O'Daffer (1987) consider that problem solving is a method used for scientific research; on the other hand NCTM (1989) considers that problem solving has a major importance in teaching mathematics. The Curriculum and Evaluation Standards for School Mathematics, it is indicated that the problem solving is not a topic that can be considered as independent from all the activities in mathematics as the aim of all teaching process in mathematics.

2.2.2. Importance of Problem Solving

The main goal of the mathematics education can be defined as to bring in individuals mathematical knowledge and abilities required by daily life and to teach problem solving and to provide them with a style of thinking by means of problem solving approach (Altun, 2008). In other words, the main goal of mathematics teaching is to provide students with the abilities that make possible to solve different kinds of complex problems (Wilson, Fernandez, and Hadaway, 1993).

In the countries such as Italy, Sweden, Brazil, Japan, The United Kingdom, Portugal, China problem solving has a role in the mathematics classes from kindergarten to the high school (Lester, 1994). According to Branca (1979), the problem solving ability should have priority in improvement because it occupies a very important point in mathematics and also according to NCTM (2000) it broadens the horizon of students by teaching how to cope with different situations by using different ways. According to Skemp (1978), the most important role of problem solving in mathematics is that problem provide "an environment for students to reflect on their conceptions about the nature of mathematics and develop a relational understanding of mathematics" (p.9). According to the recommendation of The National Council of Teachers of Mathematics (NCTM, 1980) the role of problem solving is central in mathematics because it includes skills and functions which are beneficial in daily life in order to cope with the various problems and adjust to different situations. The Council has endorsed this recommendation recently (NCTM, 1989) and stated that students will be aware of the power of mathematics in real life when the problem solving is hidden in all aspects of mathematics teaching and also they take the problem solving into consideration as a means for students to use in processes of their or others' theories concerning mathematics.

As we cannot find solutions for all the problems that the students encounter to, we should focus on developing effective problem solving abilities. It is only possible with problem solving to have them gain abilities (Karataş, 2002). In order to use problems and problem solving as a teaching technique will lead students to research, to complete sources and share information with each other. Most important of all, the opportunity to bear his/her own responsibility and to achieve something in the end by solving the problem will have been given to the student (Açıkgöz, 2002). While solving a problem, the students learn to think systematically and to put these thoughts forth and they find new ways of thinking. All of these enable students to have self-confidence when they confront the situations that are not familiar. The studies indicate that the students' failures in problem solving are not resulted from mostly insufficient mathematical knowledge but from not being able to use this knowledge effectively (Umay, 2007). Problem solving method increases the students' interests, provides with permanent learning and improves their collecting data and commenting skills. The students will be more self-confident as long as they improve their problem solving abilities. The goal of problem solving is to improve the students' abilities of transferring their knowledge to various areas. In this method, the teacher should be a model at first and then should be a guide (Kaptan and Korkmaz, 2001).

As mentioned above, the mathematical skills are not only used in classrooms but also they are used in real life to overcome different problematic situations. According to Brown the problem solving is necessary for being successful in daily life as well as for the future of our societies and it can be observed clearly that the more successful people in the history were the people who were more successful in solving problems (Jonassen, 2004). Thus, problem solving and teaching it is very important for education.

2.2.3. Problem Solving Approaches

For problems, there are a lot of solving approaches. Schoenfeld (1992), states that the potential knowledge does not mean problem solving but the use of this knowledge forms the major part in problem solving. There are different approaches for problem solving in mathematics and Hatfiel (1978) differentiates these approaches so successfully that it is the most widely-known differentiation. Hatfield (1978) states that there are three basic approaches for problem solving instruction: *teaching via problem solving*, *teaching for problem solving* and *teaching about problem solving*. In the

following period of time these approaches are highlighted by Schroeder and Lester again in 1989. In *teaching via problem solving*, "problems are valued not only as a purpose for learning mathematics but also as a primary means of doing so" (Schroeder and Lester, 1989, p.33). In other words, for introduction and study of mathematical exercise, problems are a means.

According to Schroeder and Lester (1989) when it is considered that the main goal in mathematics is to solve problems, it is quite explicit that transferring the knowledge acquired during the class time into a practical use to reach the solution is an inevitable situation in the period of *teaching for problem solving*. "The teacher who teaches for problem solving is very concerned about students' ability to transfer what they have learned from one problem context to others" (p.32). Also, this approach involves the process of transferring the theoretical knowledge into practical use (Schroeder and Lester, 1989).

In teaching *about problem solving*, "the teacher demonstrates how to solve a certain problem and directs the students' attention to salient procedures and strategies that enhance the solution of the problem" (Lester, 1980, p.41). Polya's problem solving method which is composed of four independent phases has an important role in this type of problem solving and is emphasized in problem solving sessions under the heading of process and strategies.

It is crucial in these approaches that to realize the features such as; teaching for problem solving, teaching about problem solving. Due to the fact that style of problems which are used in mathematics is changing day by day, and the importance which is given problem solving in mathematics is chancing day by day too. That's why one approach style to problem solving could give cue for whether or not the individual has traditional view or reformist in teaching.

2.2.4. Problem Solving Strategies

In teaching problem solving, the main goal should be forced to the students to have the problem solving abilities. Being a good problem solver may provide for an individual with great advantages both in daily life and working life (NCTM, 2000). Mathematics teachers agree that the students' problem solving abilities should be improved and this should be the main goal of the education (Karataş and Güven, 2004). According to NCTM (1998) the teacher should be a guide for his students during the

problem solving in order to make them good problem solvers. Since the teachers' background concerning mathematics teaching that they were previously exposed has a considerable effect on their teaching style (Özkaya, 2002). Also, the problem solving strategy used in the classroom or another place determines the students' strategy choices. It can be inferred that the teacher has a substantial effect on the students' problem solving strategies and in terms of problem solving the students should be encouraged by the teachers.

According to NCTM (1991), as the steps for solving a problem are not learnt and conducted, the students should be exposed to as many problems as possible. Because, developing a problem solving ability which involves solving steps and strategies in a suitable situation is more important than knowing the solution of a problem. Furthermore, in NCTM Standards 2000, all students should have these types of abilities to solve the problems (NCTM, 2000). Also, according to Holton (1994), students should be allowed to learn a variety of techniques in order to apply these techniques in solving a problem. This supports Polya's problem solving processes which the students should know and which include and explain the problem solving strategies.

When teaching problem solving, Polya (1973) suggests in his book "How to Solve It?" that there are two questions to be asked by the teacher in order to help the student solve the problem: One of them is "What is unknown?" and the other is "Could you restate the problem?" Then Polya generalizes these questions under four headings each of which defines the four phases of problem solving. First one is *understanding the problem*: This is the restatement phase in which the unknown and the data given are reconsidered and according to Polya without comprehending the problem fully it is not possible to solve the problem. Second one is *making a plan*: This is the phase in which the knowledge having been learnt before is recalled and the decision about which computations will be used is given. And then *carrying out the plan*: This is the practicing phase in which the outline of the plan is worked out and the details of the problem are overviewed. Final is *looking back and extend*: In this phase the path followed and the result is reviewed for creating a general knowledge and ability to solve the problem.

Strategies are of great importance in problem solving as well as approaches and it is important to choose a strategy according to the type of the problem. Schoenfeld (1992) states that each student has a mathematical content knowledge but their unsuccessful attempts to solve a problem are stemmed from the strategies which assign a

limit to their productivity and in order not to limit the productivity they should be allowed to use strategies such as searching for patterns, listing all possible answers, and drawing diagrams which make them real problem solvers.

Other than problem solving steps, there are 11 strategies to solve a problem such as; *(1)Working backwards* is a strategy which involves from end to the beginning of the problem for solving it. *(2)Finding a pattern* is a strategy in which it is necessary to examine the given numbers and seek a pattern for them. *(3)Adopting a different point of view* is a strategy in which the problems are assumed as easy in advance although it cannot be solved easily. *(4)Solving a simpler, analogous problem* is a strategy in which it is necessary to solve the problem by the help of a solution used in similar and simpler one. *(5)Considering extreme cases* is a strategy in which the extreme values of given problem is checked out. *(6)Making a drawing* is a strategy in which it is necessary to benefit from the charts, schemes, tables, illustrations etc. in order to solve the problem. *(7)Intelligent guessing and testing* is a strategy in which it is necessary to estimate the solution or the precise value in the problem asked and check the correctness of it. *(8)Accounting for all possibilities* is a strategy in which all the possibilities of the situation the problem takes place are scanned. *(9)Organizing data* is a strategy in which it is necessary to arrange all the values and knowledge given in order to solve the problem. *(10)Logical reasoning* is a strategy in which it is necessary to examine the correlation between the values or the knowledge given and the ones asked in the problem (Krulik and Rudnick, 1987). *(11)Deriving an equation for the problem* is a strategy in which it is necessary to use the appropriate equation in order to reach the solution of the problem.

According to Bingham (1998) these strategies of problem solving play a critical role on solving a problem and for Polya (1957) it is more important how and when to use these strategies rather than know them theoretically. According to Chapman (2005) problem solving has a remarkable effect on learning, doing and teaching mathematics. For Schneider and Sanders (1980), in the process of problem solving, persuading students about the benefits of listing the details of a problem is a very challenging process for teachers. On the other hand it can be possible to achieve this at early grades by visualizing the problem which can be helpful for children to store the information. In the process of reaching the solution the students do not think over the problem deeply, they get bored and quit solving the problem very easily (Schoenfeld, 1985). In such

circumstances of the problem solving, teaching how to solve the problem by developing processes is more important than only teaching how to solve the problem (Wilburne, 1997).

2.2.5. Problem Solving and Curriculum

When researcher come to end of the studies, a special commission set by Turkish Ministry of Education, it did several changes and innovations in the mathematics curriculum of elementary schools in the mid of the year 2004. The content is blended and strained and on the other hand the teaching and learning process was designed by means of constructivist approach and so using computer and calculator which are the products of information technology was offered. Moreover, some details in the curriculum were sorted; the content of the mathematics was organized on the basis of sub-learning by being predicated on spiral approach and associating with the other school subjects. In fact the acquisitions concerning the skills of problem solving process in each grade were determined and listed in order to improve the students' skills of problem solving, researching and deciding consciously and mental habits (MoNE, 2005). This curriculum was prepared on the basis of the national and international researches carried out in mathematics education, the mathematics curriculum of the developed countries and the experiences in mathematics in our country. Mathematics curriculum is based on the principle that "Every child can learn mathematics". In the curriculum it has great importance to bring up individuals who can use mathematics in daily life, solve problems, share their solutions and thoughts, work in a team, have self confidence in mathematics and have positive attitudes towards mathematics (MoNE, 2005).

No matter how carefully its content and goals are prepared, the things that determine its efficiency are the teachers who are in the position of applying that curriculum. In other words, the quality and the efficiency of education and teaching is directly related to the quality of the teacher (Karaçalı, 2004) and therefore although the curriculum is well-prepared, if the teachers do not have the desired capacity, the desired result cannot be gained (Demirel and Kaya, 2006; Yaşar, 2005). Qualified education is only realized by well trained teachers. Whatever the methods of the education are, the most important factors in practical area are the teachers. Because of this it should be achieved that the teachers should know and adopt the new curriculum as well as behaving appropriately for the roles they have in order to guarantee its efficiency in

practical area (Ersoy, 2006). Therefore, it is important to understand their attitudes and beliefs and this is the basis of this study. The roles of the teachers and the properties that they should have is listed in the curriculum as: believing that the students can learn mathematics, enabling students to improve positive attitudes, improving themselves, orientation, guiding, motivating and using the time effectively in learning and teaching process.

Problem solving has an important role in mathematics education. According to NCTM (2000) problem solving has a remarkable effect on thinking abilities. According to Turkish Ministry of Education problem solving is not only a specific subject or algorithm for solving a problem, it is also a challenging process to reach the solution (MoNE, 2005). Topics about problem solving brought a common use after the changes in the curriculum (MoNE, 2005, 2006) and problem solving was emphasized by the help of these changes in the curriculum.

Problem solving has a great importance in the skills part in new mathematics curriculum. According to it, problem solving skill includes the necessary abilities to solve the problems that the students confront in their daily life. Sub-skills are dawning on if it is necessary finding the sub-steps or the roots of the problem, planning for solving the problem properly, observing the studies at the time of algorithm process, changing the strategies and plans when necessary, examining the methods, evaluating the data and the information at the solution step, evaluating the meaningfulness and practicality of the solution when reached to the solution and realizing the new problems (MoNE, 2005). In addition to this, problem solving is an integral part of mathematics. Problem should not be perceived as an exercise and question the solution way of which is known before. If a mathematical situation is described as a problem then there should be a need for using some different knowledge and skills together and there should not be a known way for solution. Problem should be in relation with the student's life, arouse interest and cause a need for it. Therefore the students' mathematical knowledge and skills will be more meaningful and it will be easy for them to use this knowledge in different situations. Open ended questions should be used in mathematics. Open ended problems are the ones which can be solved by using more than one strategy and from which have different results are gained (MoNE, 2005).

2.3. Attitudes toward and Beliefs about Problem Solving

The teachers' preferences of attitudes towards and beliefs about mathematics teaching have an effective role in teaching in classrooms (Ford, 1994). Özkaya (2002) indicated that attitudes toward problem solving were in a close relation with problem solving. In the next part, attitudes will be dealt with.

2.3.1. Attitudes toward Problem Solving

At first people should exactly know the definition of attitude in order to have information about it. McLeod (1992) describes the attitudes as the reactions which can be intensive and can cause positive and negative feelings in long-term affectively. Also, Jonassen defined attitudes as "how people perceived the situation in which they find themselves" (1996, p.485).

Attitude is based on three factors. Cognitive factor is composed by knowledge and beliefs concerning objects. Cognitive factor is defined as a classification phenomenon that is used by a person in his thinking process. For example, "Problem solving is the most important part of learning mathematics" is a sentence concerning cognitive factor.

Emotional factor is composed by likes-dislikes that varies from person to person and can not be explained by means of realities. For example, "I like solving mathematical problems" is a sentence concerning emotional factor. Behavioral factor is composed by behavior tendency to the object of the attitude. "If I can't solve the problem, I will try again" is a sentence concerning behavioral factor (Tavşancıl, 2006).

