



Mathematics Anxiety and Beliefs of Turkish Pre-service Elementary Teachers

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The purpose of this study was to investigate the relationship between pre-service elementary teachers' mathematics teaching beliefs and mathematics anxiety. The participants of the study consist of 96 pre-service elementary teachers from a department of primary education in a state university in Turkey during the 2010-2011 spring term. Mathematics Anxiety Rating Scale: Short Version and Beliefs about Teaching Mathematics Scale were used as the measuring instruments. The results reveal that pre-service elementary teachers' scores on beliefs about teaching mathematics were high whereas mathematics anxiety levels were low in general. The correlations between the sub-scales of the MARS-SV and child-centeredness beliefs are not significant at the 0.05 level. As a result, some recommendations concerning the situation and future research were made.

Keywords: mathematics anxiety, mathematics teaching beliefs, pre-service elementary teachers

INTRODUCTION

Affect may influence how the students utilize mathematics for their future and how they approach mathematics in contexts -like in the other cognitive domains. In this regard, affective components play a key role in influencing the learning environment in any classroom (Meelissen & Luyten, 2008; Meijer, 2007). Moreover, they can also play an important role in students' decisions about how they approach the mathematical content they do study (Reyes, 1984). So affective studies are generally at the center of mathematics education (Tsamir & Tirosh, 2009) and especially in recent years, much research has been conducted into the affective domain of mathematics education (Grootenboer & Hemmings, 2007). The complex interaction of the affective and the cognitive domains in the learning and teaching of mathematics continues to be an important area of investigation for mathematics educators (Perry, Wong & Howard, 2006). Studies (i.e., Reyes, 1984; Wigfield & Meece, 1988) have found that affective variables, such as attitude, motivation, and

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anxiety are strongly linked to learning mathematics. McLeod (1992) also indicated that one affective factor that “has probably received more attention than any other area that lies within the affective domain” (p. 584) is anxiety toward mathematics. The research investigating mathematics anxiety dates back over 40 years. As a consequence of the complexity of mathematics anxiety, research in this area has addressed a variety of related topics. Specifically, researchers of mathematics anxiety have investigated its origins, the factors associated with mathematics anxiety, the cognitive affective and behavioral consequences of mathematics anxiety as well as methods to reduce an individuals’ mathematics anxiety (Rayner, Pitsolantis & Osana, 2009). Mathematics anxiety was a critical factor not only for student learning, but also for teachers’ effectiveness (Isiksal, 2010). It exists in some adults, including teachers, and is influenced by people’s beliefs (Jackson, 2008). Kogelman and Warren (1978) claimed that erroneous beliefs about mathematics can also influence math anxiety (cited in Austin, Wadlington & Bitner, 1992). Since teachers’ beliefs influence their teaching, the role of beliefs in teaching and learning continues to interest many researchers (Paksu, 2008). Pajares (1992) suggested that beliefs are “the single most important construct in educational research” (p. 327). Although mathematics anxiety is associated with various constructs, few studies focused on the relationship among these affective variables. Therefore examining the relationship between mathematics anxiety and mathematical beliefs has important contributions to the literature.

What are beliefs?

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 upon definition (Beswick, 2006; Boz, 2008; Furinghetti & Pehkonen, 2002; Hannula, Evans, Philippou, & Zan, 2004; Leder, Pehkonen & Toerner, 2002; Pehkonen, 2004). Unfortunately, the word belief has been used with different meanings in mathematics education discourse communities. 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). Similarly, Sigel (1985) also 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). On the other hand, beliefs are frequently

State of the literature

- Affective variables play a central role in mathematics learning and teaching. As a consequence of the complexity of mathematics anxiety, research in this area has addressed a variety of related topics and investigated its origins, the factors associated with mathematics anxiety.
- At the same time, teachers’ and students’ mathematical beliefs have been a topic of interest in mathematics education research for the last three decades.
- Mathematics beliefs related studies focused heavily on teachers’ and students’ mathematical beliefs in terms of determination, the relations with other affective variables and teaching practices.

