# Examining Turkish Preservice Elementary Teachers' Beliefs about the Nature and the Teaching of Mathematics*

**Yuksel DEDE**
Department of Mathematics Education
Faculty of Education
Cumhuriyet University
58140, Sivas, Turkey.

**Figen UYSAL**
Department of Mathematics
Faculty of Science and Letters
Bilecik University
11210, Gülümbe, Bilecik, Turkey.

## Abstract

*The purpose of this study was to investigate Turkish preservice elementary teachers' beliefs about the nature and the teaching of mathematics. The participants of the study consist of 96 preservice elementary teachers from a department of primary education in a state university in Turkey during the 2010-2011 spring term. Beliefs about Teaching Mathematics Scale and Beliefs about Nature of Mathematics Scale were used as the measuring instruments. The results of this study were: a) the preservice elementary teachers' scores on about the nature and the teaching of mathematics (child-centredness) were high in general, b) statistically; there exist significant correlation between the beliefs about nature and teaching of mathematics. As a result, some recommendations concerning the situation and future research were suggested.*

**Keywords:** Mathematics teaching beliefs, beliefs about nature of mathematics, preservice teachers.

## *1. Introduction*

Teachers' and students' mathematical beliefs have been a topic of interest in mathematics education research for the last three decades and have been studied from different perspectives (Handal, 2003; Kagan, 1992; Leder et al, 2002; Roesken, 2011). About three decades ago an individual's attitude toward mathematics was brought up as one of the central research topics in mathematics education. But, the focus of research has changed from broadly defined attitudes to more specific sub-concepts: emotions, narrowly defined attitudes, values, and, most commonly, beliefs (Pehkonen, 2004, p.2). Goldin (2002) also distinguished emotions, attitudes, beliefs and values in mathematics education: (1) *emotions* (rapidly changing states of feeling, mild to very intense, that are usually local or embedded in context), (2) *attitudes* (moderately stable predispositions toward ways of feeling in classes of situations, involving a balance of affect and cognition), (3) *beliefs* (internal representations to which the holder attributes truth, validity, or applicability, usually stable and highly cognitive, may be highly structured), and (4) *values, ethics, and morals* (deeply-held preferences, possibly characterized as "personal truths", stable, highly affective as well as cognitive, may also be highly structured). (p. 61).

### 1.1 Mathematics beliefs

The importance of beliefs for the teaching and learning of mathematics is widely recognized among mathematics educators (Reosken et al., 2011). Any set of practices in a professional field is necessarily related to some perspective regarding the central objects in that field. Given the important role of the teacher in the education process, it appears quite natural to study in_depth his or her personal philosophies about mathematics. Thus, to have some insight into the way the teachers understand and carry out their job one needs to know their conceptions and beliefs about curriculum, learning, and teaching (Ponte, 1999, p. 43).

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**A part of the study was presented as "The Relationship between the beliefs about the nature and teaching of mathematics of the prospective elementary teachers" at 35th Conference of the International Group for the Psychology of Mathematics Education, Ankara, Turkey, July 2011 in the poster presentation.*

Although beliefs have been a very popular element of research in recent decades, the theoretical concept of "belief" has not yet been dealt with thoroughly, and this construct lacks a commonly agreed definition (Beswick, 2006; Boz, 2008; Furinghetti &Pehkonen, 2002; Hannula at al 2004; Leder at al 2002; Pehkonen, 2004). Hence, there is not one concept 'belief' used in the field, but many closely related ones. For example, beliefs are considered equal to concepts, meanings, propositions, rules, preferences or mental images (Thompson, 1992). On other occasions, beliefs are seen in a much broader sense as "mental constructs that represent the codifications of peoples' experiences and understandings" and that shape their perception and cognition in any set of circumstances (Schoenfeld, 1998, p.19). Schoenfeld (1985) defined mathematical belief system as one's mathematics world view that means the perspective with which he/she approaches mathematics and mathematical tasks. Sigel (1985) described beliefs as "mental constructions of experience" (p.351).