In addition, Schoenfeld (1981) states in his study that the students' performance, attitudes toward mathematics, and the teachers' attitudes can not be considered separately. Also Hembree (1992) draws attention to this correlation between performances of students and the teachers' attitudes. Thus, it is an expected result that the better feelings of teachers' about mathematics affect the students positively and consequently the students' performance in problem solving shows an increase. If you want to glance the definitions by Farrant that "learning is a process of acquiring and retaining attitudes, knowledge, understanding, skills and capabilities" (1994, p.107). In addition Olaitan also suggests that "attitude can be learned and teachers should strive hard to develop the right attitudes in their pupils particularly towards acquiring

manipulation skills" (1994, p.27). Attitudes vary according to students' styles of perception and the person who teaches.

As the mathematics is a science which has a wide area, it is quite normal that the attitudes of the students vary according to the parts of mathematics (McLeod, 1992). Liking, enjoying and interest in mathematics or vice versa or math phobia, which can be considered as the worst, are the attitudes related to mathematics (Ernest, 1989). The reactions of students to easiness and difficulty of mathematics are also considered as attitudes (Ma and Kishor 1997). At every stage of education, in order to increase the quality of mathematics education, several goals are determined such as students' having mathematical concepts and self-confidence in mathematics, having positive attitudes towards mathematics, having problem solving and researching abilities, thinking critically and creatively. There are several factors that affect the ways to reach these goals. One of them is the beliefs and attitudes about the nature and teaching of mathematics, which the teachers and the students have (Carter and Norwood, 1997; Frank, 1990; Underhill, 1988). Thus researching teacher's attitude is very important for this study.

2.3.2 Beliefs about Problem Solving

As in attitude people should know the definition in order to have information about beliefs. Pajares and Fringhetti (1996) defines beliefs as a part of attitudes, on the other hand Grigutsch (1998) defines the beliefs as a part of conceptions, and according to Thompson (1992) the beliefs undergo changes constantly by means of other people's beliefs and new experiences. Green (1971) defines the belief system as unification of a person's prescience and hypothesis, and a person's subconscious and conscious beliefs. According to Hannula (2001) belief is a personal knowledge that is completely cognitive. Artz defines beliefs as "assumptions regarding the nature of mathematics, of students, and of ways of learning and teaching" (1999, p.145). Richardson gives an explanation of beliefs "psychologically held understandings, premises, or propositions about the world that are felt to be true" (1996, p.103). Also, Schoenfeld characterizes beliefs as "as an individual's understandings and feelings that shape the ways the individual conceptualizes and engages in mathematical behavior" (1992, p.358). And also beliefs can be described as a part which constitutes a person's metacognition (Schoenfeld 1987). In brief, in all this study's summary belief is the collection of

cognitive concepts that develop gradually and which hold varying degrees of influence over one's actions (Abelson, 1979).

The teacher's mental scheme includes beliefs such as mathematics, mathematical knowledge, learning and teaching mathematics. Only the level of knowledge can not explain the difference among teachers. While one of the two teachers who teach by using teacher-centered approach the other uses student-centered problem solving approach. For this reason, it is more accurate to focus on the beliefs (Ernest, 1994).

According to a research carried out by Grouws "school goals, classroom climate, the physical setting including availability of instructional equipment and materials, school policies and curriculum guides, administrators, and teachers' colleagues"(1996, p.82) had a considerable role in affecting the teachers' beliefs. On the other hand, negative beliefs about mathematics are based on three categories such as environmental, intellectual and personal factors (Trujillo and Hadfield, 1999). Negative experiences in the classroom, insensitive teachers, parental pressure, traditional techniques including tough rules and non-participatory classrooms are the elements that form environmental factors (Stuart, 2000; Trujillo and Hadfield, 1999). Students' attitudes, insufficient determination, self-doubt, lack of confidence in mathematics skills, conflicted learning styles and lack of perceived practicability of mathematics are the elements that form intellectual factors (Trujillo and Hadfield, 1999). Reluctance to ask questions because of shyness, insufficient self-esteem and females' seeing mathematics as a field for males are the elements that form the personality factors (Levine, 1996; Trujillo and Hadfield, 1999). At the same time, it takes to much time for beliefs to come into existence (Blackwell, 2002; Kloosterman and Cougan, 1994; Schommer and Aikins, 2004). It requires too much time both to measure the effects of beliefs and to have the students acquire new beliefs.

It is stated by the researchers that if the teachers' beliefs about the mathematics or a part of the mathematics are known, an explanation about how they present the mathematical concepts and operations in the classroom can be made, a table about how they can teach with a high perception can be drawn and consequently what sort of reactions they show to new conceptions in mathematics can be predicted (Helms, 1989). The definition of the beliefs about mathematics is a significant step before being described. While making definition of the beliefs about mathematics, most of the researchers used the concept of belief systems which was suggested by Schoenfeld

(1985). This is explained as follows: Beliefs system is a person's understandings about the mathematical world and the way he/she chooses to approach mathematics or mathematical tasks. The beliefs about mathematics can include such issues as the person's style of approaching a problem, the techniques he/she chooses and the time he/she spends and the effort he/she makes, etc. The context that includes resources heuristics is set up by beliefs and the beliefs also control the operations (Schoenfeld, 1985).

Teachers' beliefs about mathematics play an important role in effecting the students' views about mathematics both positively and negatively. A teacher who has positive beliefs about mathematics provides for the students with an enjoyable atmosphere that leads them to success and considers mathematics as field of study worth studying, while a teacher who has negative beliefs about mathematics creates a learned-helplessness atmosphere which the students are in (Karp, 1991). Therefore, the effect of the teachers' beliefs on students' and on their formation of beliefs and attitudes towards success are very significant and inevitable (Emenaker, 1996). In this reason, belief has a very important role in mathematics. This means that to determine the teachers' existing attitudes and beliefs about mathematical problem solving was the starting point of this study.

2.3.3. Relations and Differences between Attitudes and Beliefs

There are several definitions for attitudes and beliefs two of which have been the subjects of many studies, and with having little difference they have been found acceptable. Anxiety, confidence, likes, dislikes, interests and reactions to an object are tendencies that form attitude (Allport, 1935; Brown, 2003; Green, 1959; Mcleod, 1992; Romberg and Wilson, 1969; Thompson, 1992). Gathering cognitive concepts which affect the person's activities is a process called belief (Abelson, 1979; Brown, 2003; Emenaker, 1993; Ensor, 1998; Mcleod, 1992; Thompson, 1992).

As playing an important role in attitudes' coming into existence, the beliefs are in a close relation with behaviors (Bandura, 1982). However, Pajares (1992) evinced that the beliefs can not be observed directly, therefore they can be judged only from the people's intentions, saying and doing. On the grounds of the relation among attitudes, belief sand behaviors, any change in attitudes can cause a change in beliefs (Pajares, 1992). The teacher's style of teaching has an important role in changing the students'

attitudes and mathematical habits (Akinsola and Olowojaiye, 2008). Because of this, the teachers' attitudes and beliefs are the key concepts in order to change the ways of teaching mathematics (Capraro, 2000).

At the same time some studies indicate that there is a strong relationship between the teachers' attitudes and beliefs and the students' attitudes and beliefs. Teachers have a great effect on formation of attitudes and beliefs of students. According to Ford's (1994) observations on the fifth-grade teachers and their students showed the remarkable similarities between the teachers' and students' attitudes and beliefs about problem solving. That the students lives both at present and in the future are affected by the teachers (Brown, 2003) and that some teachers change their own properties such as their practices, beliefs and knowledge results in changes in education system (Putnam, Wheaten, Prawat, and Remillard, 1992), therefore the comprehension of the teachers attitudes and beliefs in detailed is necessary. In addition, in a study carried out for observing the relations between the teachers' attitudes, beliefs and the ways of teaching mathematics and teachers, it was seen that the success of the students whose teachers' attitudes, beliefs and practices were in accordance with one another was higher than the ones whose teachers' attitudes and beliefs were not in accordance with one another and low one (Capraro, 2000).

Wilkins and Ma (2003) analyzed the changes in the secondary education and lycee students' attitudes towards and their beliefs about mathematics. They analyzed the changes in connection with the factors such as the classroom a student was in, the personality variables and the environmental variables. According to the results of this study, it was observed that as the students were passing to the upper grades, their attitudes towards and beliefs about mathematics changed in the direction of being less positive and also they developed more negative beliefs about mathematics and its importance. In addition to this, the students who got positive support from their friends developed less negative beliefs. In the situations where there were the supports and guidance of the families a slowdown in the increasing of the negative beliefs was observed.

Higgins (1997) analyzed the effects of teaching problem solving on the students' attitudes towards, beliefs about and abilities of mathematics. This study was carried out during a year by teaching problem solving and applying traditional mathematics teaching to 3 groups including 6^{th} and 7^{th} grade students. At the end of the year a questionnaire

measuring all the students' attitudes towards and beliefs about mathematics and problem solving was applied and also 4 non-routine problems were applied to three students in each group who had different levels of success in problem solving. 137 students participated in this study and according to the results, it was decided that the students who were in teaching problem solving group developed more positive attitudes towards problem solving proficiencies and benefit of mathematics, and they were more successful in solving problems.

Quinn (1997) carried out a study on the mathematical methods courses' effects on 47 elementary and secondary student teachers' attitudes towards and beliefs about the teaching techniques and mathematical knowledge at the University of Nevada, Las Vegas and it was observed that after the student teachers finished the cooperative learning, problem solving and technology courses, their assumptions, impressions, knowledge and beliefs as teachers changed significantly. We can infer from this research that these method courses are crucial to mathematics teachers to have sufficient knowledge about content of the mathematics and the reforms.

On the other hand, sociology and psychology make definitions for attitude and belief in order to highlight the minor differences between them. According to sociologists, attitude is a common and prior conception while belief is a description handled secretly (Biddle, 1979). Meanly, attitude stands out with description on the other hand belief stand out with preferences. Another difference between attitude and belief is that belief cannot be observed in some suitable situations unless he/she shares but attitude can be observed in suitable situations. According to psychologists, attitude means like and dislikes, and belief is a person comprehends his/her both outer world and inner world. Meanly, attitude stands out with effect on the other hand belief stands out with cognition. According to social psychologists, attitude is a learned predisposition to respond in a consistently favorable or unfavorable manner to a given object (Biddle, 1979). Attitude is a permanent reaction that is shown to an event or a situation in same way. To sum up the definitions, the belief is a personal temperament that is filtered cognitively and the attitude is a choice that includes effective preferences. Most of the researchers do not define the attitude clearly; instead, they give the sentences that characterized the term "attitude" (Martino and Zan, 2001). It is difficult to say that there is a cause and effect relation between the beliefs and the attitudes, but there are proofs about the fact that there is a bidirectional relation between them (Nicolaidou and

Phillippou, 2003). In other words, it can be thought that the beliefs affect the attitudes, the attitudes affect the success and as a result the success affects the belief. Compared with emotions, the attitudes are negative or positive sensuous reactions that are more intensive and more long-lasting, and the beliefs are cognitive and come into existence more slowly than emotions and attitudes (McLeod, 1992).

The teachers can support and improve their students' attitudes towards mathematics and beliefs about their efficiencies by designing the lesson carefully (Kloosterman and Cougan, 1994; Mason, 2003). The teachers and the educationalists tend to believe that the students learn more effectively when they find the subject interesting and they are more successful when the like the subject (Ma and Kishor, 1997). In other words, when the students like mathematics, they become motivated to learn mathematics. Because of this, it is obvious that it is necessary to make a continuous effort to help students develop positive beliefs and attitudes (Middleton and Spanias, 1999; Pintrich, 1999).

In the next part, research studies about problem solving, attitudes and beliefs will be dealt with.

2.4. Research Studies

Research studies related to problem solving, attitudes and beliefs will be deal with in the next parts.

2.4.1. Research Studies related to Problem Solving

Problem solving has great importance in mathematics as stated above so firstly, research studies related to problem solving will be given. In Turkey, Sezgin, Çallıca, Ellez and Kavcar (2000), carried out a study that would state the problem solving strategies which the students taking science classes at university level were using and examine the deficiencies in these subjects. According to the results of the study, it was identified that there was a slight difference between the girls and the boys in terms of using strategies. When the results were examined in terms of programs it was also evident that there was a slight difference between the programs in terms of using strategies. It was observed that the same situation was valid in terms of success in problem solving. Also another study was done by Kandemir (2006) the problem solving skills and attitudes toward problem solving are adhered strictly to each other. In his study

on pre-service mathematics teachers, he revealed the fact that the pre-service teachers' problem solving skills showed an increase by means of acquiring knowledge of creativity techniques.

When looking studies carried out in abroad, Kertil (2008) carried out a different study in which it was indicated that the teachers had insufficient abilities to transfer their knowledge to real life situations. It was different because the participants and the problems were different from the ones having been applied on in other studies. It was found out in the study, in which real life problems were used, that three week mathematics modeling created a difference in the teachers' problem solving abilities in mathematics even slightly. Consequently, he advised that in order to be a well-qualified teacher it was necessary to be trained with Problem Solving Methods and Polya's ideas about the teachers, which emphasized that in order to be a successful teacher a teacher, him/herself should have the ability to do what s/he teaches.

In different countries there are popular researches on problem solving. One of these researches was carried out by Vanayan, White, Yuen and Teper (1997), which was applied to 3rd and 5th grade students. The results of the research indicated that 40 % of the female students and 45% of the male students at 3rd grade were very interested in solving problems while 28% of female and 35% of the male students had these interests at 5th grade. 77% of the female and 81% of the male students perceived the importance of mathematics, while 91% of the female and 92% of the male students perceived this importance at 5th grade. Moreover, the percentages concerning the consideration mathematics as memorization were 51% for female and 53% for male students at 3rd grade and 59% for female and 64% for male students at 5th grade.

2.4.2. Research Studies related to Attitudes

In many researches, the teachers' attitudes toward and beliefs about problem solving in mathematics was put forth into consideration. The strong relation between a student's success and his/her attitudes toward mathematics take place in the resources (Akman, 2005; Hanley, 1995; Kandemir, 2006; Koç, 1998; Mayo, 1994; McLoad, 1989; Özkaya, 2002). Firstly, when looking the studies performed in Turkey, Kasap (1997) analyzed the 4th grade students' problem solving success and problem solving attitudes. This research was carried out with 399 students who were at 4th grades of elementary schools in İstanbul in 1995-1996 academic years and were chosen by using random

sampling method. According to the results of this research, it was observed that there was a positive and significant correlation between the attitudes towards problem solving and success in problem solving. The students who had high scores of attitudes towards problem solving were also highly successful in problem solving. The attitudes towards and the success in mathematics varied according to the gender variable.