Contribution of this paper to the literature

- The majority of existing research treats math anxiety and mathematical beliefs separately. Although some studies have reported the importance of research about math anxiety, mathematical beliefs and the relation between these two variables, a few studies have been conducted to investigate this relation and more research is certainly needed.
- The research on mathematics anxiety and beliefs about mathematics in Turkey is quite a recent achievement.
- Therefore, this current study intends to provide insight into relationship between the beliefs about teaching mathematics and anxiety level of Turkish pre-service elementary teachers.

confused with other affective components: attitudes and emotions. McLeod (1992) explained the differences among these as below:

... emotions as the most intense and least stable, beliefs as the most stable and least intense, and attitudes as somewhere in between on both dimensions. Beliefs were seen as the most 'cognitive', and emotions as the least so. (p. 107)

Leder and Grootenboer (2005) have also proposed a model which distinguishes these concepts in the affective domain of mathematics (including also values) from each other as shown in Figure 1.

Teachers' mathematical beliefs

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. 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 does to learn mathematics. 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).

Teachers' and students' mathematical beliefs have been a topic of interest in mathematics education research for the last three decades. As the beliefs of the mathematics teachers have a strong effect on the mathematics teaching (Ernest, 1989), to determine the beliefs of the teachers about learning and teaching mathematics have a predominant role (Perry, Wong, & Howard, 2006). Emenaker (1996) indicated that teachers' beliefs play a major role in their students' achievement and in the formation of their beliefs and attitudes towards mathematics. Addressing the beliefs held by pre-service elementary school teachers toward mathematics therefore is critical for improving their teaching skills and the mathematical learning of their students. Two categories of mathematics teachers' mathematics beliefs can be described as follows:

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

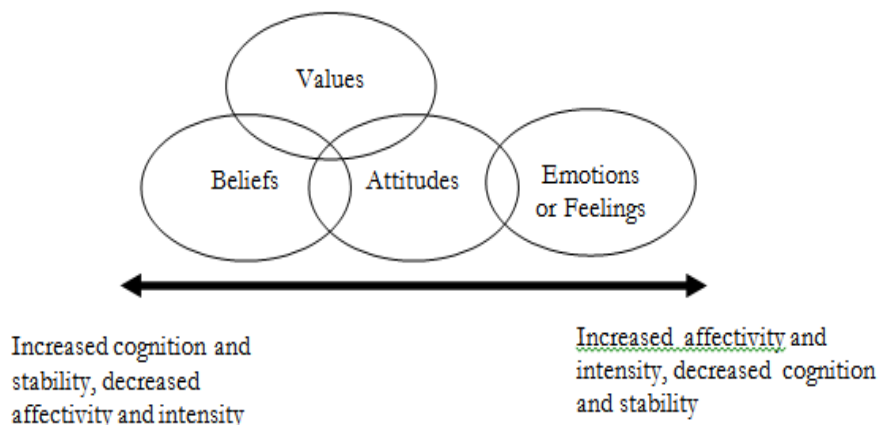


Figure 1. A model of conceptions of attitudes, beliefs, emotions, and values (p. 2)

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, Wong, & Howard, 2006, p. 439).

Child-centeredness

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).

Teachers' beliefs about mathematics were also categorized by Ernest (1989) as below:

First of all, there is a dynamic, problem-driven view of mathematics as a continually expanding field of human inquiry. Mathematics is not a finished product, and its results remain open to revision (the problem-solving view). Secondly, there is the view of mathematics as a static but unified body of knowledge, consisting of interconnecting structures and truths. Mathematics is a monolith, a static immutable product, which is discovered, not created (the Platonist view). Thirdly, there is the view that mathematics is a useful but unrelated collection of facts, rules and skills (the instrumentalist view). (p. 250)

According to explanations above, transmission and child-centeredness beliefs in Anderson (1996) can be considered, up to some extent, as the Platonist view and the problem-solving view in Ernest (1989), respectively.