According to Richardson (1996), beliefs are "psychologically held understandings, premises, or propositions about the world that are felt to be true" (p. 103). Raymond (1997) defined mathematics beliefs as personal judgments about mathematics formulated from experiences in mathematics, including beliefs about the nature of mathematics, learning mathematics, and teaching mathematics. Gorman (1991) also divided mathematics beliefs into three parts: beliefs about mathematics as a discipline, beliefs that individuals hold about themselves and how they learn mathematics, and beliefs about what an individual do to learn mathematics. Since the spectrum of an individual's beliefs are very wide, usually being grouped in clusters. Beliefs form systems that have a quasi-logical structure, and that might- or might not- be in connection with other belief systems. Therefore, the term belief system is used as a metaphor to represent how the individual's beliefs are structured (Pehkonen, 2004, p.3).

### 1.2. Teachers' mathematics beliefs

Educationalists have attempted to systematize a framework for teachers' mathematical belief systems into smaller sub–systems. Most authors agree with a system mainly consisting of beliefs about (a) what mathematics is, (b) how mathematics teaching and learning actually occurs, and (c) how mathematics teaching and learning should occur ideally (Handal, 2003, Ernest, 1989; Thompson, 1991). Ernest (1989) identified three main components of teachers' mathematical belief systems: teachers' views of the (1) nature of mathematics, (2) features of mathematics teaching, and (3) process of learning mathematics. According to Ernest (1989), the teachers' conception of nature of mathematics, is his or her belief system concerning the nature of mathematics as a whole and closely related beliefs about mathematics teaching and learning. In relation to the nature of mathematics, He has identified three conceptions of mathematics:

a) Instrumentalist view that mathematics is an accumulation of facts, rules and skills to be used in the pursuance of some external end. Thus mathematics is a set of unrelated but utilitarian rules and facts, b) Platonist view of mathematics as a static but unified body of certain knowledge. Mathematics is discovered, not created, c) The problem solving view of mathematics as a dynamic, continually expanding field of human creation and invention, a cultural product. Mathematics is a process of enquiry and coming to know, not a finished product, for its results remain open to revision (p.1). There are many ways in which teachers' beliefs about mathematics and its teaching and learning have been characterized. Two categories of beliefs can be described as below:

**transmission:** The traditional view of mathematics as a static discipline which is taught and learned through the transmission of mathematical skills and knowledge from the teacher to the learner and where "mathematics [is seen] as a rigid system of externally dictated rules governed by standards of accuracy, speed and memory." (National Research Council 1989, p.44; cited in Perry et al., 2006, p.439).

**child-centredness:** Students are actively involved with mathematics through "constructing their own meaning as they are confronted with learning experiences which build on and challenge existing knowledge." (Anderson, 1996, p. 31).

Another classification posits four dominant views on how mathematics can be taught: content-focused with an emphasis on performance, content-focused with an emphasis on understanding, classroom-focused where the focus is on mathematical content through classroom activity, and learner-focused where mathematics teaching focuses on the learner's personal construction of knowledge (Kuhs & Ball, 1986). According to Thompson (1992), teachers' beliefs about teaching mathematics can be revealed in following aspects: desirable goals of the mathematics program, a teacher's role in teaching, appropriate classroom actions and activities, desirable instructional approaches and emphases, and legitimate mathematical procedures.

Similarly, teachers' beliefs about the learning of mathematics cover the processes of learning mathematics, what behaviors and mental activities are involved on the part of the learner, and what constitute appropriate and prototypical learning activities. Ernest (1989) has also proposed three teaching models to reflect the various roles a teacher might play in a classroom: instructor model, explainer model, and facilitator model. In addition to setting forth three philosophies of mathematics, Ernest (1989) discussed how those philosophies might be related to philosophies about the teaching and learning of mathematics. Leatham (2002) had summarized these posited relationships in the following table (Table 1):