Another study was carried out by Bulut, Yetkin and Kazak (2002) and applied to the 4th grade mathematics student teachers in Secondary Education of Mathematics Programs in three universities in Ankara. They aimed at analyzing their success in probability and their attitudes towards probability and mathematics in terms of gender. The results of the analysis indicated that there was a statistically significant positive difference found in favor of the males in mathematics student teachers' average success in probability, while there was a positive difference found in favor of females in the averages of the attitudes towards mathematics. It was determined that there was not a significant difference in the averages of attitudes towards probability in terms of gender.

In their studies Başer and Yavuz (2003) analyzed whether or not the attitudes of student teachers towards mathematics were affected from branch, gender, type of the school graduated from, the order of the preference of the program, the graduate degree from lycee, the educational levels and the occupations of the parents, the socio-economic structure of the family, and the teacher's attitude. According to the results of the research, it was observed that the branch and type of the school graduated from had an effect on the student teachers' attitudes towards mathematics. On the other hand, it was observed that the factors such as the order of the preference of the program, the graduate degree from lycee the educational levels and the occupations of the parents, the socio-economic structure of the family and the teacher's attitude had no effect on their attitudes towards mathematics. And in their studies, Saracaoğlu, Başer, Yavuz and Narlı (2004) analyzed the student teachers' scores of attitudes towards mathematics in terms of gender and determined that the attitudes did not statistically and significantly differ according to the gender variable.

In a study on determining the effects of the attitudes of the teachers teaching at 4th grades on the students' success in mathematics, it was observed that the students whose teachers had high attitudes towards mathematics were more successful in mathematics than the students whose teachers had low attitudes towards mathematics. Significant differences in favor of the male students were observed between the male and

female students whose teachers had low attitudes towards mathematics. It was observed that the teachers who taught at 4th grades and had positive attitudes towards mathematics affected the students' success positively; on the other hand the teachers who taught at 4th grades and had negative attitudes towards mathematics affected the students' success negatively (Alcı, 2001).

In a study carried out by Güzel with the aim of searching the relation between the students' success in physics and their attitudes towards mathematics. According to the results of the analysis of the statistics, it was seen that the students having high scores of attitude towards mathematics were more successful in physics and mathematics. There was a statistically significant difference in the students' attitudes towards mathematics in terms of gender. The female students' scores of attitude were higher than the male students.

On the other hand in studies carried out in abroad, Tussey (2002) carried out a study on analyzing the relation between anxiety and motivational variables. According to the one of the results it was observed that the level of anxiety and the task value of the female students were higher than the male students.

Norman (1977) analyzed whether the students' attitudes towards mathematics varied according to the gender and grade levels. This research was carried out by applying a questionnaire of attitudes towards mathematics to the students at 2nd, 6th, 7th and 8th grades in elementary schools and to the students at 9th and 10th grades in lycee. According to the results of this research, it was observed that average scores of the students' attitudes towards mathematics was decreasing while their grade levels were going up. Although the students' attitudes towards mathematics did not vary according to gender at 2nd, 6th, 7th and 8th grades, at 9th and 10th and the other grades in lycee the male students had more positive attitudes towards mathematics than the female students.

Utsumi and Mendes (2000) analyzed whether the students' attitudes towards mathematics varied according to the type of school, gender and grade level variables. This research was carried out with 209 students at 6th, 7th and 8th grades in elementary schools. According to the results of this research, it was observed that there was no difference in the scores of the attitudes towards mathematics in terms of gender. While the grade levels were going up, the scores the attitudes towards mathematics were decreasing.

By applying MAS (Mathematics Anxiety Scale) to university students, Betz (1978) analyzed the relation of the mathematics anxiety with the variables such as gender and success in mathematics. According to the results of this research, it was found that females' mathematics anxiety were higher than the females'. In addition to this, it was also found that mathematics anxiety had a negative and significant correlation with mathematical background and success in mathematics (Reynold, 2003)

According to Truttschel's (2002) quotation, a study on analyzing the teacher factor in mathematics anxiety in 1999 was carried out by Jackson and Leffingwell. In this study which analyzed the teacher's role in forming the students' mathematics anxiety the results were interesting. According to the results, while 16% of the students participating in this research had their first traumatic encounter with mathematics at 3rd or 4th grades, 26% of them had at lycee and 27% of them had at university. In addition to this, four factors causing to arise the mathematics anxiety were found as the difficulty of material, the teacher's aggressive behavior of the, gender, the teacher's insensitive and negligent attitude.

2.4.3. Research Studies related to Beliefs

When we glance at the studies related to beliefs, there are some studies in Turkey, in Kayan's (2007) study on university students who attended Elementary Mathematics Teacher Education programs, the aim was to inquire what kinds of beliefs they had about problem solving and whether the gender and the university had a role in impacting these beliefs. The results of the study which consisted of 244 senior university students indicated that positive beliefs about problem solving among these university students were common but the traditional beliefs such as computational skills and applying pre- planned steps for solving problems were not disregarded totally by these student teachers. Furthermore, several student teachers gave too much importance to the problems which did not have any necessity to be thought hard on and took place in mathematics curriculum. According to the student teachers the technology had a great importance in problem solving but in non-routine problems this opinion was not apparent. In addition, the results of the study concluded that the gender had no effect on beliefs about problem solving in mathematics whereas the universities attended had remarkable effect on differences in beliefs.

The aim of the study carried out by Aksu (2002) was to search whether or not the elementary students' beliefs about the mathematics varied according to gender, grade and mathematical success. This research was applied on 563 students who were in both a public and a private school in Ankara by means of the scale of beliefs about mathematics. According to the results, it was observed that the scores of the beliefs about mathematics did not vary according to gender. The classroom variable varied in teaching and use of mathematics whereas it did not vary in students' beliefs about the nature of the mathematics. The scores of beliefs about the mathematics of the students who were successful in mathematics were higher than the ones who were not successful.

On the other hand in studies carried out in abroad, one of the studies that included the beliefs system was carried out by Lerch (2004) and that study was concentrated on observing four students' beliefs in detailed while solving routine and non-routine problems. These results indicated that the issues concerning belief systems proposed by Schoenfeld (1985) were in accordance with these observation results. Also, Lester, Garofalo, and Kroll explain that "beliefs constitute the individual's subjective knowledge about self, mathematics, problem solving, and the topics dealt with in problem statements" (1989, p.77). Furthermore, the effects of beliefs on mathematical problem solving have been emphasized in some studies (Lerch, 2004; Schoenfeld, 1985; Zeitz, 1999).

Mason (2003) carried out a study including 599 students on whether or not the students' beliefs about mathematics and problem solving varied according to their grade levels and genders. Besides this, he put forth the causes of beliefs about different dimensions having been acquired by students into consideration. According to the results, it was observed that the beliefs about non-routine problems and the benefit of mathematics varied according to grade levels. At the same time it was found that the beliefs about the importance of understanding mathematics varied according to gender.

A study carried out by Emenaker (1996) was on the effects of problem solving methods in mathematics on the elementary student teachers and was applied to the elementary student teachers at Indiana University. In this study a Likert style survey which was prepared by Kloosterman and Stage in 1992 and was consisted belief scales classified into categories such as memory, step, and time and understand was applied to the elementary student teachers. When it was observed at the end of the semester, apart from time, the other beliefs showed notable changes.

Ford (1994) conducted a study which included the teachers' beliefs about problem solving both in learning and teaching process in mathematics, references about the reasons that affected the problem solving process. According to the results of the interview with ten 5th grade teachers and their students in South Carolina the teachers' beliefs about problem solving in mathematics only comprised considerations which perceived problem solving as only a computational process and the degree of being successful was equaled to only being able to give right answers to problems. Thus the students' skills of reasoning were postponed by the teachers who gave much more importance the ability of computation and this affects learning in problem solving process. As a result this study indicated that the students' beliefs were parallel with the teachers'.

2.4.4. Research Studies related to Attitudes and Beliefs

Martino and Zan (2001) explained the words "belief" and "attitude" are used synonymously in mathematics education. It is usually difficult to distinguish the difference between the studies on beliefs and the studies on attitudes. Some researchers explain the attitude with the belief system, whereas some researchers never mention belief while defining the attitude. According to the research on the beliefs and the attitudes towards mathematics of student teachers of mathematics held by Ma (1999), Wagner, Lee and Özgun-Koca (1999) in different countries such as United States, Turkey and Korea put forth different results into consideration as American student teachers of mathematics were stronger than the ones in Turkey and Korea. Also the student teachers of mathematics in America considered mathematics as an important subject for everybody on the contrary the student teachers of mathematics in Turkey and Korea considered mathematics as a subject which required special properties that certain people have. According to the Koreans group work in mathematics was not useful for students to understand the subject and they thought that individual learning was more beneficial. In the final part of this research it is stated that knowledge, beliefs, attitudes and background knowledge have a remarkable influence on the pedagogy of teaching mathematics.

At the same time some studies indicate that there is a strong relationship between the teachers' attitudes and beliefs and the students' attitudes and beliefs. Teachers have a great effect on formation of attitudes and beliefs of students. According to Ford's (1994)

observations on the fifth-grade teachers and their students showed the remarkable similarities between the teachers' and students' attitudes and beliefs about problem solving. That the students lives both at present and in the future are affected by the teachers (Brown, 2003) and that some teachers change their own properties such as their practices, beliefs and knowledge results in changes in education system (Putnam, Wheaten, Prawat, and Remillard, 1992), therefore the comprehension of the teachers attitudes and beliefs in detailed is necessary. In addition, in a study carried out for observing the relations between the teachers' attitudes, beliefs and the ways of teaching mathematics and applied on 123 teachers, it was seen that the success of the students whose teachers' attitudes, beliefs and practices were in accordance with one another was higher than the ones whose teachers' attitudes and beliefs were not in accordance with one another and low (Capraro, 2000).

Wilkins and Ma (2003) analyzed the changes in the secondary education and lycee students' attitudes towards and their beliefs about mathematics. They analyzed the changes in connection with the factors such as the classroom a student was in, the personality variables and the environmental variables. According to the results of this study, it was observed that as the students were passing to the upper grades, their attitudes towards and beliefs about mathematics changed in the direction of being less positive and also they developed more negative beliefs about mathematics and its importance. In addition to this, the students who got positive support from their friends developed less negative beliefs. In the situations where there were the supports and guidance of the families a slowdown in the increasing of the negative beliefs was observed.

Higgins (1997) analyzed the effects of teaching problem solving on the students' attitudes towards, beliefs about and abilities of mathematics. This study was carried out during a year by teaching problem solving and applying traditional mathematics teaching to 3 groups including 6^{th} and 7^{th} grade students. At the end of the year a questionnaire measuring all the students' attitudes towards and beliefs about mathematics and problem solving was applied and also 4 non-routine problems were applied to three students in each group who had different levels of success in problem solving. According to the results, it was decided that the students who were in teaching problem solving group developed more positive attitudes towards problem solving proficiencies and benefit of mathematics, and they were more successful in solving problems.

Quinn (1997) carried out a study on the mathematical methods courses' effects on elementary and secondary student teachers' attitudes towards and beliefs about the teaching techniques and mathematical knowledge at the University of Nevada, Las Vegas and it was observed that after the student teachers finished the cooperative learning, problem solving and technology courses, their assumptions, impressions, knowledge and beliefs as teachers changed significantly. We can infer from this research that these method courses are crucial to mathematics teachers to have sufficient knowledge about content of the mathematics and the reforms.

Nicolaidou and Philippou (2003) analyzed the relation between the students' attitudes towards mathematics, self-efficacy beliefs about problem solving and their success in problem solving. According to the results of the research, it was observed that their scores of self-efficacy beliefs about problem solving and scores of attitudes toward mathematics did not vary according to gender. There is a positive relation between the students' attitudes towards mathematics, self-efficacy beliefs about problem solving and their success in problem solving.

In studies concerning gender and mathematics, the factors such as attitude, anxiety, self-efficiency, motivation, confidence, belief should be taken into consideration. Also new research paradigms why differences in gender emerge should be developed. In other words gender as a critical variant should be given importance in mathematics education (Fennema, 2000). In a study, while the female students' levels of interests in mathematics and learning abilities of mathematics, confidence in problem solving in mathematics were low, the level of anxiety of mathematics were high**.** Also, female students had less belief in the fact that mathematics would be beneficial for their work and education life (McMullen, 2005).

2.5. Summary

To sum up in this chapter firstly definition of problem is located. After that information about what's a problem, exercises and their difference were given problem types are mentioned. With this what problem is and which are their types. Then getting closer to our main topic information about problem solving was given and importance of problem solving was mentioned. And then information about problem solving approaches and problem solving strategies is cleared like problem. In changed and

renewed curriculum problem solving has great importance problem solving which is taken. That's why information about in the new curriculum is given

Secondly the attitudes and belief topic are started. Primarily attitudes then beliefs definition is done and importance is mentioned. While the information differences and similarities of attitudes and beliefs is being given two topics' togetherness importance is emphasized.

Finally research studies are given a place primarily studies which are done about problem and problem solving in Turkey and another states of world are given a place. Then studies which are done about attitudes in Turkey and another state of world are given a place. Studies done about attitude for gender and grade level being taught effect research are given a place. After attitude studies done about belief in Turkey and another states of world are given a place. As in attitude beliefs gender and grade level being taught effect research is given a place.

CHAPTER 3

METHODOLOGY

In this chapter, methods and procedures of the study are explained. Particularly, design of the study, population and sample, instruments, data collection procedures, reliability and validity of the study, data analysis, and lastly assumptions and limitations of the study are stated.

3.1. Design of the Study

The aim of this study was to investigate elementary teachers' and elementary mathematics teachers' attitudes toward and beliefs about mathematical problem solving in terms of gender and grade level being taught. Moreover, the relationship between elementary teachers' and elementary mathematics teachers' attitudes and beliefs were evaluated in this study.

In order to investigate the research questions, quantitative methods were used. Specifically, two associational research types, causal-comparative research and correlational research were preferred. Data were analyzed through descriptive statistics, two-way ANOVA, and Pearson Product-Moment Correlation.

3.2. Population and Sample

The target population of the study was all in-service elementary teachers and elementary mathematics teachers who study at the public elementary schools located in Central Anatolia Region. As it would be difficult to reach all in-service elementary teachers and elementary mathematics teachers, a convenience sampling method was preferred. All elementary teachers and elementary mathematics teachers who study at the public elementary schools located in Nevşehir in Anatolian Region participated in the study because it was an accessible sample for the researcher. Therefore, the sample of the study consisted of 141 in-service elementary teachers and elementary mathematics teachers studying in 41 different elementary schools located in the centre of Nevşehir in

2010-20011 spring semesters. The questionnaire was applied to all in-service teachers. Those teachers were teaching from 4th to 8th grade in public schools.