Anxiety and mathematics anxiety

Anxiety is a situation which includes a multi-dimensional formation in which backgrounds about different situations occur (Hembree, 1990). Spielberg (1972) conceptualized anxiety as a state, a trait, and a process. Through his model of anxiety-as- process, he explained anxiety as a result of a chain reaction that consisted of a stressor, a perception of threat, a state reaction, cognitive reappraisal, and coping. Trait anxiety indicates an anxiety that doesn't appear with regard to a specific time and situation and tends to be a permanent one. Individuals who have this kind of anxiety can be anxious in any time and situation. State anxiety is a type of anxiety that reflects itself in a specific time and situation and when it appears, it can appear a harmful and dangerous situation potentially (Croft, 2000).

On the other hand, mathematics is a part of the curricula of primary, secondary, and higher education. In fact, mathematics can be considered as an abstract discipline that depends on reasoning. But, mathematics awakens in many people a deep emotionality. It's so deep that people either love it or hate it (Hannula, 2005). Reynolds (2003) underlined that how many people suffer from mathematics anxiety and this couldn't be known well as there were no reliable records of it and in fact, mathematics teachers know and see what the mathematics anxiety is from the everyday mimics and reactions of the students. So, mathematics anxiety is one of the common attitudinal and emotional factors that have received attention in recent years. As mentioned above, McLeod (1992) stated that one affective factor that "has probably received more attention than any other area that lies within the affective domain" (p. 584) is anxiety toward mathematics. In the literature, numerous definitions of mathematics anxiety have been suggested. Richardson and Suinn (1972) described mathematics anxiety as a feeling of tension and anxiety which prevents the solutions of mathematical problems and manipulation of numbers in situations that do not depend on practice and in everyday life. Ashcraft and Faust (1994) also explained mathematics anxiety as mental disorder, desperation, terrify, and tension feelings which happen when solution and manipulation of mathematical problems, numbers, and figures are needed. This description was essential as it

proved that mathematics anxiety contains both cognitive and affective structures and it can be identified within state anxiety (Brady & Bowd, 2005). Mathematics anxiety has been also considered as an interaction of many factors, including mathematics itself, educational and curriculum-related issues, parental attitudes, values, and expectations toward mathematics (Lazarus, 1974). As a result of a literature review, Shodahl and Diers (1984) concluded that the sources of mathematics anxiety included inadequate preparation, attitudes of the mathematics teachers and their teaching methods, inadequate mathematics textbooks, and the students' level of thinking (in cited Baloğlu & Koçak, 2006). Mathematics anxiety is a generally-known problem in education and it is an obstacle for many people to learn mathematics. Mathematics anxiety isn't considered as a learning obstacle, but it gets people into irresistible troubles (Reynolds, 2003). It contains generally three kinds of anxiety dimensions as test, numeral and abstraction anxieties. While test anxiety is related to success in mathematics tests, numeral anxiety is related to the manipulation of numbers and abstraction anxiety is related to abstract mathematical contents (Ma & Xu, 2004).

Teachers' mathematics anxiety and mathematics achievement

In general, two major theories address the effects of anxiety on achievement: the Cognitive Interference Theory [CIT] (Wine, 1980) and the Deficit Theory [DT] (Tobias, 1986). The CIT posits that high levels of anxiety lead to poor outcome performance. On the other hand, the DT assumes that because of poor performance anxiety levels increase (cited in Birgin, Baloğlu, Çatlioğlu & Gürbüz, 2010). Therefore, effects of math anxiety on students' achievement in mathematics have interested researchers for several years and this negative relationship between mathematics anxiety and achievement has been reported by many researchers (Hembree, 1990; Richardson & Suinn, 1972; Zakaria & Nordin, 2008). For example, Hembree (1990) found in his meta-analysis including 151 studies that mathematics anxiety is related to poor performance on mathematics. In another meta-analysis, Ma (1999) found a significant negative relationship ($r = -.27$, $p < .05$) between mathematics anxiety and mathematics achievement among elementary and middle school students. Likewise, Dede (2008) also determined for middle and high school students in Turkish context that there was a significant and negative relationship ($r = -.378$, $p < .01$) between these two variables. He also found that Turkish middle and high school students who have the highest mathematics achievement have the lowest mathematics anxiety. On the other hand, studies revealed that teachers with mathematics anxiety are likely to generate students with mathematics anxiety (Vinson, 2001). Tooke (1998) also showed that teachers' anxiety causes students' poor academic achievement. Swars, Daane, and Giesen (2006) determined that teachers with mathematics anxiety tend to teach using traditional approaches instead of reform-based approaches. Similarly, Levine (2008) revealed also that teachers with mathematics anxiety emphasize rule-based strategies. Benken and Brown (2007) found that the complex relationship between teachers' mathematics anxiety and professional identity, including fear of public recognition of a lack of content knowledge, was crucial to learning.

