant difference between the scores of "Traditional Beliefs" factor of the teacher candidates in terms of grade level. Results of one-factor ANOVA were given in Table 12.

Table 12.

Results of one-factor ANOVA of the Scores of "Traditional Beliefs" Factor according to Grade Levels

	Sun of squares	Sd	Mean squares	F	η^2
Between groups	203,355	3	67,785		
Within groups	1926,682	227	14,821	4.574*.	.09
Total	2130,037	230			

* One-factor ANOVA, p < 0.05

When Table 12 is examined, it is seen that "Traditional Beliefs" factor of the teacher candidates differed significantly in terms of grade level ($F_{(3-229)}$ =4.574; p< .05). In other words, it appeared that there was a significant difference between the scores of the teacher candidates related to the factor of "Traditional Beliefs" in terms of grade level. According to the result of eta squared, it can be said that the size of the difference was moderate (η^2=.09). Variance homogeneity between groups was examined to determine the source of this difference obtained between grade levels and variance between groups was found to be homogenous. Therefore, LSD test, used when variances are found to be homogenous, was used to determine the source of the difference. The results of LSD test were given in Table 13.

Tablo 13. *Results of LSD Test*

Grade Levels(I)	Grade Levels (J)	Mean Difference (I-J)	Standard Error	p
1	3	2.27	.68	.001
	4	4.31	1.98	.031

* LSD Test, p < .001

According to Table 13, it was found that there was a significant difference between 1st grade teacher candidates and 3rd and 4th grade teacher candidates in terms of the scores of the "Traditional Beliefs" factor.

The factor of constructivist beliefs in terms gender

Means and standard deviations of the scores related to the factor of "Constructivist Beliefs" of primary teacher candidates at each grade level were calculated to test whether there is a significant difference between constructivist beliefs of the teacher candidates in terms of gender (See Table 14).

Table 14.

The Scores of the "Constructivist Beliefs" Factor according to Gender

Gender	n	$\bar{x}$	s	t
Female	152	76,17	15,17	3.134*
Male	78	82,54	7,56	

*t-test, p< 0.05

When Table 14 is examined, it is seen that mean score of the males (82.54) is higher than that of girls (76.17). Independent samples t-test was run to test whether there is a significant difference between the scores of "Constructivist Beliefs" factor of the teacher candidates in terms of gender. It was found that the difference was statistically significant.

The factor of traditional beliefs in terms gender

Means and standard deviations of the scores related to the factor of "Traditional Beliefs" of primary teacher candidates at each grade level were calculated to test whether there is a significant difference between traditional beliefs of the teacher candidates in terms of gender (See Table 15).

Table 15.

The Scores of the "Traditional Beliefs" Factor according to Gender

Gender	n	$\bar{x}$	s	t
Female	152	21,07	4,42	-.705
Male	78	20,48	3,89	

When Table 15 is examined, it is seen that mean score of the males (20.47) is lower than that of girls (21.06). Independent samples t-test was run to test whether there is a significant difference between the scores of "Traditional Beliefs" factor of the teacher candidates in terms of gender. It was found that the difference was not significant statistically.

Difference between the Beliefs of Primary and Primary Mathematics Teacher Candidates

Constructivist beliefs

Independent samples t–test was run to determine whether there is a significant difference between the scores of primary and primary mathematics teacher candidates related to the factor of "Constructivist Beliefs". t-test results were given in Table 16.

Table 16.

The Comparison of PME and PE Teacher Candidates' Scores related to the Factor of "Constructivist Beliefs"

Department of Primary Eduction	n	$\bar{x}$	s	t
PMTE	199	82.21	7,31	1.108
PTE	230	81.16	9,33	

*t-test, p< 0.05

When Table 16 is examined, it appeared that there is not a sgignificant difference between the scores of primary and primary mathematics teacher candidates related to the factor of "Constructivist Beliefs".

Traditioanal beliefs

Independent samples t–test was run to determine whether there is a significant difference between the scores of primary and primary mathematics teacher candidates related to the factor of "Traditional Beliefs". t-test results were given in Table 17.

Table 17.

The Comparison of PME and PE Teacher Candidates' Scores related to the Factor of "Traditional Beliefs"

Department of Primary Eduction	n	$\overline{x}$	s	t
PMTE	199	19,45	3.99	-2.568
PTE	230	19,75	4,00	

*t-test, p< 0.05

When Table 17 is examined, it appeared that there is not a sgignificant difference between the scores of primary and primary mathematics teacher candidates related to the factor of "Traditional Beliefs".

Discussion

This study was conducted with the aim of determining the beliefs of primary and primary mathematics teacher candidates related to the nature, learning and teaching of mathematics. Obtained findings related to the traditional and constructivist beliefs of the teacher candidates were examined in terms of grade level, gender and department.