Table 3.1 shows the demographics of in-service teachers with respect to gender and grade being taught. Out of 141 in-service teachers, 82 (58.15%) were males, and 59 (41.85%) were females. Also, out of 141 in-service teachers 99 (70.21%) were elementary teachers and 42 (29.79%) were elementary mathematics teachers.

Table 3.1

Participants Demographics by Gender and Grade Being Taught

Grade	Female	Male	Total (N)
4th – 5th	39	60	99
6th – 7th– 8th	20	22	42
Total (N)	59	82	141

The next section gives detailed information about the data collection instruments.

3.3. Instruments

The purpose of this study was to investigate the attitude and beliefs of elementary teachers and elementary mathematics teachers toward mathematical problem solving. To gather the data questionnaires were used. First instrument is the *Whitaker Mathematical Problem Solving Attitude Scale* which consists of 35 items. Second instrument is the *Belief Survey on Mathematical Problem Solving* which consists of 39 items. In the demographic information sheet attached to the questionnaires, there were questions about participants' personal information such as gender and grades level being taught. Details of the instruments are given below.

3.3.1. The Mathematical Problem Solving Attitude Scale (WMPSAS)

The Whitaker Mathematical Problem Solving Attitude Scale (WMPSAS) was developed by Whitaker (1982) in order to measure the attitude of the individuals about mathematical problem solving. The attitude scale has 5-point Likert type items (1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly Agree). Brown, (2003) categorized the Whitaker Mathematical Problem Solving Attitude Scale items. Thirty-one of these items measured a teacher's reactions and personal feelings to problem

solving and anxiety when solving problems and related to feeling of liking or disliking word problems. Also, teacher's feelings of confidence and ability were assessed in these items. The remaining items measured the teacher's teaching feelings about problem solving skills and practices and detected feelings related to liking or disliking teaching. Totally these items assessed a teacher's attitude toward mathematical problem solving (Whitaker, 1982). Whitaker separated the surveys into 5 categories such as (1) like and dislike, (2) interest, (3) anxiety, (4) confidence and (5) miscellaneous.

The Whitaker Mathematical Problem Solving Attitude Scale originally has 40 multiple-choice items. After the pilot study, the researcher decided to erase some of WMPSAS items, since the reliabilities of the 5 items was very low in the pilot study. The reliability value of these items were lower than 0.3, so they were erased from the survey to obtained high reliability. Final questionnaire which consist of 35 multiple-choice items, 17 of which ere positively stated and 18 were negatively stated, was obtained. For the final form of tests, see Appendix B. The scores of the attitude test for the all items were summed to give a total attitude score for each participant, 175 indicating the most favorable attitude whereas 35 represented the least. Obtaining high score in this scale means that the participants have high mathematical problem solving attitude.

3.3.1.1. Pilot Study of the Mathematical Problem Solving Attitude Scale

The aim of the pilot study was to check validity and reliability of the instruments that were translated into Turkish and to determine the possible difficulties that may occur in the actual administration. For these purposes, the pilot study of WMPSA scales was conducted with 68 pre-service teachers who are 3rd and 4th year pre-service elementary mathematics teachers enrolled in elementary mathematics education program in Erciyes University in Kayseri. There were 35 females and 13 males in 3rd grades and 11 females and 9 males in 4th grades in the pilot study.

First of all, WMPSA scale questions were translated into Turkish by the researcher since the education language is not English in all public schools in the present study. When translating a scale into another language, the appropriateness of the expressions is important with respect to cultural and psychological aspects (Hambleton, 2005). In the translation process, the tests were controlled by two English teachers and four teacher educators. They examined the tests for whether the meanings of sentences were the same in original test and clear for pre-service teachers. Next, the Turkish

version of the instrument was given to the colleagues to evaluate the translated items and problems in terms of the content and clarity. Finally, with the help of their interpretations, the instrument was revised and necessary changes were made on the unclear instructions and mathematical vocabulary. As a last step for the instrument, a number of demographic information questions were added to the questionnaire in order to get more information about participants' characteristics. For the final forms of tests, see Appendix B.

3.3.1.2. Reliability and Validity of WMPSAS

For reliability of WMPSAS, Cronbach's alpha coefficient was computed. Ideally, the Cronbach's alpha coefficient of a scale should be "above .70" (Pallant, 2001, p.85). Cronbach's alpha for the scale was calculated as .88 by Whitaker (1982). For the present study, it was calculated as .65. The measured coefficient was not indicating very high reliability. When the coefficients were examined for each item one by one 5 items were extracted from the questionnaire. Since, the items 1, 11, 20, 23 and 24 decreased the overall reliability; they were extracted from the instrument. Therefore, after extracting 5 items from the study Cronbach's alpha for the scale was calculated as .78 indicating satisfactory reliability and internal consistency between items. For the final forms of test is given in Appendix B.

The original scale WMPSAS has 5 dimensions according to Brown (2003) such as; *(1) Like, dislike, (2) Interest, (3) Anxiety, (4) Confidence and (5) Miscellaneous.* And the item numbers and their categories which found by Brown (2003) in original study are given in the Table 3.2.

Table 3.2
Attitude Indicators in Study

Attitude Indicators	Item Numbers
Like, dislike	1, 2, 3, 4, 7, 8, 9, 12, 18, 19
Interest	15, 20, 21, 22, 23, 24, 25, 26, 28, 30
Anxiety	5, 6, 10, 11, 13, 14, 16, 17, 34
Confidence	27, 29, 31, 32
Miscellaneous	33, 35

The Cronbach's alpha values of each category are given in the Table 3.3.

Table 3.3
Reliability Table of Attitude Indicators

Attitude Indicators	Item Numbers
Like, dislike	.80
Interest	.79
Anxiety	.72
Confidence	.72
Miscellaneous	.78

In research studies, Cronbach's alpha coefficient is one of the most commonly used internal consistency indicators. Values of this coefficient range from 0 to 1 and higher values indicate greater reliability (Green, Salkind & Akey, 2000). The reliability of *like and dislike* category is .80; *interest* is .79; *anxiety* is .72; *confidence* is .72 and *miscellaneous* is .78 in the present study. In addition, the overall reliability of the items in the final instrument was calculated as 0.78 which indicates high consistency between instrument items. As the reliability of a scale indicates "how free it is from random error" (Pallant, 2000, p.6), a reliability coefficient of 0.78 means that 78 % of the variance depends on true variance in the construct measured, and 22 % depends on error variance.

3.3.2. The Belief on Mathematical Problem Solving Scale (BMPSS)

The Belief on Mathematical Problem Solving Scale (BMPSS) was developed by Kayan (2007) in order to measure the belief of the individuals about mathematical problem solving. Kayan stated that the instrument was formed by using 4 different instruments. First instrument is Indiana Mathematical Belief Scales, was constructed by Kloosterman and Stage (1992). Second instrument was prepared by Emenaker (1996). Third instrument is the Standards Belief Instrument was developed by Zollman and Mason (1992). And forth instrument is Mathematical Beliefs Instrument was constructed by Hart (2002). The Belief on Mathematical Problem Solving Scale (BMPSS) has 39 multiple-choice items, 22 of which were positively stated and 17 were negatively stated. Similar to the attitude scale, belief scale has 5-point Likert type items

(1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly Agree). And the scores of the belief test for the all items were summed to give a total belief score for each participant, 195 indicating the most favorable belief whereas 39 represented the least. Obtaining high score in this scale means that the participants have high mathematical problem solving belief.

Kayan (2007) separated the surveys into 6 categories such as understanding, step by step solutions, time, multiple solutions, instruction and technology. The instrument is given in Appendix B.

3.3.2.1. Reliability and Validity of BMPSS

Kayan (2007) developed a belief survey for her study. In this study Kayan's survey was used without making any change. According to Kayan (2007), the questionnaire items were grouped into six categories which are *(1) Understanding, (2) Step by Step Solutions, (3) Time, (4) Multiple Solutions, (5) Instruction, and (6) Technology.* And the item numbers and their categories which found by Kayan (2007) are given in the Table 3.4.

Table 3.4
Belief Indicators in Study

Belief Indicators	Item Numbers
Understanding	1, 6, 12, 18, 24, 29
Step by Step Solutions	2, 7, 13, 19, 25, 30, 34, 37
Time	3, 8, 14, 20
Multiple Solutions	4, 9, 15, 21, 26, 31, 35, 38
Instruction	10, 16, 22, 27, 32
Technology	5, 11, 17, 23, 28, 33, 36, 39

Kayan (2007) was translated and adapt belief scale into Turkish in her study. Thus pilot study for belief test was not performed. Cronbach's alpha coefficient was calculated as 0.87 by Kayan (2007) indicating high satisfactory reliability and internal consistency between items. As a result, the BMPSS was reported to be highly reliable and valid.

3.4. Data collection procedures

The purpose of this study was to investigate the elementary teachers' and elementary mathematics teachers' attitudes and beliefs toward mathematical problem solving. First of all the data collection instruments were selected. In the spring semester of academic year 2010-2011, the official permissions were taken from Middle East Technical University Human Subjects Ethics Committee and Ministry of National Education, respectively, before the data collection process. The data of the pilot study were collected during the spring semester of the 2010-2011 academic years. And the data of the main study were collected during the summer semester of the 2010-2011 academic years. The main study was administered to fourth, fifth, sixth, seventh and eighth grade elementary school teachers' to schools in the centre of city in Anatolian Region. Before the administration, the purpose and procedure of the study were explained to participants by the researcher. The participants didn't write their names, the reason of this, making them feel comfortable in the process and to ensure confidentiality of the research data. Moreover, the demographic information such as gender, and grade level being taught was collected from the participants. All the participants filled in the tests voluntarily. Although there was no time limit for the application, it took approximately 45 minutes of participants to fill in the questionnaire.

In this section, the data collection procedure was explained in detail, and the following section will give information about analysis of the data.

3.5. Data analysis

In the present study, quantitative research methodologies were used to analyze data through SPSS 16.0 software program. First, the demographic information was analyzed by using frequencies, percentages and mean. Then, each questionnaire items were analyzed by using its frequency, percentage, mean and standard deviation.

Inferential statistics such as two-way ANOVAs were performed to determine in-service elementary teachers' and elementary mathematics teachers' attitudes and beliefs toward mathematical problem solving with respect to gender and grade level being taught. In addition, Pearson product- moment correlation analyses were run to examine the relationship between attitude (WMPSAS) and belief (BMPSS) scales. Eta square was calculated to investigate the practical significance of the results.

3.6. Assumptions and Limitations of the study

The basic assumptions and limitations of the present study are discussed in this section. At the beginning, the participants were assumed to respond to the items of the two instruments (attitude scale and belief scale) independently and honestly.

However, the application time was different for participants. Some of the teachers took the tests in the morning, some of them in the afternoon, and some in the evening. This might affect teachers' concentration. The teachers taking the scales in the afternoon might be tired and this might effect their concentration which could be accepted as a limitation. Sampling method could be another issue for limitations. In this study, the city of schools was not selected in random sampling method so the generalization of the results of the study to a larger population will be limited. Assumptions and limitations of the study were explained in this section. In the following section the validity of this study will be mentioned.

3.7 Internal and External Validity of the Study

Internal and external validities will be discussed in this part of the study.

3.7.1 Internal Validity

Internal validity of the study refers "observed differences on the dependent variable are directly related to the independent variable" (Fraenkel & Wallen, 2006, p.169) not any other variables. In this study, causal-comparative research and correlational research were used. Fraenkel and Wallen (2006) stated that, the possible internal threats were subject characteristics, mortality, location, and instrumentation.

"The selection of people for study may result in the individuals (or groups) differs from one another in unintended ways that are related to the variables to be studied" was referred to a subject characteristics threat (Fraenkel & Wallen, 2006, p.170). To control subject characteristics threat, the teachers were chosen according to their close classes (4^{th} - 5^{th} - 6^{th} - 7^{th} - 8^{th}). In addition, their personal characteristic such as branch was similar to each other. In this study, the participants were elementary teachers and elementary mathematics teachers. Moreover, data were collected from teachers' room where is the same atmosphere. As a result, subject characteristics should not be a threat for this study.

Mortality is another threat to be considered. In this study, all elementary teachers who are teaching 4th and 5th graders and elementary mathematics teachers who are teaching 6th, 7th and 8th graders are selected. However, when the administration was done, some of the teachers were absent. Researcher went to the same schools again for administering the questionnaires to the absent teachers. Thus, maximum participation was assured. The participants of the present study filled in all of the scales so each participant had a score for each variable. Therefore, it was assumed that there was no mortality threat.

Location threat refers "the particular locations in which data are collected, or in which an intervention is carried out, may create alternative explanations for results" Fraenkel and Wallen (2006, p. 172). The researcher administered the scales on teachers in their teachers' rooms in their schools but all schools did not have the same room conditions. Moreover, the time of application was variable. Some of the teachers took the tests in the morning and some in the afternoon. This might affect teachers' thinking ability or concentration. In addition, the teachers who are taking the scales in the afternoon might be tired and this might lessen their motivation and it can be a negative effect. However, the researcher tried to provide standard conditions for all teachers such as extra time for scales was given, researcher didn't make any pressure to participants.

Next, instrumentation threat is explained as some problems in the results of research studies related to the instrument of the study. Instrument decay may occur, when the instrument was changed in a different way (Fraenkel & Wallen, 2006). In the present study, belief scale was already adapted but the scoring of those scales were the same. In other words, the scales were Likert type and scores were computed in SPSS software program. The characteristic of the data collector is another important issue for controlling instrumentation threat (Fraenkel & Wallen, 2006). In this study data collector was the researcher and he administered the scales to all teachers himself. In other words, the data collector characteristics were the same for all teachers. As a result, instrumentation should not be a threat for this study.

The final issue to be thought for instrumentation threat was data collector bias. Data collector means that in a study data collectors or scorers may change the result in the way intended unconsciously (Fraenkel & Wallen, 2006). In this study, the researcher implemented the scales in the teachers' room. In addition, there was no treatment in the

application that encourages the interaction and communication between the participants and the data collector. Therefore, data collector bias could not be a threat for this study.