**Table 1. Ernest's three philosophies of mathematics**

| | Instrumentalist | Platonist | Problem solving |
|---|---|---|---|
| Nature of mathematics | An accumulation of facts, rules, and skills | A static but unified body of certain knowledge | A dynamic continually expanding field of human creation and invention |
| Teacher's role | Instructor | Explainer | Facilitator |
| Intended outcome | Skills mastery with correct performance | Conceptual understanding with unified knowledge | Confident problem posing and solving |
| Use of curricular materials | Strict adherence to a text or scheme | Modification of the textbook approach, enriched with additional problems and activities | Teacher, student, or school construction of the mathematics curriculum |

### 1.3. Studies on teachers' mathematics beliefs

Two types of research have dominated the literature about mathematics teachers' beliefs. Some studies have aimed to investigate descriptively mathematics teachers' beliefs about mathematics teaching, learning and the nature of mathematics; other studies have explored the relationship between mathematics teachers' beliefs and their teaching practices (see Boz, 2008; Handal, 2003; Kagan, 1992). For example, Frank (1990) surveyed the mathematical beliefs of preservice teachers and found a high level agreement in items such as: (a) "Some people have a mathematical mind and some don't", (b) "Mathematics requires logic not intuition", and (c) "You must always know how you got the answer" (p. 11) (cited in Handal, 2003). Handal (2003) indicated in his review study that a growing body of literature suggests that preservice teachers hold sets of beliefs more traditional than progressive with respect to the teaching of mathematics. Nisbet and Warren (2000) surveyed 389 primary school teachers with regard to their views on mathematics as a subject, and teaching and assessing mathematics.

They found that: a) primary teachers hold limited views of what mathematics is static and mechanistic views, rather than the view as a dynamic problem-driven ever expanding field of human creation (a view more aligned with the constructivist model of learning) and this impacts on their approach to teaching, b) the factors relating to teaching mathematics seem to reflect the types of environments mathematics teaching tends to occur in a traditional environment with tasks unrelated to the real world and few concrete materials, and a contemporary environment where hands-on materials are valued, mathematics is related to out-of-school experiences and problem solving is encouraged. Paksu (2008) surveyed 324 teachers' (195 primary school teachers, 52 science teachers, 40 mathematics teachers, and 37 preschool teachers) mathematical beliefs in terms of their branches and gender. The result of this study revealed that finding the correct answer is very important to be successful in mathematics and the mathematics can only be learned from teacher and, questions should be solved by the way taught by the teacher and exercises in a book can only be done by using the methods given in the book, they are in a transition with the idea of in order to be successful in mathematics, you need to be good at memorizing.

Boz (2008) investigated pre-service mathematics teachers' beliefs about teaching mathematics in terms of the instructional approach, role of the teacher, interaction among students and between students and the teacher during class. The study found that few of the preservice teachers held traditional beliefs; most followed the constructivist view of teaching.

## *2. Purpose and Importance of the Study*

What goes on in the mathematics classroom may be directly related to the beliefs teachers hold about mathematics. Hence, it has been argued that teacher beliefs play a major role in their students' achievement and in their formation of beliefs and attitudes towards mathematics (Emenaker, 1996).

Studies show that the relationship between teachers' mathematical beliefs and their instructional practice is dialectical in nature and is mediated by many conflicting factors (see Thompson, 1992; Wood et al., 1991; Pajares, 1992, Ponte, 1999). Teachers' beliefs do influence their instructional practice; however, a precise one-to-one causal relationship cannot be asserted because of the interference of contingencies that are embedded in the school and classroom culture. Elementary teachers have a central position in mathematics teaching, since they are responsible for children's first mathematics studies. Teachers' teaching methods and classroom practices convey little by little their view of mathematics to students (Laine at al., 2004). Addressing the beliefs preservice elementary school teachers hold toward mathematics is critical to improving the mathematical performance of students, because these beliefs can have a strong influence on his/her approach to teaching mathematics (Emenaker, 1996). At the same time, according to results of various research studies, beliefs of teachers about the nature and the teaching of mathematics influence both effectiveness of teaching of mathematics and the occurrence of their students' beliefs about those subjects (Bulut & Baydar, 2002).