PURPOSE AND IMPORTANCE OF THE STUDY

The vast majority of existing research treats math anxiety and mathematical beliefs separately. However, a few studies have been conducted to investigate relationship between these two issues (Haciomeroglu, 2013). Uusimaki and Nason (2004a) indicated that in the case of many pre-service teachers, negative beliefs and anxiety about mathematics have their origins in prior school experiences such as

their experiences as a mathematics student. But Austin and her colleagues (1992) determined that math beliefs had no significant effect on math anxiety in their research. Kogelman and Warren (1978) claimed that erroneous beliefs about mathematics also cause math anxiety (cited in Austin, Wadlington & Bitner, 1992). Wigfield and Meece (1988) assessed math anxiety in elementary and secondary school students' beliefs, attitudes, and values concerning mathematics. They found that affective component of math anxiety related more strongly and negatively than did the worry component to children's ability perceptions, performance perceptions, and math performance. They also determined that students who believe that math is important and put more effort into it are more concerned about doing well in math. Ertekin (2010) examined correlations between the mathematics teaching anxieties and beliefs about mathematics of Turkish pre-service primary education mathematics teachers. He found meaningful correlations between the field training based teaching anxiety and attitude towards anxiety directed at teaching mathematics sub-categories of the mathematics teaching anxiety scale and all sub-categories of the beliefs about mathematics scale.

Since teachers have been shown to have more of an influence on student achievement than methods or curriculum, it is crucial to understand the math anxiety and self-defeating math beliefs held by many elementary teachers to try to alleviate them (Austin, Wadlington & Bitner, 1992). Research focusing on the influence of perceptions of ability, math values, and math performance on math anxiety may help better explain the development of math anxiety (Wigfield & Meece, 1988).

Although some studies mentioned before reported the importance of research about math anxiety, mathematical beliefs and the relations between the two variables, research regarding math anxiety as well as math beliefs and the correlation between these two variables is certainly needed. Therefore, this current study intends to provide insight into relationship between the beliefs about teaching mathematics and anxiety level of the pre-service elementary teacher candidates. Hence, in this study, we will investigate the following questions:

- What are the pre-service elementary teacher candidates' beliefs about the teaching of mathematics and mathematics anxiety level?
- Is there any significant correlation between the pre-service elementary teacher candidates' beliefs about the teaching of mathematics and mathematics anxiety level?

METHOD

Research design

In the literature, beliefs (and anxiety) were measured using a variety of techniques. One of the most commonly used approaches to assess teachers' beliefs is case-study methodology. With case-study methodology that includes some combinations of classroom observations, interviews, surveys, concept mapping, mathematics education researchers reach rich data set which is important for theory building (Philippe, 2007). But testing theory requires tools such as Likert scales for measuring the beliefs of larger groups of teachers. Low cost, ease of administration and scoring are some of the advantages of many self-report techniques over interviews and observation methods (Leder & Forgasz, 2002). Additionally Op't Eynde, De Corte and Verschaffel (2002) stated the need for more questionnaire studies showing whether categories and subcategories of beliefs and their relationship are empirically valid. The present study was limited with data quantitative in nature. The research data were collected through two survey questionnaires: "Mathematics Anxiety Rating Scale: Short Version [MARS-SV]" of

Suinn and Winston (2003) which was adapted by Baloğlu (2010) into Turkish and "Beliefs about the Teaching of Mathematics [BaToM]" which was developed by Baydar (2000). They were selected because such survey questionnaires could provide valuable information about related issues and carry out to gather information on how people think about a certain issue, in this case, about their own mathematics anxiety level and beliefs about the teaching of mathematics (Rosnow & Rosenthal, 1996). This study revealed the present situation of pre-service elementary teacher candidates' beliefs about teaching mathematics and mathematics anxiety level.