3.7.2 External Validity

The degree to which the results of a study can be generalized from a sample to a population is defined as an external validity (Fraenkel & Wallen, 2006). The target population of the study was all in-service elementary teachers and elementary mathematics teachers who study at the public elementary schools located in Central Anatolia Region. The accessible population of this study was determined as all elementary teachers and elementary mathematic teachers who study at the public elementary schools located in Nevşehir. The sampling method was convenience sampling so it is hard to generalize the results of the study to the population. However, the results of the present study can be generalized in some clearly defined conditions. Fraenkel and Wallen (2006) explained this type of generalization as ecological generalization which is generalizing results of the study to other conditions and settings.

CHAPTER 4

RESULTS

The purpose of this research study was to investigate the in-service elementary teachers' and mathematics teachers' attitudes toward and beliefs about mathematical problem solving in terms of gender and grade level being taught. Besides, the relationship between in-service elementary teachers' and mathematics teachers' attitudes toward, and beliefs about mathematical problem solving was examined. In the first part, the results of descriptive statistics were reported. Then, inferential statistics of the quantitative analysis of the study are summarized in the second part.

4.1. Descriptive Results

In this section, descriptive statistics regarding the Mathematical Problem Solving Attitude Scale (WMPSAS) and Belief on Mathematical Problem Solving Scale (BMPSS) will be given. The data were collected during the spring semester of the 2010-2011 academic years from in-service elementary teachers and elementary mathematics teachers in a city in Anatolian Region. Totally, 141 in-service teachers responded to all two scales.

The percentages and frequencies associated with gender and grade level being taught summarized in Table 4.1. There were 59 females (41.8%) and 82 males (58.2%) in the sample of the study, giving a total of 141 participants.

Table 4.1

Participants' Descriptive Information

Gender	Frequency (N)	Percentage (%)
Male	82	58,2
Female	59	41,8
Grade Level		
4^{TH} -5^{TH}	99	70,2
6^{TH} -7^{TH} -8^{TH}	42	29,8

In addition, there were 99 (70.2%) participants who are teaching 4^{th} and 5^{th} graders and 42 (29.8%) participants who are teaching 6^{th}, 7^{th} and 8^{th} graders. The standard deviation and total attitude and total belief scores of in-service teachers are listed in Table 4.2.

Table 4.2

Participants' Total Attitude and Total Belief Scores

	N	Minimum	Maximum	Mean	SD
Total Attitude	141	92	169	134.21	15.99
Total Belief	141	114	190	145.91	13.62

As can be seen in Table 4.2, the total attitude score for participants was 134.21 (*SD* = 15.99). The attitude scores of the in-service elementary mathematics teachers in this study indicated that their attitudes were generally positive. The total belief score for participants was 145.91 (*SD* = 13.62). The belief scores of the in-service elementary mathematics teachers in this study indicated that their beliefs were generally positive.

The standard deviation and mean scores of Whitaker Mathematical Problem Solving Attitude Scale (WMPSAS) with respect to gender and grade level being taught are listed in Table 4.3.

Table 4.3

Descriptive Statistics of WMPSAS with respect to Gender and Grade Level

Gender	Grade Level	M	SD	N
Female	4th – 5th	134.23	16.05	39
	6th – 7th – 8th	143.10	12.49	20
	Total	137.24	15.42	59
Male	4th – 5th	129.20	15.33	60
	6th – 7th – 8th	139.77	16.10	22
	Total	132.04	16.14	82
Total	4th – 5th	131.18	15.73	99
	6th – 7th – 8th	141.36	14.42	42
	Total	134.21	16.00	141

The analysis for WMPSAS was done with total scores of the items to obtain an attitude level score for each participant. As can be seen in Table 4.2, the mean score for participants who are teaching 4^{th} and 5^{th} graders was 131.18 (*SD* = 15.73) and the mean score for participants who are teaching 6^{th}, 7^{th} and 8^{th} graders 141.36 (*SD* = 14.42). The mean scores of WMPSAS for all grade level being taught were reported as above midpoint score that is 105. This means that participants of the study had relatively moderate levels of attitude. If the WMPSAS scores are examined in terms of gender, it can be noticed that the mean scores of females were greater than who of males regardless of grade level being taught. Moreover, for both males and females elementary mathematics teachers had the greatest mean scores.

The standard deviation and mean scores of Belief on Mathematical Problem Solving Scale (BMPSS) with respect to gender and grade level being taught are listed in Table 4.4.

Table 4.4

Descriptive Statistics of BMPSS with respect to Gender and Grade Level Being Taught

Gender	Grade Level	M	SD	N
Female	4th – 5th	147.44	14.28	39
	6th – 7th – 8th	150.30	12.52	20
	Total	148.41	13.67	59
Male	4th – 5th	142.13	12.82	60
	6th – 7th – 8th	149.50	13.72	22
	Total	144.11	13.39	82
Total	4th – 5th	144.22	13.59	99
	6th – 7th – 8th	149.88	13.01	42
	Total	145.91	13.62	141

The analysis for BMPSS was done with total scores of the items to obtain a belief level score for each participant. As can be seen in Table 4.3, the mean score for participants who are teaching 4^{th} and 5^{th} graders was 144.22 (*SD* = 13.59) and the mean score for participants who are teaching 6^{th}, 7^{th} and 8^{th} was graders 149.88 (*SD* = 13.01). The mean scores of BMPSS for all grade level being taught were reported as above midpoint score that is 117. This means that participants of the study had relatively moderate levels of belief. If the BMPSS scores are examined in terms of gender, similar to the attitude scores, it can be noticed that the mean scores of females were greater than that of males for all elementary teachers and elementary mathematics teachers. Moreover similar to the attitude scores, for both males and females elementary mathematics teachers had the greatest mean scores.

4.1.1. In-service Teachers' Attitudes

As mentioned before, the purpose of this research study was to investigate the in-service elementary teachers' and elementary mathematics teachers' attitudes toward and beliefs about mathematical problem solving.

The first research question was "*What are the in-service elementary teachers' and elementary mathematics teachers' attitudes toward mathematical problem solving?"* This question aimed to investigate the kinds of attitudes of the participants had about

mathematical problem solving. In order to explore this question, the participants' responses to the questionnaire items were analyzed.

The questionnaire items were grouped into five categories as follows; attitudes toward (1) Like-Dislike, (2) Interest, (3) Anxiety, (4) Confidence and (5) Miscellaneous. Therefore, the responses given to the questionnaire items were analyzed under five categories.

4.1.1.1. Attitudes with respect the Like and Dislike

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the like and dislike. There were five negatively stated items (Items 1, 3, 8, 18 and 19) and five positively stated items (Items 2, 4, 7, 9 and 12) related to this category. In Appendix C, descriptive statistics of these questionnaire items were reported. The scores were in inverse proportion with the negative items when the outcomes of the questionnaire were taken into consideration. In other words, the high mean showed the participants' disagreements with the statements, on the other hand the low mean showed that there was an agreement between the participants and the statements. In terms of scores, 1 indicated the minimum and 5 indicated the maximum mean score.

The majority of the participants (90 %) (With the mean of 1.65 and 1.72 respectively) indicated their disagreement (overall responses of strongly disagree and disagree) to the idea that solving mathematical problems to be dull and boring (Item 1) and mathematical problems to be a form of drudgery (Item 3). Moreover 3/4 of the participants (with the mean of 2.13) indicated their disagreement to the idea that having trouble understanding why some students thought mathematical problems were fun (Item 19). Furthermore, 86 % of the participants (with the mean of 4.23) indicated their agreement (overall responses of strongly agree and agree) to the idea that mathematical problems were something that enjoying a great deal (Item 7).

In addition, 4/5 of the participants (86,5 %) (with the mean of 4.12, and 4.22 respectively) indicated their agreement (overall responses of strongly agree and agree) to the idea that, games that involve some intellectual challenge can be enjoyable (Item 9) and mathematical problems as being more like games than hard work (Item 12). Also 3/4 of the participants (76,6 %) (With the mean of 4.03) indicated their agreement to the idea that enjoying solving puzzles (Item 2).

The participants did not show very rich attitudes to the attitudes related to solving time of the problem. 81,6 % of the participants (with the mean of 4.08) indicated their agreement to the idea that mathematical problems which could not be immediately solved (Item 4). For example, it was negatively stated item, however, only 52 % of the participant (with the mean of 2.70) stated their disagreement with item 8 which proposed that the most mathematical problems, rather than the simplest types, took too long to solve. Also, 62 % of the participants disagreed with the idea (with a mean of 2.49) that having difficulty when thinking about a problem long enough to solve it (Item 18).

4.1.1.2. Attitudes in terms of the Interest

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the interest. There were five negatively stated items (Items 20, 22, 23, 28 and 30) and five positively stated items (Items 15, 21, 24, 25 and 26) related to this category. In Appendix C, descriptive statistics of these questionnaire items were reported.

The participants showed very rich attitudes about the solution of problems. 4/5 of the participants (with the mean of 4.03 and 4.05 respectively) indicated their agreement (overall responses of strongly agree and agree) with the idea that if they cannot solve a problem immediately, they stick to it until it has been solved (Item 21), generally mathematical problems were very interesting (Item 25). Also 73 % of the participants (with the mean of 3.86) indicated their agreement with the idea that required working on tricky mathematical problems (Item 24). Moreover approximately 2/3 of the participants (with the mean of 2.43 and 2.30 respectively) indicated their disagreement with the idea that they did not particularly like doing difficult mathematical problems (Item 22) and most mathematics problems were frustrating (Item 23).

The majority of the participants indicated their agreement (with the mean of 4.22 and 4.07 respectively) with the idea for trying to discover the solution to a new type of mathematical problem was an exciting experience (Item 15) and the feeling towards mathematical problems was a pleasant feeling (Item 26). Besides, 64,5 % of the participants (with the mean of 2.35) showed their disagreement with the negative item 28 which stated that did not particularly use thinking about mathematical problems outside the schools.

Also for item 30; 82,3 % of the participants (with the mean 2.04) indicated their disagreement with the idea that if they cannot solve a problem immediately, they tend to give up. And 2/3 of the participant (with the mean 2.21) indicated their disagreement with the negative idea finding it difficult to concentrate on mathematical problems for a very long period of time (Item 20).

4.1.1.3. Attitudes in respect of the Anxiety

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the anxiety. There were three negatively stated items (Items 13, 14 and 17) and six positively stated items (Items 5, 6, 10, 11, 16 and 34) related to this category. In Appendix C, descriptive statistics of these questionnaire items were reported.

More than 90 % of the participants (with the mean of 4.37; 4.48 and 4.52 respectively) showed very rich attitude and agreed with the idea that students should be encouraged to use the method that suited them best when solving a problem (Item 10), and encouraged students to check their answers to problems to see if the answers actually make sense (Item 11) and stressed that there were often many different ways to solve the same problem (Item 16). In addition, 85 % of the participants (with the mean of 4.01) showed their agreement with the idea encouraging students to use trial-and-error procedures when solving any mathematical problems (Item 6).

The participants reflected rich attitude to the solution of problem solving. For instance, the majority of them (93 %) indicated (with a mean of 4.23) that a person should not mind taking a chance on making a mistake when solving a mathematical problem (Item 5). Moreover, more than %75 of the participants (with a mean of 2.21) were against the idea that person would rather have someone told how to solve a difficult problem than have to work it out (Item 14).

Even though it was a negatively stated item, the participants did not show very rich attitudes towards the mathematical problems. For example, only 69 % of the participants (with the mean of 2.32) stated their disagreement with item 13 which proposed that often finding myself unable to think clearly when trying to solve mathematical problems. In addition, 55 % of the participants disagreed with the idea (with a mean of 2.55) that mathematical problems make people feel as though people were lost in a jungle of numbers and could not find their way out (Item 17).

For item 34; 86 % of the participants (with the mean of 4.11) determined that believing could be enough for solving most mathematical problems with sufficient time.

4.1.1.4. Attitudes with respect to the Confidence

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the confidence. There were three negatively stated items (Items 29, 31 and 32) and one positively stated item (Item 27) related to this category. In Appendix C, descriptive statistics of these questionnaire items were reported.

Almost all participants (% 97) (with the mean of 4.35) agreed with the statement that encouraged students to adopt a stop-and-think attitude when solving problems (Item 27).

For item 31, in-service teachers had no such rich attitude that their responses were distributed among agreement and disagreement. For item 31 (with the mean of 2.97) expressed that the numbers of rules one must learn in mathematics make solving problems difficult, 44,7 % of the participants reported their agreement, 44,7 % of the participants reported their disagreement.

Approximately 3/5 of the participants (with the mean of 2.50 and 2.48 respectively) indicated their disagreement with the idea that was regardless of how much effort was put forth to experience a feeling of confusion when solving mathematical problems (Item 29) and it made person nervous to think about having to solve difficult mathematical problems (Item 32).

4.1.1.5. Attitudes in terms of the Miscellaneous

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the miscellaneous. There were two negatively stated items (Items 33 and 35) related to this category. In Appendix C, descriptive statistics of these questionnaire items were reported.

Even though there were negatively stated items, 68 % of the participants (with the mean of 3.71) and 79 % of the participants (with the mean of 3.97) expressed negative attitude to item 33 and 35 respectively. These teachers were against the idea that the development of computational skills should take precedence over the development of problem solving skills in the teaching of elementary school mathematics

(Item 33) and knowing how to compute is about all that is necessary for students to be able to solve most mathematical problems in elementary school (Item 35).

Elementary teachers and elementary mathematics teachers who have rich attitude in mathematical problem solving showed rich attitude to attitudes sub-dimensions. In service mathematics teachers have rich attitude in solving problem. Liking problem and taking enjoyment in mathematical games. In service teachers showed rich attitudes in interesting solving mathematical problems and mathematics in solving mathematical problem solving anxiety in in-service teacher has rich attitude, with showing a poor attitude to negative items they provide rich total attitude. They showed rich attitudes to the mathematical confidence and solving problem against to the confident sub-dimension. New curriculum emphasized that rich attitude is important for implementing new curriculum. Rich attitudes show unity with new curriculum.

4.1.2. In-service Teachers' Beliefs

The second research question was "*What are the in-service elementary teachers' and elementary mathematics teachers' beliefs about mathematical problem solving?"* Similar to the attitude, this question aimed to investigate the kinds of beliefs the participants had about mathematical problem solving. In order to explore this question, the participants' responses to the questionnaire items were analyzed. The questionnaire items were grouped into six categories as follows; beliefs about (1) Understanding, (2) Step by Step Solutions, (3) Time, (4) Multiple Solutions, (5) Instruction, and (6) Technology. Therefore, the responses given to the questionnaire items were analyzed under six categories by forming six sub-research questions for each category.