Taking account into the reasons which mentioned above, the research about mathematical beliefs of preservice elementary teachers is important and useful in education. In addition, investigating relationship between nature and teaching of mathematics will enable a better understanding of mathematical beliefs. Hence, in this study we aimed to determine preservice elementary teachers' beliefs about nature and teaching of mathematics and to point out the relationship in between these two issues. In particular, it considered these research questions:

**1)** What are the preservice elementary teachers' beliefs about the nature and the teaching of mathematics?
**2)** Is there any significant correlation between the preservice elementary teachers' beliefs about the nature of mathematics and the teaching of mathematics?

## *3. Method*

According to Pajares (1992), "beliefs cannot be directly observed or measured but must be inferred from what people say, intend, and do fundamental prerequisites" (p. 207). The advantages and disadvantages of the techniques used to measure attitudes and beliefs continue to be debated in the literature. When looking at the literature, beliefs were measured using a variety of techniques. These included questionnaires, interviews, content analysis of journal entries, reflections, post lesson conferences, and observations (Leder&Forgasz, 2002).

The present study was only limited with data quantitative in nature. The research data were collected through a survey questionnaire, in which two six-point scales were used to ascertain the preservice elementary teachers' beliefs about how the teaching of mathematics should be and the nature of mathematics and to point out the relationship in between these two issues. It was selected because such a survey questionnaire could provide valuable information about preservice elementary teachers' beliefs about mathematics. It is normally carried out to gather information on how people think about a certain issue, in this case, about their own mathematics beliefs (Rosnow&Rosenthal, 1996). It is appropriate for collecting descriptive data, as it tries to describe, because, in descriptive model, the features are found out as their original forms (McMillan, 2000). In this study, the description of the Ernest (1989) and Anderson (1996) about the mathematics beliefs were used. This study indicated the present situations of preservice elementary teachers' beliefs about mathematics. The research was conducted in 2010-2011 spring term with 96 students of Department Primary Education in a state university in Central Anatolia in Turkey. The sample involves 72 female and 24 male student teachers.

They were enrolled in a four-year teacher education program at the Primary Education. During this period, preservice elementary teachers in this program are obliged to complete subject matter courses related to mathematics such as General Mathematics I and General Mathematics II. They are also obliged to complete the pedagogical courses such as Introduction to Teaching Profession, Methods of Mathematics Teaching, Classroom Management, Instructional Technology and Material Development. They also have to complete two School Experience courses in the last two semesters so as to have the chance to observe teaching as a profession and the culture of a school and classroom. While the current study have been carried out, the pre-service teachers in our sample have only taken General Mathematics (4 hour per week) as subject matter course related to mathematics and Introduction to Teaching Profession (3 hour per week) as pedagogical course. They have also taken Computer I, Turkish I: Writing skills, Atatürk's Principles and History of Turkish Revolution I, Foreign Language I and some elective courses. For data collection a scale for the "Beliefs about the Teaching of Mathematics [BaToM]" and "Beliefs about the Nature of the Mathematics [BaNoM]" which was developed by Baydar (2000) were used. Short information about the scales is presented below:

The BaToM was used to assess preservice elementary teachers' beliefs on the teaching of mathematics. It was developed by Baydar (2000) and was prepared as a six-point rating scale. The participants were asked to indicate their level of support for each item in the scale, ranging from "strongly disagree = 1" to "strongly agree = 6". Furthermore, negatively worded items were reversed to a positive direction for scoring purposes. This six-point scale was used to disallow the undecided response in five-point scales. High scores indicate to more fully convey beliefs toward mathematics teaching. The single factor could be labeled and described as "general belief about the teaching of mathematics". The alpha reliability coefficient of the BaToM was found as 0.84 (for all the items of the BaToM, see Table 2).