Subjects

Subjects 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), it suits the aims of the study and is convenient (Gall, Borg & Gall, 1996). The research was conducted in 2010-2011 spring term with ninety-six students of Department Primary Education in a state university in Central Anatolia in Turkey. The sample involved 72 female and 24 male student teachers. They were enrolled in a four-year teacher education program for Primary Education. During this period, pre-service 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. At the time of this study, the pre-service teachers in our sample had only taken General Mathematics (4 hours per week) as subject matter course related to mathematics and Introduction to Teaching Profession (3 hours per week) as a pedagogical course. They had also taken Computer I, Turkish I: Writing skills, Atatürk's Principles and History of Turkish Revolution I, Foreign Language I and some elective courses.

Instruments

In this study, the description of problem-solving view in Ernest (1989), the child-centeredness beliefs in Anderson (1996) and the beliefs about what an individual does to learn mathematics in Gorman (1991) about the mathematical beliefs are used. On the other hand, as mentioned before, a number of definitions of mathematics anxiety can be found in the research literature. We used Richardson and Suinn's (1972) description of mathematics anxiety and Baloğlu's (2010) factor classification for mathematics anxiety. With this sense, two questionnaires were used in this current study. Short information about the questionnaires is presented below:

The BaToM was used to assess pre-service 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. The BaToM

reflects the child-centeredness beliefs and the problem-solving view. All items of the questionnaire will be given in the findings.

On the other hand, one of the ways to measure math anxiety is an anxiety questionnaire. In literature, there are some studies for developing anxiety questionnaire in order to determine mathematics anxiety. Some of these questionnaires try to measure mathematics anxiety either as one-dimensional, two dimensional or multi-dimensional. In this study, the MARS-SV of Suinn and Winston (2003) was used. Short information about the questionnaire is presented below:

The MARS-SV is mostly used to determinate mathematics anxiety not only in the United States of America but also all over the world. MARS-SV was adapted by Baloğlu (2010) into Turkish. It has 30 items and five factors which are labeled as the Mathematics Test Anxiety [MTA], Course Anxiety [COA], Computation Anxiety [CA], Application Anxiety [AA], and Social Anxiety [SA]. Baloğlu mentioned in his study that all subscales were significantly correlated with the total scale score as well as among themselves and the adapted scale measures the construct of mathematics anxiety in Turkish college student populations. More information about these factors is in Baloğlu (2010). High scores indicate to more fully convey mathematics anxiety level.

Some examples of items designed to measure mathematics anxiety include:

- Taking an examination (final) in a math course (MTA).
- Waiting to get a math test returned in which you expected to do well (MTA).
- Receiving your final math grade in the mail (COA).
- Realizing that you have to take a certain number of math classes to fulfill the requirements in your major (COA).
- Dividing a five digit number by a two digit number in private with pencil and paper. (CA).
- Adding up $976+777$ on paper (CA).
- Figuring the sales tax on a purchase that costs more than \$1.00 (AA).
- Studying for a driver's license test and memorizing the figures involved, such as the distances it takes to stop a car going at different speeds (AA).
- Having someone watch you as you add up a column of figures (SA).
- Being given a set of division problem to solve (SA).

Procedure

The BaToM and the MARS-SV were administered to ninety-six participants and they took thirty minutes to complete the scales. The purpose of the study was clearly explained to the pre-service elementary teacher candidates by the researchers. Furthermore, the teachers were ensured of the confidentiality of their responses.

Data analysis

Data analysis involved descriptive and inferential statistics. A significance level of 0.05 was set for all inferential tests. Descriptive statistics were calculated to provide means and standard deviations. Bivariate correlation analysis was also performed to analyze the collected data.

FINDINGS

Explanations towards the study problems are given in an order.

What are the pre-service elementary teachers' beliefs about the teaching of mathematics and mathematics anxiety level?