4.1.2.1. Beliefs about Understanding's Significance

In the present study, similar to the attitude, it was aimed to examine the participants' responses to several questionnaire items related to the understanding. There were two negatively stated items (Items 1 and 12) and four positively stated items (Items 6, 18, 24, and 29) related to this category. In Appendix D, descriptive statistics of these questionnaire items were reported.

The scores were in inverse proportion with the negative items when the outcomes of the questionnaire were taken into consideration. In other words, the high mean showed the participants' disagreements with the statements, on the other hand the

low mean showed that there was an agreement between the participants and the statements. In terms of scores, 1 indicated the minimum and 5 indicated the maximum mean score

Approximately half of the participants (with the mean of 2.72) indicated their disagreement (similar to the attitude, overall responses of strongly disagree and disagree) with the idea that it was not important to understand why a mathematical procedure worked as long as it gave a correct answer (Item 1). Similarly, 95 % of the participants (with the mean of 4.40) reported that a person who did not understand why an answer of a mathematical problem was correct did not solve the problem (Item 6).

More than 3/4 of the participants (with the mean of 2.08) stated their disagreement with the idea that it does not really matter if you understand a mathematical problem and get the right answers (Item 12). Similarly, 94 % of the participants (with the mean of 4.44) through that in addition to getting a right answer in mathematics, it was also important to understand why the answer was correct (Item 29).

Almost 90 % of the participants (with the mean of 4.21 and 4.27 respectively) appreciated time as investigating why a solution to a mathematical problem worked was well spent time (Item 18), and supported the idea of a demonstration of good reasoning should be regarded even more than students' ability to find correct answers (Item 24).

4.1.2.2. Beliefs about Forethought Steps Solutions

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the step by step solutions. There were four negatively stated items (Items 2, 13, 25, and 34) and four positively stated items (Items 7, 19, 37, and 30) related to this category. In Appendix D, descriptive statistics of these questionnaire items were reported.

Above half of the participants (with the mean of 3.39) indicated their disagreement to the ideas that any problem can be solved if you know the right steps to follow (Item 2) and approximately half of the participants (with the mean of 2.82) indicated their disagreement to the ideas that without a step-by-step procedure, there is no way to solve a mathematical problem (Item 34). Similarly, 3/4 of the participants (with the mean of 3.79) stated that there are problems that just can not be solved by following a predetermined sequence of steps (Item 37). However, although it is a positively stated item, 44 % of the in-service teachers expressed negative belief and just

23 % of the in-service teachers (with the mean of 2.78) expressed positive belief to the item 7 which is stated that mathematicians seldom have step-by-step procedures to solve mathematical problems.

Item 13 was the opposite of the item 30. Even though it was a negatively stated item, 69 % of the in-service teachers (with the mean of 3.50) agreed with the item 13 stating that learning to do problems was mostly a matter of memorizing the right steps to follow. Likewise, even though it was a positively item, 63 % of the in-service teachers (with the mean of 2.51) disagreed with the idea that memorizing steps was not useful for learning to solve problems (Item 30).

Approximately % 60 of the participants indicated their agreement (with the mean of 3.54) with the idea that problems could be solved without remembering formulas (Item 19. Furthermore, despite the fact that it was a negatively stated item, 56 % of the participant (with the mean of 3.39) stated their agreement with the idea that solving most mathematical problems, students should be taught the correct procedure (Item 25).

4.1.2.3. Beliefs about Spending Time

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the time. There were two negatively stated items (Items 8 and 20) and two positively stated items (Items 3 and 14) related to this category. In Appendix D, descriptive statistics of these questionnaire items were reported.

Almost 79 % of the participants (with the mean of 2.11) indicated their disagreement with the idea that mathematical problems that take a long time to complete can not be solved (Item 8).

Above half of the participants (55 %) (With the mean of 3.38) indicated their agreement to the idea that mathematical problems that take a long time are not bothering (Item 3).

Furthermore, almost 92 % of the participants (with the mean of 4.24) supported the idea that hard mathematical problems can be done if one just hangs in there (Item 14). Even though it was a negatively stated item, more than half of the participants (with the mean of 3.30) agreed with the idea that being good in mathematics, one had to be able to solve problems quickly (Item 20).

4.1.2.4. Beliefs about Problem Solution's Ways

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the multiple solutions. There were four negatively stated items (Items 9, 21, 31, and 38) and four positively stated items (Items 4, 15, 26, and 35) related to this category. In Appendix D, descriptive statistics of these questionnaire items were reported.

90 % of the participants (with the mean of 1.68 and 1.77 respectively) disagreed with the idea that there was only one correct way to solve a mathematical problem (Item 9), and if a number of mathematicians were given a mathematical problem, they would all solve it in the same way (Item 21). Besides, 82 % of the participants (with the mean of 4.02) stated that if a student is unable to solve a problem one way, there are usually other ways to get the correct answer (Item 26).

94 % of the participants (with the mean of 4.25 and 4.32 respectively) indicated that it was possible to get the correct answer to a mathematical problem using methods rather than the teacher or the textbook used (Item 4), and if a student forgets how to solve a mathematical problem the way the teacher did, it will be possible to develop different methods given the correct answer (Item 15).

Approximately 94% (with the mean 4.55) of the participants had an idea that the teachers who were good at their jobs broadened their students' horizons by giving them plenty of ways for approaching the same questions (Item 35) and also 80% of the in-service teachers (with the mean of 2.04) did not share the same idea with the negative item 38 stating that the students' exposure to various ways for solving a problem could create a confusing atmosphere for students. As a conclusion, participants' responses varied from disagreement, neutral to agreement, in other words 42 % of the participants disagreed, 25% of them agreed with the item 31 while 18% of the participants were neutral to item 31 which stated that the teachers who were good at their jobs gave the precise way for solving the mathematical problem.

4.1.2.5. Beliefs about Instructions

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the instruction. There were two negatively stated items (Items 16 and 27) and three positively stated items (Items 10, 22, and 32) related to

this category. In Appendix D, descriptive statistics of these questionnaire items were reported.

Approximately 4/5 of the participants (with the mean of 3.97) agreed with the idea that problem solving was a process that should permeate the entire program (Item 10). In addition, despite the fact that it was a negatively stated item, 90 % of the participants agreed with the idea (with the mean of 4.13) that problem solving was primarily the application of computational skills in mathematics (Item 16).

Approximately all of the participants (with the mean of 4.43 and 4.57) determined that students should share their problem solving thinking and approaches with other students (Item 22), and teachers should encourage students for writing their own mathematical problems (Item 32). Finally, 2/3 of the in-service teachers showed their disagreement (with the mean of 2.36) with the idea that it was better to tell or showed students how to solve problems than let them discover on their own (Item 27).

4.1.2.6. Beliefs about Using Technology

In the present study, it was aimed to examine the participants' responses to several questionnaire items related to the technology. There were three negatively stated items (Items 11, 28, and 36) and five positively stated items (Items 5, 17, 23, 33, and 39) related to this category. In Appendix D, descriptive statistics of these questionnaire items were reported.

The majority of the participants stated that (with the mean of 4.43) **t**eachers could create new learning environments for their students with the use of technology (Item 23). And also about 85 % of the in-service teachers (with the mean of 4.18 and 4.11 respectively) agreed with the ideas using technology in solving problems could give students greater choice in their tasks (Item 33), and students could learn more mathematics more deeply with the appropriate and responsible use of technology (Item 39).

Approximately 3/4 of the participants (with the mean of 2.21 and 2.11 respectively) disagreed with the ideas that using technological equipments in problem solving was cheating (Item 11), and using technology was a waste of time while solving problems (Item 28). Besides, 70 % of the participants (with the mean of 3.78) disagreed with the idea that technologic equipments harmed students' ability to learn mathematics (Item 36).

Almost all of the participants (with the mean of 4.53) showed strong belief with the idea that appropriate technologic equipments should be available to all students at all times (Item 5), and also four fifth of the in-service teachers (with the mean of 3.90) agreed with the idea that technological equipments were useful for solving problems (Item 17).

As in attitude elementary teachers and elementary mathematic teacher who showed high belief in mathematical problem solving showed high belief in sub dimensions. In service teachers have high belief in understanding problem and understanding problem solving ways using step by step way problem solving and encouraging this way they showed high belief using time efficiently while solving problem in service teachers high belief. As in attitudes they showed low belief towards to negative items with this they managed to provide high belief degree. In service teachers who are using different ways and encouraging students have high beliefs that are why they are in harmony with new curriculum. Elementary teachers and elementary mathematic teachers who are using calculator and technology efficiently while solving problem have high belief in this point.

4.2. Inferential Statistics

In the previous section, descriptive statistics of participants were given. The difference between in-service elementary teachers' and elementary mathematics teachers' attitudes toward and beliefs about mathematical problem solving in terms of gender and grade level being taught were examined. The relationship among in-service elementary teachers' and elementary mathematics teachers' attitudes and beliefs was examined.

4.2.1 In-service Teachers' Attitudes in terms of Gender and Grade Level Being Taught

The third research question was "Is there a significant difference in in-service teachers' attitude toward mathematical problem solving in terms of gender and grade level being taught?"

The difference in terms of gender and grade level being taught was investigated by means of two-way ANOVA. In the following sections, the assumptions and analysis results were summarized.

4.2.1.1 Assumptions of Two-way ANOVA for Attitude Scores

Before conducting two-way ANOVA, Pallant (2007) mentioned the assumptions to be examined. There were four assumptions to be satisfied that *level of measurement, independence of observations, normality and homogeneity of variance*.

Level of measurement:

Pallant (2007) explained that the dependent variable is expected to be continuous. In the present study, the dependent variable was the total scores of the participants for the attitude tests which were continuous as the level of measurement assumption was assured.

Independence of observations:

Independence of observations assumption was assumed to be assured and sample size (N = 141) was appropriate.

Normality:

The normal distribution of population is expected for this assumption. The distribution for attitude scores for each group was normally distributed when skewness and kurtosis values were examined. In Table 4.5, skewness and kurtosis values of attitude tests were summarized.

Table 4.5

Skewness and Kurtosis Values of Total Attitude Scores

	Skewness	Kurtosis
Total Attitude	-,016	-,384

Kunnan (1998) stated that in order to supply approximately normal distribution, the values of skewness and kurtosis should be between +2 and -2.

As it can be inferred from Table 4.6 the skewness and kurtosis values were between -,016 and -,384 which means that there was no violation for the normality assumption.

Table 4.6

Kolmogorov-Smirnov[a] Values of Total Attitude Scores

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	statistic	df	sig.	statistic	df	sig.
Total Attitude	,044	141	,200[*]	,991	141	,497

Moreover, the sig. value in the table Kolmogorov-Smirnov[a] is important for normality. Pallant (2007) stated that, the value of sig. more than .05, indicates normality. As it can be inferred from Table 4.6 the sig. value is .200, suggesting agreement of the assumption of normality. Thus, normality assumption was assured in the present study for attitude scores.

Homogeneity of variance:

Homogeneity of variance means that the selected samples must be the same variances (Green, Salkind and Akey, 2000). In order to determine whether or not homogeneity of variance assumption was satisfied, Gravetter and Wallnau (2003) recommended conducting Levene's test of equality of error variances.

Table 4.7

Levene's Test of Equality of Error Variances for Gender

	F	df1	df2	sig.
Total Attitude	,196	1	139	,659

Table 4.8

Levene's Test of Equality of Error Variances for Grade Level

	F	df1	df2	sig.
Total Attitude	1,023	1	139	,314

As shown in Table 4.7, the sig. column of attitude for gender is 0.659. And shown in Table 4.8, the sig. column of attitude for grade being taught is 0.314. Therefore, from Levene's test, it was found that the homogeneity of variances

assumption was not violated. As a conclusion, all assumptions of two-way ANOVA for attitudes were checked and it was found that they were all satisfied.

4.2.1.2 Two-Way ANOVA Results of In-service Teachers' Attitudes Scores

Table 4.9 is an overall summary of the Two-way ANOVA results of attitudes scores with respect to gender and grade level being taught.

Table 4.9

ANOVA Results of Attitudes Scores with respect to Gender and Grade Level

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
GENDER	507,083	1	507,083	2,166	,143	,016
CLASS	2743,783	1	2743,783	11,723	,001	,079
GENDER * CLASS	21,065	1	21,065	,090	,765	,001

The results brought out that there was statistically significant difference ($F(1, 137) = 11.72$, $p = .001$) between elementary teachers and elementary mathematics teachers in terms of attitude test scores.

The mean score for mathematics teachers who have $6^{th} – 7^{th} – 8^{th}$ grade, were 141,36 (SD = 14,420) higher than the mean score for elementary teachers who have $4^{th} – 5^{th}$ grade, were 131,18 (SD = 15,732).

The effect size for grades level being taught on attitudes test was calculated as .079. Based on Cohen's (1988, p.284-287) criterion, this could be described as medium effect size.

The results also revealed that there was not statistically significant ($F(1, 137) = 2.17$, $p = .143$) main effect for gender,. This means that males and females do not differ in terms of their attitude scores.

4.2.2. In-service Teachers' Beliefs in terms of Gender and Grade Level Being Taught

The fourth research question was "Is there a significant difference between in-service teachers' belief about mathematical problem solving in terms of gender and grade level being taught?"

The difference in terms of gender and grade level being taught was investigated by means of two-way ANOVA. In the following sections, the assumptions and analysis results were summarized.

4.2.2.1 Assumptions of Two-way ANOVA for Belief Scores

Before conducting two-way ANOVA, Pallant (2007) mentioned the assumptions to be examined. There were four assumptions to be satisfied that *level of measurement, independence of observations, normality and homogeneity of variance*.

Level of measurement:

Pallant (2007) explained that the dependent variable is expected to be continuous. In the present study, similar to the attitude tests, the dependent variable was the total scores of the participants for the belief tests which were continuous as level of measurement assumption was assured.

Independence of observations:

Independence of observations assumption was assumed to be assured and sample size (N = 141) was appropriate.

Normality:

The normal distribution of population is expected for this assumption. The distribution for belief scores for each group was normally distributed when skewness and kurtosis values were examined. In Table 4.10, skewness and kurtosis values of attitude tests were summarized.