**Table 2. The means and the standard deviations of the teacher candidates' scores for the items of beliefs about teaching mathematics**

| Items | n | Mean | SD |
|---|---|---|---|
| 1. It should be explained why mathematics is taught to students. | 96 | 5.34 | 1.02 |
| 2. To provide students' understanding of mathematics is not a responsibility of the teacher. | 96 | 4.63 | 1.52 |
| 3. Teachers should give importance to the estimation of the results. | 94 | 4.40 | 1.36 |
| 4. It should be endeavored to have the students gain the ability to make a connection between mathematics and the other fields. | 94 | 5.33 | 0.88 |
| 5. The students don't need to gain reexamine skills for the complete solution. | 96 | 4.63 | 1.40 |
| 6. It should be aimed to have the students gain the ability to make a connection between mathematics and the other fields. | 95 | 5.08 | 1.35 |
| 7. It is unnecessary to endeavor to gain the ability for setting up the relationship between daily life and mathematical language. | 95 | 4.39 | 1.59 |
| 8. Teacher should try to use different strategies so as to have the students gain problem solving skills. | 96 | 5.56 | 0.70 |
| 9. It should be endeavored for the students to gain mathematical ability. | 95 | 5.40 | 0.84 |
| 10. It is not necessary to concentrate on solving real life problems. | 94 | 4.55 | 1.58 |
| 11. Attention should be paid to teach mathematical thinking. | 95 | 5.25 | 1.04 |
| 12. Teacher should endeavor to change students' attitudes towards mathematics in a positive way. | 94 | 5.48 | 0.95 |
| 13. Importance should be given to problem solving including understanding the problem, making a plan, applying the plan and control steps. | 96 | 5.23 | 0.98 |
| 14. Many mathematical subjects are unsuitable for teaching method of exploring. | 94 | 3.88 | 1.55 |
| 15. Importance should be given more on to memorize concepts and rules. | 93 | 4,08 | 1.66 |
| 16. Students' self-confidence in mathematics should be increased. | 96 | 5.54 | 0.84 |
| 17. In most of the mathematics subjects, it is impossible to find examples from actuall life. | 93 | 3.48 | 1.55 |
| 18. Mathematics teacher should mention historical development process of the taught subject. | 94 | 5.56 | 0.70 |
| 19. Mathematics teacher should give importance to students' ideas and should listen their opinions about mathematical subjects. | 96 | 5.40 | 0.84 |
| 20. In class, there is no need for the students to express their ideas by mathematical language. | 95 | 3.91 | 1.79 |
| 21. The students should derive new problem from the problem solved in the class. | 96 | 5.09 | 1.14 |
| 22. It should not be allowed to use calculators in teaching mathematics. | 96 | 2.68 | 1.61 |
| 23. Students can understand math beter if they study together. | 92 | 4.30 | 1.42 |
| 24. For better understanding concrete materials graphs and charts should be used. | 96 | 5.00 | 1.19 |
| 25. The importance of the mathematics in real life applications must be thought with using references to the application areas. | 96 | 5.00 | 1.11 |
| 26. It should be encouraged to use the terms proposed by the students besides traditional terms and symbols. | 95 | 4.60 | 1.20 |
| 27. Methods different then the traditional ones must be used. | 94 | 4.85 | 1.11 |
| 28. Should be encouraged to use symbolic narratives such as metaphors, analogy and comparison. | 92 | 4.59 | 1.28 |
| 29. Computers should be used in teaching mathematics. | 96 | 3.75 | 1.42 |
| 30. Teacher should not teach the short way when doing exercises and solving problems. | 92 | 4.75 | 1.48 |
| 31. More exercises and repetitions should be used in teaching mathematics | 95 | 5.27 | 1.01 |
| 32. The overhead should be used in teaching mathematics. | 92 | 4.18 | 1.57 |
| 33. The best way of teaching mathematics is lecture method. | 95 | 3.81 | 1.62 |
| 34. Discussion method should not used in teaching mathematics. | 96 | 4.32 | 1.62 |
| Total | 96 | 4.63 | 0.43 |

The BaNoM was used to assess prospective elementary teachers' beliefs on the nature of mathematics. It was also developed by Baydar (2000) and was also prepared as a six-point rating scale.