As a result of data analysis, it was found that primary mathematics teacher candidates' scores of constructivist beliefs have increased when their scores of traditional beliefs have decreased as time passed. The constructivist beliefs of primary mathematics teacher candidates did not differ significantly in terms of grade level, yet it was found that their traditional beliefs differed significantly in terms of grade level. 1st grade teacher candidates had traditional beliefs more and these beliefs have decreased together with upper grade levels. The teacher candidates at upper grade levels were found to have constructivist beliefs more. It is thought that this result may stem from the fact that teacher candidates mostly get pure mathematics courses at 1st grade level and more education courses for teaching mathematics at upper grades. Since constructivist approach in mathematics has been adapted after the revision of the mathematics curriculum in 2005 (Ministry of National Education [MoNE], 2005). Teacher candidates are tought parallel to this approach in the frame of constructivist approach in education courses. Therefore, education courses may provide that teacher candidates have more constructivist beliefs at upper grades.

It appealed the result obtained by being examined the traditional and constructivist beliefs of the primary teacher candidates and primary mathematics teacher candidates were similar to each other. The primary teacher candidates' traditional beliefs decresed while their constructivist beliefs increased with upper grade levels. However, it was found that only the traditional beliefs of the primary teacher candidates differed significantly in terms of grade level. The increase of the number of education courses at upper grades is thought to appear this result, too. In the study conducted by Dede and Uysal (2012) with the teacher candidates educating at the Department of Primary Education, it was found that the participants adopted student-centered

approach more. In this study, it also appeared that both primary and primary mathematics teacher candidates' constructivist beliefs increased with upper grade levels. Therefore, it can be said that the results of this study and the study conducted by Dede and Uysal were parallel to each other. In another study conducted with the teacher candidates educating at the Department of Primary Education, it was also found that the big percentage of the teacher candidates had constructivist beliefs (Sanalan, Bekdemir, Okur, Kanbolat, Baş & Özturan Sağırlı, 2013). It is thought that the idea of these candidates that mathematical knowledge is changable and a kind of human product supports the findings of this study about constructivist beliefs. Similar findings were reached in the study of Boz (2008). In the study examining the beliefs of teacher candidates about the nature and teaching of mathematics, it appealed that teacher candidates had constructivist beliefs generally. In the study conducted by Duatepe Paksu (2008), it was aslo found that the teacher candidates had constructivist beliefs more. Therefore, it is thought that these findings correspond to the findings of the study.

As a result of analysis of data related to the mathematics teacher candidates in terms of gender, it was found that females had more traditional beliefs whereas males had more constructivist beliefs. However, it appealed that beliefs of the mathematics teacher candidates about the nature, learning and teaching of mathematics did not differ significantly in terms of gender. In the study conducted by Kayer, Haser and Bostan (2013), it was found that there was not a significant difference between constructivist beliefs of the teacher candidates in terms of gender and grade level. The reaserchers concluded that the mean score of traditional beliefs of males was lower than that of females, hence it can be said that this finding corresponds to the related finding of this study. Similarly, in another study conducted with primary teachers, it was not found that significant difference in terms of gender (Duatepe Paksu, 2008). It was stated that primary teachers' constructivist beliefs differed significantly in terms of gender, however, the female and male tecahers had similar traditional beliefs. According to this result, it appealed that males had higher scores of constructivist beliefs. In the study of Aypay (2011) conducted with the teacher candidates educating at various departments, it was found that females had more constructivist beliefs whereas males had traditional beliefs more. Therefore, it is seen that this finding of the study of Aypay is not parallel to the finding of this study about gender. However, in the same study, it corresponds to the finding of this study that the decrease in the scores of traditional beliefs with upper grade levels.

As a result of data analysis of the teacher candidates' beliefs about the nature, learning and teaching of mathematics in terms of department, it appeared that there was not a significant difference between the constructivist and traditional beliefs of the primary and primary mathematics teacher candidates. However, it is seen that the score of the primary mathematics teacher candidates related to the constructivist beliefs was higher than that of the primary teacher candidates while their score of traditional beliefs was lower than that of the primary teacher candidates. Therefore, it can be said that the primary teacher candidates had more traditional beliefs. In the study of Duatepe Paksu (2008), it was found that the score of primary mathematics teachers related to constructivist beliefs was higher than the sores of other teachers. In this study, it appealed that the primaty mathematics teacher candidates had constructivist beliefs more although the difference was not significant statistically. Hence, it can be asserted that this finding is parallel to the finding found in the study conducted by Duatepe Paksu (2008).

As a result of this study it was found that both primary and primary mathematics teacher candidates had constructivist beliefs more as time passed. Therefore, the reason of the change of the beliefs of teacher candidates from traditional to constructivist may be investigated deeply and real reasons may be exposed. Moreover, it is stated in some researches that beliefs of teachers tend to differ through ther pre-service program (Stipek, Givvin, Salmon & MacGyvers, 2001). Therefore, it is thought that examination of teachers' beliefs at the beginning and at the end of the program could also contribute to evaluate the effectiveness of pre-service programs.

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