Table 4.10

Skewness and Kurtosis Values of Total Belief Scores

	Skewness	Kurtosis
Total Belief	,200	,204

Kunnan (1998) stated that to supply approximately normal distribution, the values of skewness and kurtosis should be between +2 and -2.

It can be inferred from Table 4.11 that the skewness and kurtosis values were between ,200 and ,204 which means that there was no violation for the normality assumption.

Table 4.11

Kolmogorov-Smirnov[a] Values of Total Belief Scores

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	statistic	df	sig.	statistic	df	sig.
Total Belief	,056	141	,200[*]	,989	141	,303

Moreover, the sig. value in the table Kolmogorov-Smirnov[a] is important for normality. Pallant (2007) stated that, the value of sig. more than .05, indicates normality. It can be inferred from Table 4.10 that the sig. value is .200, suggesting agreement of the assumption of normality. Thus, similar to the attitude scores, normality assumption was assured in the present study for belief scores.

Homogeneity of variance:

In order to determine whether or not homogeneity of variance assumption was satisfied, Gravetter and Wallnau (2003) recommended conducting Levene's test of equality of error variances.

Table 4.12

Levene's Test of Equality of Error Variances for Gender

	F	df1	df2	sig.
Total Belief	,296	1	139	,587

Table 4.13

Levene's Test of Equality of Error Variances for Grade Level

	F	df1	df2	sig.
Total Belief	,172	1	139	,679

As shown in Table 4.12, the sig. column of belief for gender is 0.587. And shown in Table 4.13, the sig. column of belief for grade being taught is 0.679. Therefore, from Levene's test, it was found that the homogeneity of variances assumption was not violated. As a conclusion, all assumptions of two-way ANOVA for beliefs were checked and it was found that they were all satisfied.

4.2.2.2 Two-Way ANOVA Results of In-service Teachers' Beliefs Scores

Table 4.14 is an overall summary of the Two-way ANOVA results of beliefs scores with respect to gender and grade level being taught.

Table 4.14

ANOVA Results of Beliefs Scores with respect to Gender and Grade Level

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
GENDER	270,330	1	270,330	1,520	,220	,011
CLASS	759,777	1	759,777	4,272	,041	,030
GENDER * CLASS	147,160	1	147,160	,827	,365	,006

The results brought out that there was statistically significant difference ($F(1, 137) = 4.27$, $p = .041$) between elementary teachers and elementary mathematics teachers in terms of belief test scores.

The mean score for mathematics teachers who have 6^{th} – 7^{th} – 8^{th} grade, were 149,88 (SD = 13,009) higher than the mean score for elementary teachers who have 4^{th} – 5^{th} grade, were 144,22 (SD = 13,591).

The effect size for grades being taught (class) on beliefs test was calculated as .030. Based on Cohen's (1988, p.284-287) criterion, this could described as small effect size. That is, although grades being taught (class) on beliefs test difference reached

statistical significance, the actual differences in the mean values were inconsiderable. It means that the difference between grades level being taught on beliefs test seemed to be little practical significance.

The results also brought out that there was not statistically significant ($F(1, 137) = 1.52$, $p = .220$) main effect for gender,. This means that males and females do not differ in terms of their belief scores.

4.2.3. Relationship between In-service Teachers' Attitudes and Beliefs

The last research question to investigate was "Is there a significant relationship between in-service teachers' attitudes toward and beliefs about mathematical problem solving?"

Pearson product-moment correlation coefficient was calculated to investigate the direction and strength of relationship between attitudes and beliefs variables.

4.2.3.1 Assumptions of Pearson Product-Moment Correlation

Before conducting Pearson product-moment correlation, Pallant (2007) mentioned the assumptions to be examined. There were four assumptions to be satisfied; *level of measurement, related pairs, independence of observations, normality and homogeneity of variance.*

Level of measurement:

In the present study, the dependent variable was the total scores of the participants for the attitude and belief tests which were continuous, so level of measurement assumption was assured.

Related pairs:

To satisfy related pairs assumption (Pallant, 2007), all of the subjects must have a score for each variable. In the present study, this assumption was assured. All participants had the scores for all two variables.

Independence of observations:

Independence of observations assumption was assumed to be assured and sample size ($N = 141$) was appropriate to assure the normality assumption of the study.

Normality and homogeneity of variance:

The distribution for attitude and belief scores as mentioned above, for each group was normally distributed when skewness and kurtosis values were examined.

Linearity assumption requires a linear relationship between variables. In order to examine linearity, scatter plots were constructed for variables in pairs. Figure 4.1, shows the scatter plot of total attitude and total belief scores.

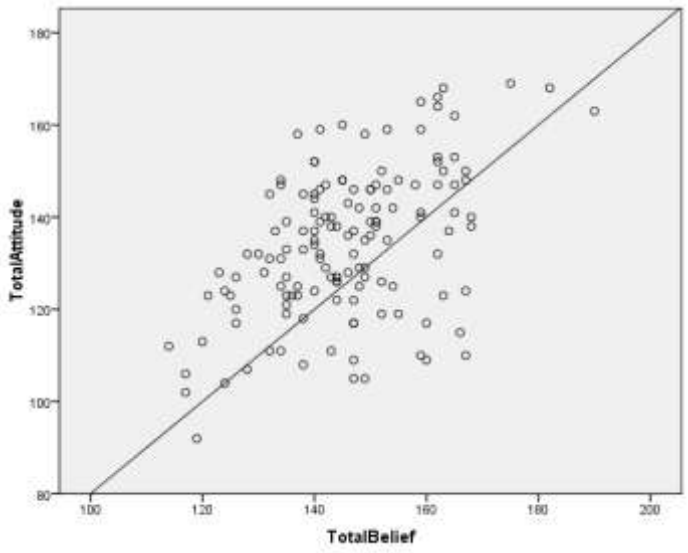

Figure 4.1
Scatter plots of Total Attitude and Total Belief Scores

When Figure 4.1 above was examined, the spread of the points in the scatter plot indicated that there was a reasonable correlation between the variables. To use the Pearson correlation, the fit line could be drawn. The direction of relationship was positive since the line drawn through points upward from left to right. That is, high scores in attitude scores associated with high scores in belief scores. As a result, when attitude of an individual increases, the belief also increases and the relationship seems to be reasonable.

Thus, preliminary analyses ensure that there is no violation of the assumptions of normality, linearity and homoscedasticity.

4.2.3.2 Pearson Product-Moment Correlation Results

The relationship between in-service teachers' attitudes toward mathematical problem solving (as measured by the Total Attitude) and in-service teachers' beliefs about mathematical problem solving (as measured by the Total Belief) was investigated by using Pearson product-moment correlation coefficient. Results brought out that there

was a positive significant correlation between attitudes and beliefs scores of the in-service teachers, $r = .495$, $p = .05$. This means that the participants having higher attitude scores tended to have higher scores in belief test.

4.3 Summary for the Results

The purpose of this research study was to investigate the in-service elementary teachers' and elementary mathematics teachers' attitudes toward and beliefs about mathematical problem solving in terms of gender and grade level being taught. Besides, the relationship between in-service elementary teachers' and mathematics teachers' attitudes toward, and beliefs about mathematical problem solving was examined.

Firstly, the attitude scores of the in-service elementary mathematics teachers in this study indicated that their attitudes were generally positive. Moreover, the belief scores of the in-service elementary mathematics teachers in this study indicated that their beliefs were also generally rich.

Secondly, the results revealed that there was statistically significant main effect for grades level being taught on attitudes test scores. The results also revealed that there was not significant main effect for gender. In addition, in this study, the interaction effect between grades level being taught and gender was not statistically significant for attitude scores.

Results also revealed that there was statistically significant main effect for grades level being taught on beliefs test scores. But, there was not significant main effect for gender. In addition, in this study, the interaction effect between grades level being taught and gender was not statistically significant for belief scores.

Finally, Pearson product-moment correlation analysis indicated a positive correlation between attitude and belief scores. That is to say, participants having higher attitude tended to have higher scores in belief test.

CHAPTER 5

DISCUSSION

The main purpose of the study was to investigate the in-service teachers' attitudes and beliefs toward mathematical problem solving in terms of gender and grade level being taught. Besides, the relationship between in-service elementary teachers' and elementary mathematics teachers' attitudes, and also beliefs toward mathematical problem solving were examined. In this chapter findings will be discussed in line with the previous research studies. In addition, implications and recommendations for the future research studies will be presented.

5.1 Discussion of the Findings

In this section, the results of the research questions regarding the difference between in-service teachers' attitudes toward and beliefs about mathematical problem solving in terms of gender and grade being taught will be discussed. Moreover, the relationship between in-service teachers' attitudes and beliefs will be discussed.

5.1.1 Discussion for Attitudes toward Problem Solving

Alcı (2001) stated that teachers' positive attitudes affect the students' success. Alcı (2001) observed that the students whose teachers had high attitudes towards mathematics were more successful in mathematics than the students whose teachers had low attitudes towards mathematics. In the present study, the attitude results showed that the in-service elementary teachers' and elementary mathematics teachers' total attitude score are relatively high. In other words, they have positive attitudes toward mathematical problem solving. This finding is consistent with the research studies that emphasized teachers' positive attitudes toward problem solving in mathematics (Brown, 2003; Coxford, 1971; Karp, 1991; Kasap 1997, Schoenfeld, 1981; Woods, 1989).

There are some reasons stated in the literature for the positive attitudes toward problem solving. Kasap (1997) observed that there was a positive and significant correlation between the attitudes towards problem solving and success in problem

solving. The teachers who had high scores of attitudes towards problem solving were also highly successful in problem solving. In other words, being successful in mathematical problem solving may cause the high attitudes toward mathematical problem solving.

As well, success in solving problems can have affects of higher attitudes. Supporting works were stated in the literature. Woods (1989) mentioned that the teachers' satisfaction with problem solving causes having positive attitudes toward problem solving. If the teachers in this study are satisfied while solving a problem, this could lead them to have relatively high problem solving scores. Thus, in order to make the student aware of the content and get them involved in the activity, problem solving could be used as a means by the teachers, who had positive attitudes toward mathematics (Karp, 1991).

Enjoying problem solving in mathematics might be the other reason for the positive attitude. It can be inferred from the Brown's (2003) research that if teachers enjoy solving problems, their attitudes were generally positive toward mathematical problem solving. New mathematics curriculum is based on the principle that every child can learn mathematics. In this curriculum the bringing up the individuals that can use mathematics in daily life, solve problems, share their solutions and thoughts, work in a team, have self-confidence in mathematics and have positive attitudes towards mathematics have great importance. Also, it is aimed at that the people who teach mathematics should love mathematics (MoNE, 2005). According to in-service teachers' answers which are given in the questionnaire, they took pleasure in solving crossword puzzles, playing thought-provoking games, handling mathematical problems and they did not yield against the problems that they could not solve. On the other hand, majority of the in-service elementary and elementary mathematics teachers show them against to the questionnaire items "the mathematical problems were boring and heavy work" and "one had difficulty in thinking long enough while solving them". Answers which are given for the questionnaire show that teachers enjoy problem solving enjoy very much which could be regarded as the other reason of high attitude.

"Providing students with positive attitudes towards mathematics" and "orientation, guiding and motivating" (MoNE, 2005, p.8) are in the new mathematics curriculum defined in the part of teachers' roles and the qualities that they should have. One can develop positive attitude towards mathematics and has self-confidence, (MoNE, 2005) which is in the general aims mentioned in the new mathematics curriculum. High

self-confidence toward problem solving in mathematics might be the other reason for the positive attitude. State differently, self confidence's high degree to mathematical problem solving may have caused positive and high attitude. The answers which were given in questionnaire about confidence support the idea, too. For example, the participants indicated their disagreement with the idea that was "regardless of how much effort was put forth to experience a feeling of confusion when solving mathematical problems "and "it made person nervous to think about having to solve difficult mathematical problems".

There is another principle in the new mathematics curriculum that the teachers should encourage their students while solving problems (MoNE, 2005). Questions which are related with encourage have an important place in anxiety part of attitude scale. The results show that the answers, given to the items in the anxiety part, are generally positive. For example, the items that "one should take possibility of making mistakes into consideration while solving problems" and "the teachers encouraged students for using the method of trial and error while solving problems" have high mean. This could be the indication that in-service elementary teachers and elementary mathematics teachers had positive attitudes towards problem solving. At the same time in-service elementary teachers and elementary mathematics teachers agreed with the ideas that "they encouraged their students for choosing the most suitable way to solve the problems" and "controlling their answers, as well as emphasizing the idea to the students that there could be many ways to solve the problems". On the other hand, teachers stated that they did not agree with the idea that "one could not think clearly and would rather one another solved the problem than solve him/herself". Results of these items could also be an indication for the high attitude towards problem solving.

5.1.2. Attitudes in terms of Gender and Grade Level Being Taught

It is believed that the males are more successful than the females in mathematics. The thoughts such as "mathematics is for males", "the females have to make more effort than the males do in order to be successful in mathematics" reveal the expectations that the females develop negative attitudes toward mathematics because of the fact that they have difficulty in mathematics and they have fears of mathematics (Brown, 2003). On the other hand, the fact that actually success in mathematics was not related with the gender was supported by many researches (Akay, 2004; Akdemir, 2006; Drysdale and Milne, 2004; Kasap, 1997; Norman, 1977; Perry, 1998; Utsumi and Mendes, 2000; Yetim,

2006). Sonmaz (2002) found that the problem solving skill did not differ in terms of gender. Also some studies found that the pre-service teachers' attitudes toward problem solving did not differ in terms of gender (Özdoğan, Bulut and Kula, 2005; Saraçaloğlu, Başer, Yavuz and Narlı, 2004). And, Fulk, Brigham and Lohman (1998) stated that there was no correlation between the gender and the participants' use of cognitive strategy, self-efficacy and self regulation. The common point in these research studies was that there was no significant mean difference between males' and females' attitudes toward mathematical problem solving. Result of present study is also in line with the literature where males and females do not differ in terms of their attitude scores.

The reason of the non-significant difference between male and female teachers is both of them may have the same emotional intelligence for problem solving. State differently, emotional intelligence, the ability to understand the way people feel and react and to use this skill to make good judgments and to avoid or solve problems, is one of the factors which affect the attitude (Fennema, 2000). Emotional intelligence's corresponding may have caused no differences between male and female teachers' problem solving attitudes.

General attitudes' high level can cause no difference in both genders. In other words, the same experience of teachers may result no difference in attitude in terms of gender. We know that both male and female in-service teachers have same education during their enrollment in teacher education program. State differently they have similar experiences during their teacher training. Thus; this could be the reason that there is no difference between male and female teachers' attitude scores regarding problem solving.