The subjects were asked to indicate their level of support for each item in the scale, ranging from "strongly disagree =1" to "strongly agree = 6". Furthermore, negatively worded items were reversed to a positive direction for scoring purposes. This six-point scale was used to disallow the undecided response in five-point scales. High scores indicate to more fully convey beliefs toward the nature of mathematics. The single factor was named as "general belief about the nature of mathematics". The alpha reliability coefficient of the BaNoM was found as 0.63 (for all the items of the BaNoM see Table 3).

**Table 3: The means and the standard deviations of the teacher candidates' scores for the each item of beliefs about nature of mathematics**

| Item | n | Mean | SD |
|---|---|---|---|
| 1. Mathematics has no effect on mental development. | 94 | 5.40 | 1.21 |
| 2. Mathematics is a language. | 95 | 4.63 | 1.57 |
| 3. Mathematics is an issue to be addressed for everybody. | 95 | 4.82 | 1.34 |
| 4. Mathematics is a science which explains the natural events by numbers. | 94 | 4.49 | 1.45 |
| 5. Mathematics improves problem solving skill. | 95 | 5.59 | 0.59 |
| 6. Mathematics is an art like painting, music and poetry. | 95 | 3.73 | 1.78 |
| 7. Mathematics is a science dealing with numbers. | 94 | 5.43 | 0.87 |
| 8. Mathematics is a form of thinking that people have developed to solve problems encountered in their life. | 93 | 4.95 | 1.24 |
| 9. Mathematics is not a need for the society. | 95 | 5.07 | 1.26 |
| 10. Mathematics makes life easy. | 95 | 5.13 | 1.16 |
| 11. Mathematics is not a tool used for development of civilization. | 94 | 4.79 | 1.46 |
| 12. The logic is necessary for the understanding of mathematics but intuition is not. | 95 | 4.94 | 1.31 |
| 13. Creativity has no place in mathematics. | 94 | 4.68 | 1.59 |
| 14. Mathematics helps to gain reasoning. | 94 | 5.54 | 0.77 |
| 15. Mathematics is a game. | 95 | 4.42 | 1.56 |
| 16. Mathematics is a tool for the development of other sciences. | 94 | 5.16 | 1.12 |
| Total | 96 | 4.92 | 0.63 |

The scales were administered to ninety-six participants who were selected by convenience sampling. It was used because the subjects were chosen on the basis of their willingness and accessibility to participate (Gravetter & Forzano, 2008) and it fits the goals of the research and is convenient (Gall & Borg, 1996). It took thirty minutes to complete the scales. The purpose of the study is clearly explained to the preservice elementary teachers by the researchers. Furthermore, the researchers ensured that teachers by the researchers' responses of the scales would be confidential. Data analysis involved descriptive and inferential statistics. A significance level of 0.05 was set for all inferential tests. Descriptive statistics were calculated to analyze the beliefs of the subjects. Bivariate correlation analysis was also performed to analyze the collected data.

## *4. Results*

The findings related with each question will be given in an order.

**Question 1. What are the prospective elementary teachers' beliefs about the nature and the teaching of mathematics?**

The means and the standard deviations of the preservice elementary teachers' scores of the scales "Beliefs about the teaching of Mathematics [BaToM]" displayed in Table 2.The mean scores changes between 2.68 and 5.56 out of 6 for the items of the scale. In terms of the six-point scale, these means indicate that the beliefs expressed toward the teaching of mathematics were positive ($M > 4.5$ but $< 5.0$).

According to these scores, we can say that the teacher candidates strongly agreed with the items 1, 4, 6, 8, 9, 11, 12, 13, 16, 19, 21, 24, 25, 31. All of these indicate child-centredness beliefs except item 31. Particularly, teacher candidates believed that it should be explained why mathematics is thought to students and students should have ability to express the relations between mathematics topics.

Teacher candidates also believed that teacher should try to use different strategies so as to gain problem solving skills to the students. According to the teacher candidates, teacher should give importance to problem solving and mathematical thinking in teaching of mathematics. The preservice elementary teachers also believed that teacher should endeavor to change students' attitudes towards mathematics in a positive way and to increase students' self-confidence in mathematics. The preservice elementary teachers thought that teachers should give importance to students' ideas and should listen their opinions about mathematical subjects. They also believed that concrete materials, graphs and charts should be used. The preservice elementary teachers also strongly agreed that methods different from the traditional ones such as computers should be used in teaching mathematics.