Descriptive analysis of mathematics related beliefs instrument indicated generally positive beliefs expressed by the participants regarding mathematics teaching ($M > 4.5$ but < 5.0). The mean scores changes between 2.68 and 5.56 out of 6 for the items of the scale and the mean of entire scale is 4.63. Means of 14 items of 34-item BaToM scale are 5.0 and up. These items were displayed in Table 1.

When the scores for the strongly agreed upon items of BatoM are examined, it can be said that teacher candidates believed that teacher should explain and teach why he/she teaches mathematics, connections between mathematics and other fields and real life applications of mathematics. Looking at the items numbered 8, 9, 11, 12, 13, 21 it can be concluded that mathematical ability, mathematical thinking and problem solving skills are important elements of teaching mathematics for the pre-service elementary teachers. They also believed that teachers should take into account students' ideas and opinions about mathematical subjects and strive to increase their self-confidence and attitudes towards mathematics. According to the teacher candidates, to for better understanding concrete materials, graphs and charts should be used in teaching mathematics. Interestingly, the mean scores of items about using calculators and computers in teaching mathematics (2.68 and 3.75) were not high. However the teacher candidates mostly agreed on beliefs items of the scale which reflect child-centeredness or problem solving view, they also agreed on some traditional beliefs items. For instance, they believed more exercises and repetitions should be used in teaching mathematics ($M = 5.27$) and the best way of teaching mathematics is with the lecture method ($M = 3.81$).

Means and the standard deviations of the pre-service elementary teachers' mathematics anxiety scores (the MARS-SV) were shown in Table 2.

As can be seen in Table 2, in terms of the five-point Likert scale [MARS-SV], the anxiety expressed by pre-service elementary teacher candidates toward the CA and SA subscales were very low ($M > 1.0$ but < 1.5), the AA subscale was almost low ($M > 1.5$ but < 2.0), the MTA subscale was almost somewhat neutral ($M \sim 3.0$), and the entire scale and the COA subscale were low ($M > 2.0$ but < 2.5).

Table 1. The means (M) and the standard deviations (SD) for the strongly agreed items of BatoM

Items	n	Mean (M)	SD
Teachers should explain to students why he/she teaches mathematics.	96	5.34	1.02
4. Teachers should endeavor to help students gain the ability to make a connection among mathematics subjects.	94	5.33	0.88
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
8. Teachers 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
11. Attention should be paid to teach mathematical thinking.	95	5.25	1.04
12. Teachers 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
16. Students' self-confidence in mathematics should be increased.	96	5.54	0.84
18. Mathematics teachers should mention historical development process of the taught subject.	94	5.56	0.70
19. Mathematics teachers should give importance to students' ideas and should listen their opinions about mathematical subjects.	96	5.40	0.84
21. The students should derive new problems from the problems solved in the class.	96	5.09	1.14
24. For better understanding of mathematics, 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 taught using references to the application areas.	96	5.00	1.11
31. More exercises and repetitions should be used in teaching mathematics.	95	5.27	1.01

Table 2 - Descriptive statistics of the pre-service elementary teachers' mathematics anxiety scores

Sub-scales	Mean	SD	n
Mathematics Test Anxiety [MTA]	2.83	0.82	96
Course Anxiety [COA]	2.11	0.63	96
Computation Anxiety [CA]	1.08	0.24	96
Application Anxiety [AA]	1.78	0.62	96
Social Anxiety [SA]	1.31	0.48	96
Entire scale	2.03	0.45	96

Table 3- Correlation between the MARS-SV sub-scales and the BaToM

	MARS-SV Sub-Scales					Entire scale
	MTA	COA	CA	AA	SA	
BaToM	.156	.042	.019	-.073	-.089	.088

Is there any significant correlation between the pre-service elementary teacher candidates' beliefs about the teaching of mathematics and mathematics anxiety level?

Table 3 shows correlations between the MARS-SV sub-scales and the BaToM. As can be seen Table 3, correlations between the child-centeredness beliefs or the problem solving view of the pre-service elementary teachers and their mathematics anxiety level vary between -.089 and .156. It can be seen that the correlations between the sub-categories and entire scale of the MARS-SV, and child-centeredness beliefs or the problem solving view, a sub-category of the BaToM, are not significant.