The preservice elementary teachers also believed that it should be encouraged to use the terms proposed by the students besides traditional terms and symbols. The teacher candidates agree that teachers should pay attention to estimate and verify the results. They also believed that it should be endeavored to gain the ability to set up the relationship between daily life and mathematical language. The preservice elementary teachers thought that teachers should teach how the student can solve real-life problems and can think in mathematical way. The preservice elementary teachers also believed that teacher must not teach the short way when doing exercises and solving problems. However teacher candidates didn't agree that calculators should be used and they believed that more exercises and repetitions must be used in teaching mathematics. They also believed that the best way of teaching mathematics is by lecture method.

The means and the standard deviations of the preservice elementary teachers' scores for the each item of the scales "Beliefs about the nature of the mathematics [BaNoM]" are displayed in Table 3. The mean scores changes between 3.73 and 5.59 out of 6 for the items of the scale. According to these scores, we can say that teacher candidates strongly agreed with the items 1, 5, 9, 10, 14, 16. The preservice elementary teachers thought that mathematics affects mental development and improves problem solving skills of children.

They also believed that mathematics is a need for the community and makes life easy. The preservice elementary teachers thought that mathematics is a tool for the development of other sciences and helps to gain reasoning. The teacher candidates also agreed that mathematics is a language, a game, an issue to be addressed for everybody and a form of thinking that people have developed to solve problems encountered in their life. We can see from the Table3, the lowest mean score belongs to Item 6 which mentions mathematics as an art like painting, music and poetry. All items we explained above indicate child-centredness beliefs. However teacher candidates believed that mathematics is a science dealing with numbers and explains the natural events by numbers. These items are not consistent with child-centredness view.

Considering the mean score of preservice elementary teachers on about nature of mathematics, we can say that students who included in the study have child-centredness view. At the same time, from the mean score of the students' beliefs about teaching of mathematics, we can categorize their beliefs as child-centredness.

**Question 2. Is there any significant correlation between the preservice elementary teachers' beliefs about the nature of mathematics and the teaching of mathematics?**

After performing Bivariate correlation analysis to our data, we have seen that there exist a positive and meaningful relationship ($r = 0.51$, $p < .001$) at a medium level between the preservice elementary teachers beliefs' about the nature of mathematics and the teaching of mathematics.

## *5. Discussion*

The findings of the study revealed that preservice elementary teachers of the study have child-centredness view about nature and teaching of mathematics. These results are inconsistent with some findings of previous studies (Frank, 1990; Foss & Kleinsaser, 1996; Paksu, 2008; Nisbet & Warren, 2000). Paksu reported that teachers held more traditional beliefs and perceive mathematics as a discipline with rules and procedures that has to be memorized rather than a dynamic, continually expanding field of human creation and invention, a cultural product. Foss, Foss and Kleinsaser (1996, cited in Handal (2003)) found that preservice elementary teachers placed great emphasis on practice and memorization. Frank (1990) and Nisbet & Warren (2000) reported similar conservative trends in teachers' beliefs. From our second research question, we also found that there exists a positive and meaningful relationship at a medium level between the preservice elementary teachers' beliefs' about the nature of mathematics and the teaching of mathematics.

This result is consistent with some previous studies. For instance, Hersh stated (1986) "one's conception of what mathematics affects one's conception of how it should be presented" (p.31) (cited in Emenaker, 1996). Emenaker (1996) also indicated that beliefs preservice elementary school teachers hold toward mathematics can have a strong influence on his/her approach to teaching mathematics. Furthermore, Ernest (1989) examined the relationships between teachers' views of the nature of mathematics and their model of its teaching and learning and showed how teachers' views of the nature of mathematics provide a basis for teachers' mental models of teaching and learning of mathematics. For example, the instrumental view of mathematics is likely to be associated with the instructor model of teaching, and with strict following of text or scheme. From our result, we can say that the problem solving view is to be associated with the model of teaching that see the teacher as facilitator and learning as the active construction of understanding (i.e child-centredness model).

On the other hand, results of the present study revealed that preservice elementary teacher candidates were generally expressing beliefs compatible with the mathematics education curricula in Turkey (MEB 2009a, b). In making this perspective it is thought that preservice elementary teacher candidates have still adopted or adapted the constructivist approaches (child-centeredness beliefs) to their math learning. Boz (2008) also conducted a study on Turkish preservice mathematics teachers' beliefs and our finding about teaching of mathematics is consistent with his findings. Most of the participants in his study held non-traditional beliefs about mathematics teaching as well. To interpret these findings and to get better understanding, it is useful to look at Turkish educational system. Because the influence of teacher education programs have been covered in the literature (for further details see Borko et al., 1992). Turkish Ministry of National Education [MEB] for Elementary and Secondary Education, and Higher Education Council [YÖK] for Higher education in Turkey are responsible bodies for planning, implementation and coordination. The national and international comparative studies on mathematics teaching showed that Turkish students' mathematics achievement was observed to be lower than the students' mathematics achievement in other countries (Education Research and Development Directorate [EARGED] 2005).

In order to understand this problem, primary school and secondary school mathematics curricula were newly developed on the basis of constructivist approaches in Turkey (see MEB 2009a, MEB 2009b). Then, accreditation of faculties of education based on constructivism was started in 1997 and continued in successive years till 2007. MEB (2005) explained the purpose of mathematics teaching in Turkey as follows:

Learning and teaching the system of mathematical thinking; relating basic mathematical skills (e.g. problem solving, reasoning, connections, generalization, and affective and psycho-motor skills development) and abilities based on these skills to real life problems; improving their mathematics skills and abilities while preparing the youth to the real life with math studies; understanding some of the elements on which math based; assessing our place in earth culture society; teaching the importance of math in the artistic dimension; teaching that math is a systematic knowledge and a computer language. (pp. 4-5).

On the other hand, in the Turkish elementary school and high school math curriculum (MEB 2009a, b), it was emphasized that students' affective development should be taken into consideration when mathematical concepts and skills are developed. In curriculums, some targets at attitudes are: Enjoyment in dealing with mathematics, thinking mathematics contributes scientific and technological developments, not having too much anxiety which negatively affects mathematics success and feelings and thoughts related to mathematics, belief in mathematics for contributing the logical decisions (MEB 2009a, b)

## *6. Limitations and Implications for Future Studies*

Addressing the beliefs preservice elemantary school teachers hold toward mathematics is critical to improving the mathematical performance of students, because these beliefs can have a strong influence on his/her approach to teaching mathematics (Emenaker, 1996). Investigating the beliefs of teachers and making reasonable inferences from these findings to teacher candidates is useful but it would require longitudinal investigations. Teachers' beliefs can be understood in context of teaching practice and student outcomes, but as these are not in evidence during the preservice experience, the conceptions of teacher candidates have few referent points against which to be compared (Pajares, 1993, p.49). The findings of this current study revealed that the preservice elementary teachers have the child-centredness beliefs. One of the underlying reasons for the findings of this study might be the reform movements in education in Turkey.

As mentioned before, primary and secondary school mathematics curricula were newly developed on the basis of constructivist approaches and a new system for education faculties in Turkey was started in 1997. The preservice elementary teachers who involved in this current study held child-centredness beliefs which may result from their university training.

This present study is limited with the responses given by preservice elementary teachers to items in the scales in a natural setting. It may be difficult to identify teachers' beliefs using only a survey therefore further studies could involve in-depth interviews with the preservice elementary teachers in order to understand what key reasons behind their mathematics beliefs. It is also needed to study why the teacher candidates put more emphasis on the child-centredness beliefs. Furthermore the questions of what is the effect of newly developed primary and secondary school curriculum on this result and what is the effect of preservice elementary teacher education programme can be investigated. Future study might investigate, as an open issue, change in teachers' beliefs.

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