DISCUSSION

Results of the current study confirm that pre-service elementary teachers' scores on beliefs about teaching mathematics (the child-centeredness or the problem solving view) were high whereas the mathematics anxiety levels were low in general. On the other hand, it was found that the correlations between the sub-scales of the MARS-SV and child-centeredness beliefs are not significant at the 0.05 level.

As mentioned in literature review, since teacher beliefs play a major role in their students' achievement and in formation of their beliefs and attitudes towards mathematics, to determine mathematical beliefs of teacher candidates have an important role and it is critical for improving their teaching skills and the mathematical learning of their students. In our study, we found that pre-service elementary teachers mostly have child-centeredness beliefs or the problem solving view about teaching mathematics which means they believe that students are actively involved with mathematics through "constructing their own meaning and the role of the teachers is facilitator. Our result is in consonance with the recent study of mathematical beliefs of pre-service elementary teachers. For instance Boz (2008) also conducted a study on Turkish pre-service mathematics teachers' beliefs and he found that most of the participants in his study held non-traditional beliefs about mathematics teaching. Toluk-Ucar and Demirsoy (2010) also reported that all teachers in their study possessed non-traditional beliefs about the nature of mathematics, teaching and learning mathematics, but they taught in a traditional manner. In contrast to our result, Paksu (2008) 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 and Kleinsasser

(1996), found that pre-service elementary teachers placed great emphasis on practice and memorization (cited in Handal (2003)). Frank (1990) and Nisbet and Warren (2000) reported similar conservative trends in teachers' beliefs. Uçar, Pişkin, Akkaş & Taşçı (2010) also found that 6th, 7th and 8th grade students mostly have negative beliefs about mathematics and mathematics teachers. Viholainen, Asikainen and Hirvonen (2014) addressed Finnish mathematics student teachers' epistemological beliefs about the nature of math and the goal of mathematics teaching and learning in the beginning of their university life. They categorized the views presented by 18 Finnish students in terms of four orientations which was put forward by Grigutsch, Ratz and Törner (1998): formalism-related, scheme-related, process-related, and application-related. It was found that students' beliefs about goals of mathematics teaching and learning consisted of features that derive from all of the four orientations.

Our findings also revealed that Turkish pre-service elementary teachers have low levels of mathematics anxiety. Similarly, Çatlıoğlu, Birgin, Çoştu & Gürbüz (2009) investigated the level of mathematics anxiety among pre-service elementary school teachers and interpreted their level of mathematics anxiety as low. Uldaş (2005) reported similar findings about Turkish students. Other studies about elementary school students' mathematics anxiety in Turkey such as Arıkan (2004), Birgin et al. (2010), Dede (2008), and Yüksel-Şahin (2008) reported that mathematics anxiety scores of Turkish students are not extremely high. But Birgin et al. (2010) found that mathematics anxiety levels increase as grades increase. On the other hand, studies in the literature indicated that mathematics anxiety is particularly prevalent among college students majoring in elementary education (Brown, Westen Skow & Moyer-Packenham, 2011) and elementary pre-service teachers have higher levels of mathematics anxiety than the general college population (Hembree, 1990; Kelly & Tomhave, 1985). One of the underlying reasons for the inconsistency between our finding and literature might be the reform movements in education in Turkey. The elementary mathematics curriculum and elementary teacher education curriculum have recently been considerably changed as part of a large scale curriculum reform on the basis of constructivist approaches in Turkey (The Minister of National Education [Turkish: MEB] 2009a, MEB 2009b). In the Turkish elementary school and high school math curriculum, it was emphasized that students' affective development should be taken into consideration when mathematical concepts and skills are developed. In curriculums, some targeted 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 to logical decisions (MEB 2009a, b). With the impact of the new curriculum reform movements, teacher education courses reorganized to promote active involvement of pre-service teachers so that they can get ready to effectively implement the reform-based curriculum (Isiksal, 2010). Boz (2008) mentioned in his study that in curriculum development movements from elementary education to high school, curriculum developers and the Minister of National Education cite the dominant effect of the constructivist approach which has become very popular in recent years in Turkey, affecting prospective teachers' beliefs about education.

Our findings revealed that Turkish pre-service elementary teachers mostly have child-centeredness or problem-solving view beliefs about teaching mathematics and have low level mathematics anxiety. In line with the changes in mathematics education in the country, new elementary teacher education curriculum might be the major reason for these findings. In making this perspective it is thought that pre-service elementary teachers have still adopted or adapted the constructivist

approaches (the child-centeredness beliefs or the problem-solving view) to their math learning.

Our results also confirm that the correlations between the sub-scales of the MARS-SV and child-centeredness beliefs are not significant. In the literature, relatively few studies focused on the relationship between mathematical beliefs and mathematics anxiety. In agreement with our result, Austin and her friends (1992) found that math beliefs had no significant effect on math anxiety in their research. On the other hands, Kogelman and Warren (1978) claimed that erroneous beliefs about mathematics contribute to math anxiety (in cited Austin, Wadlington & Bitner, 1992). Uusimaki and Nason (2004b) indicated that in the case of many pre-service teachers, negative beliefs and anxiety about mathematics have their origins in prior school experiences such as their experiences as a mathematics student.

Wigfield and Meece (1988) assessed math anxiety in elementary and secondary school students' beliefs, attitudes, and values concerning mathematics. They found that affective component of math anxiety related more strongly and negatively than did the worry component to children's ability perceptions, performance perceptions, and math performance. They also determined that students who believe that math is important and put more effort into it are more concerned about doing well in math. Ertekin (2010) examined correlations between the mathematics teaching anxieties and beliefs about mathematics of Turkish pre-service primary education mathematics teachers. He found meaningful correlations between the field training based teaching anxiety and attitude towards anxiety directed at teaching mathematics sub-categories of the mathematics teaching anxiety scale and all sub-categories of the beliefs about mathematics scale. In accordance with our results Haciomeroglu (2013) reported in her study that pre-service teachers generally had positive beliefs regarding mathematics teaching and learning and held low level mathematics anxiety regarding test, course, application, computation, and social. She also found that there was a small negative relationship between math anxiety and mathematical beliefs among pre-service teachers.

In summary, as a result of our research, Turkish pre-service elementary teachers have child-centeredness beliefs or problem solving view about teaching mathematics and low level mathematics anxiety. These results are a hopeful development for the future and might be interpreted that newly changed teacher education system has positive impacts on reducing mathematics anxiety and having non-traditional beliefs.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

This study may have important contributions to the literature since it examines the mathematical beliefs in terms of child-centeredness beliefs or problem solving view about teaching mathematics and the mathematics anxiety levels of Turkish pre-service elementary teachers and relationships between these two variables. Nevertheless, this study has some limitations. Our research has a quantitative paradigm and it is limited by the responses given by pre-service elementary teachers to items in the questionnaires in a natural setting. In-depth investigations into the reasons of the child-centeredness belief or the problem solving view and low mathematics anxiety and the role of educational reforms on these two variables in future qualitative research can play a significant role in the training of teacher students. Some studies in the literature show inconsistencies between teachers' beliefs and practices. Kaplan (1991) mentioned that teachers' non-traditional beliefs about mathematics could be surface beliefs. When teachers who seem to have non-traditional beliefs do practice, their deeper traditional beliefs come to surface. Moreover, although teachers' beliefs seemed to have changed to a more liberal position during their education, more conservative positions are preferred upon

beginning to teach in order to comply with the routines of schools and the workplace (Felbrich & Müller, 2008). Consequently, it can be suggested that the way student beliefs develop and change during their educational and professional life course are still open questions and hence more research is needed in order for the results to be a guide for teacher education programs and policy makers.

We also may suggest that since the investigation addressing both mathematical beliefs and mathematics anxiety is not straightforward, some factors such as students' previous mathematics involvements, perceptions of ability and mathematics values should be taken into account in the future research. In addition, students' mathematics achievement can also be handled together with mathematical beliefs and mathematics anxiety.

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