Although literature results are in parallel with the result of the study, there are researches that do not support the results (Ai, 2002; Manger and Gjestad, 1997; Tussey, 2002). In Güzel's study on the students' attitudes towards mathematics differed statistically. The scores of female students' attitudes were found higher than the males. In their study, Bulut, Yetkin and Kazak (2002) found that there was a difference in terms of gender. Boekaertss, Vermeer and Seegers (2000) found that the differences in problem solving depended on gender.

In addition, results revealed that there is a significant difference between elementary teachers' and elementary mathematics teachers' attitudes scores. The mean score for mathematics teachers who are teaching at 6^{th}, 7^{th}, and 8^{th} grades is higher than the mean score of elementary teachers who are teaching at 4^{th} and 5^{th} grades. The reason

might be elementary mathematics teachers who are teaching at 6th, 7th, and 8th grades are more concerned and have more self-efficiency in mathematics than the teachers teaching at 4th and 5th grades because of the fact that the teachers teaching at 6th, 7th and 8th grades are in-field-teachers while the others are not. State differently, the difference between attitudes of elementary teachers and elementary mathematics teachers might be due to competency in mathematics. In other words, compared with elementary teachers teaching at 4th and 5th grades, elementary mathematics teachers teaching at 6th, 7th and 8th grades have more pedagogical and content knowledge of problem solving strategies and this can be considered as the factor which increases their attitude scores toward problem solving.

5.1.3 Discussion for Belief about problem Solving

In the study, elementary teachers' and elementary mathematics teachers' beliefs about mathematical problem solving were also investigated. The belief result showed that the in-service elementary teachers' and elementary mathematics teachers' total belief score is relatively high. In other words, they have positive beliefs toward mathematical problem solving. This finding is consistent with the research studies that emphasized teachers' positive beliefs toward problem solving in mathematics (Brown, 2003; Coxford, 1971; Kayan, 2007; Schoenfeld, 1981). There are some reasons suggested in the literature for the positive beliefs toward problem solving. As stated above, one of the reasons might be derived enjoying from solving problems (Brown, 2003). Brown (2003) mentioned the fact that the teachers enjoyed solving problems was the reason of their having positive beliefs about mathematics. In the present study, items "mathematics problems are something that I enjoy a great deal" and "mathematics problems, generally, are very interesting" which are given place in questionnaire have high mean. Those items indicated that teachers' enjoyments is high that could lead high belief scores as well.

High computational skills can be considered as the other reasons for developing positive beliefs (Coxford, 1971 and Schoenfeld, 1981). According to Brown (2003), the teachers who did not consider the mathematics only as the collection of rules, facts and procedures had positive beliefs about mathematics. All of the teachers agreed with the idea that "to understand the solution of the problem is more important than the result of the problem and how it has been done". And also "computational skills are useless if you can't apply them to real life situations" item have a high mean degree. Results of these items could also be an indication for the positive beliefs about problem solving.

If we take the items about the procedures into consideration, it can be said that in-service teachers share the same idea that mathematical problems are possibly solved without memorized step by step procedures. The teachers stated negative belief to the item that "it is impossible to solve a mathematical problem without using a specific way for solution" and this indicated that they thought there could be many ways to solve a problem. In addition, they encourage their students for finding different solutions to the problems. If item's mean is high, this lead finding different strategies toward problem solving and it supports the idea of memorizing is not necessary. This could be the evidence for rich beliefs too.

Teachers who have high self-efficacy belief tends to use different teaching methods in teaching application, tends to search to develop their teaching methods, tends to use student –centered strategies and tends to use instruments in their application (Küçükyılmaz and Duban, 2006). In-service teachers self efficacy's high degree is one of the most important factor which effects the teachers' success. If sophisticated teacher is bereaved of self efficiency feelings, nobody can't hope efficiency in lessons (Küçükyılmaz and Duban, 2006). Because of this reason, in-service teachers' high self efficacy may lead positive beliefs toward problem solving.

The other important issue for the problem solving is technology. Technology is developing very fast and it creates new opportunities for a meaningful mathematics teaching. As a result of constant development the computer technology, teaching software is increasing both in terms of quantity and quality and the alternatives are constantly increasing. Hence, it is useful to benefit from the computer technology while solving a problem. The calculators are also important devices which can be benefited from mathematics teaching. By means of calculators, the students can work on more realistic mathematical problems and use their remaining time that remains from the long algorithms in reasoning and creative thinking (MoNE. 2005). All of the teachers agreed with the idea that "using the technological devices are not a time consumer on the contrary it is useful and necessary in problem solving". At the same time, teachers have high beliefs about the point that "the suitable technological devices should be always available for the students and using technological devices present more choices for their studies". Given importance for using technology can be considered as the factor which increases their belief scores about problem solving.

5.1.4. Beliefs in terms of Gender and Grade Level Being Taught

According to the results, gender was not a very determining factor on in-service teachers' belief scores similar to the attitude scores. The scores of the beliefs about mathematics did not vary according to gender was supported by research studies (Aksu, 2002). The classroom variable varied in teaching and use of mathematics whereas it did not vary in students' beliefs about the nature of the mathematics. This means; males and females do not differ in terms of their beliefs scores. When we look at the literature, it was found that limited research studies in mathematics education have observed gender issues with respect to teachers' beliefs. Kayan's (2007) study supported the result of present study. In Kayan's (2007) study the results indicated that in terms of beliefs there was no difference between the male and female pre-service elementary teachers. On the other hand, in the literature it was observed that the beliefs of participants differed meaningfully in terms of gender (İnan, 2005; Pajares and Graham, 1999).

General beliefs' high level can cause no difference in both genders. In other words, the same experience of teachers may result no difference in belief in terms of gender. We know that both male and female in-service teachers have same education during their enrollment in teacher education program. State differently they have similar experiences during their teacher training. Thus; this could be the reason that there is no difference between male and female teachers' belief scores regarding problem solving.

In addition, results revealed that there was a significant difference between elementary teachers' and elementary mathematics teachers' belief scores. The mean score for mathematics teachers who are teaching at 6^{th}, 7^{th}, and 8^{th} grades is higher than the mean score of elementary teachers who are teaching at 4^{th} and 5^{th} grades. The researches on mathematics education that include the grades level being taught issues in terms of the teachers' beliefs were minority in number. In Brown's (2003) findings of the study revealed that there was not an important difference among the teachers teaching at 3^{rd}, 4^{th} and 5^{th} grades by taking their beliefs into consideration and this result are contrary to the results in present study. Subject teachers who are teaching in 6^{th}, 7^{th}, 8^{th}, grades teach only mathematics lesson but on the other hand 4^{th} and 5^{th} graders' not only teaches mathematics but also teaches other subjects. At the same time; elementary mathematics teachers' high achievement expectation of students is higher than elementary teachers'. Elementary mathematics teachers' students are preparing exams like SBS and this is the reason of raising expectations for their student achievement in mathematics. The fact that

the students will be quizzes, leads to an increase in the expectation of teacher teaching. That's to say elementary mathematics teacher may have high belief to provide students' need. In other words, compared with elementary teachers teaching at 4^{th} and 5^{th} grades, elementary mathematics teachers teaching at 6^{th}, 7^{th} and 8^{th} grades have more content knowledge of problem solving strategies and this can be considered as the factor which increases their belief scores toward problem solving.

In the literature, the new curriculum is possibly the reason that determines the difference between the elementary teachers and the elementary mathematics teachers (Kayan, 2007). The new curriculum emphasizes that the importance of problem solving in mathematics has probably effect on the teachers' beliefs, in other words, the teachers' beliefs may improve after the new curriculum (Kayan, 2007). In the new curriculum problem solving is considered as an integral part of the mathematics and it has an important role in learning mathematics accurately (T.T.K.B., 2009). This emphasis might possibly effect the teachers' beliefs significantly. As a result, the in-service mathematics teachers' beliefs might show an increase. Hence, the changes in the new curriculum might cause the fact that the teachers teaching the upper grades have more positive beliefs about problem solving in the present study.

5.1.5 Discussion of the Findings for the Relationship between Attitude and Belief Scores

The last aspect of the present study was investigating the relationship between attitudes and beliefs of in-service teachers. The results of Pearson product moment correlation analysis revealed that there was a positive relationship between attitude test scores and belief test scores of in-service elementary teachers and elementary mathematics teachers. According to Brown's (2003) study the elementary mathematics teachers' attitudes toward problem solving were strictly adhered to their beliefs about problem solving, so the scores on beliefs and attitudes are in correlation with each other. In other words, the high scores on beliefs were the result of the high scores on attitudes and vice versa. Thus, in this study it was assumed that in-service teachers who had higher attitude toward problem solving also obtained higher scores in belief toward problem solving. As it is mentioned in literature, attitude and belief are relevant. That's why consistence of them is important. Students' high expectations and student focused teaching provide these consistence. Students' expectations from teachers for education

effect the teachers' belief directly. If teacher have high attitude this make teacher's belief rich. In this study in service teachers who have high attitude have rich belief at the same time. With these attitudes and beliefs support each other in positive way.

5.2 Implications and Recommendations for Further Research studies

In the present study, the main focus was to investigate elementary teachers' and elementary mathematics teachers' attitudes toward and beliefs about mathematical problem solving in terms of gender and grade level being taught. Besides, the relationship between elementary teachers' and mathematics teachers' attitudes and beliefs were also evaluated. In the view of findings and in the critique of previous literature, some recommendations were suggested for further studies.

Convenience sampling was used as a sampling method and this method includes the data gathered from the participants available (Fraenkel and Wallen, 2006). In order to make generalization of the findings to the population, further research could be conducted with randomly selected sample from teachers teaching at various grade levels.

The sample consisted of in-service elementary teachers who are teaching at 4^{th} and 5^{th} grades and elementary mathematics teachers who are teaching at 6^{th}, 7^{th} and 8^{th} grades in public schools. The secondary teachers who are teaching at 9^{th}, 10^{th}, 11^{th} and 12^{th} grades could be selected to make comparison in terms of the attitude and belief of in-service teachers toward mathematical problem solving. In addition, this study can be applied to teachers working in private schools, too. Thus, the differences and similarities between the teachers in private schools and in public schools can be observed.

In the present study, the researcher investigated the attitude and belief levels of in-service teachers toward problem solving in mathematics. Similar research study might be conducted to investigate the elementary school students' attitudes toward and beliefs about mathematical problem solving. Another research can be done to be aware of the effect of the teachers' attitudes and beliefs on problem solving. Also the effect of the revisions in mathematics education on students' performance could be analyzed in more detailed. Further research studies that include the analysis of the elementary students' problem solving attitudes and beliefs can be performed. Additionally, in the further research studies other motivational variables like self-efficacy could be added to the study. In other words, the relationship among in-service teachers' attitudes, beliefs and other constructs could be investigated.

The findings of the research were limited with the teachers in Nevşehir and hence, handling the other cities in the new researches can provide more comprehensive information. The teachers attitudes towards and beliefs about problem solving can be analyzed in different cities. Forming and changing of the beliefs require a long time so it is more useful to do long-lasting studies. Also the cultural aspect of the beliefs about mathematics can be analyzed.

Lastly, there are some implications for teacher educators, teachers and curriculum developers. The findings revealed that attitude and belief levels of in-service teachers could be accepted as positive. In-service teachers' attitudes and beliefs have a great importance in the improvement of problem solving abilities of their students. Based on the findings it could be deduced that in-service teachers could organize their lessons by considering the improvement of problem solving abilities of their students from early years. To put it clearly, the teachers could help all students to improve their problem solving abilities by making different activities and solving different types of problems during the instruction.

Moreover, this study revealed that problem solving has important role in mathematics education. As mentioned before the importance of problem solving was stated in the new elementary mathematics program. Thus, more activities about the steps of problem solving can be added to textbooks. Also, there should be problem solving guide books for both students and teachers. For instance, the book for students should contain activity sheets about the mathematical concepts including problem solving activities. Parallel to this view, a guide book for teachers should have clear instructions on how to apply problem solving strategies to the given problems. By this way, it is believed that teachers feel more comfortable in using problem solving strategies and this will positively affect their attitudes and beliefs toward problem solving.

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APPENDICES

APPENDIX A

İLKÖĞRETİM MATEMATİK ÖĞRETMEN ADAYLARININ MATEMATİKSEL PROBLEM ÇÖZME TUTUMLARI

AÇIKLAMA:

Bu anketin amacı ilköğretim matematik öğretmen adaylarının matematiksel problem çözme hakkındaki tutumlarını araştırmaktır. Ankete katılmak tercihe bağlıdır. Ankete katılırsanız sizinle ilgili kişisel bilgiler tamamen saklı tutulacaktır. Anketteki her bir maddeyi yanıtlamanız bu çalışma için çok faydalı olacaktır.

Katkılarınızdan dolayı şimdiden teşekkür ederim.

Hasan ÇOKÇALIŞKAN
ODTÜ İlköğretim Bölümü
Yüksek Lisans Öğrencisi

1. BÖLÜM : KİŞİSEL BİLGİLER

1. Cinsiyetiniz: Bay ( ) Bayan ( )

2. Sınıfınız: 1.sınıf ( ) 2.sınıf ( ) 3.sınıf ( ) 4.sınıf ( )

3. Genel not ortalamanız: ……..

4. Problem çözme ile ilgili herhangi bir ders aldınız mı?

Aldım ( ) Almadım ( )

Aldıysanız, hangi dersleri aldınız?

……
……
……

5. Ders alma dışında problem çözme ile ilgilendiniz mi?

İlgilendim ( ) İlgilenmedim ( )

İlgilendiyseniz, ne şekilde ilgilendiniz?

……
……
…….

6. Öğretmenlik uygulama dersini aldınız mı?

Aldım ( ) Bu Dönem Alıyorum ( ) Almadım ( )

7. Almak zorunda olduğunuz matematik içerikli bütün dersleri bitirdiniz mi?

Evet ( ) Hayır ( )

2. BÖLÜM: MATEMATİKSEL PROBLEM ÇÖZMEYE YÖNELİK DAVRANIŞLAR

Lütfen aşağıdaki her madde için düşüncenizi en iyi yansıttığını düşündüğünüz tercihin karsısındaki rakamı işaretleyiniz.

(Tamamen Katılıyorum:5, Katılıyorum:4, Tarafsızım:3, Katılmıyorum:2, Hiç Katılmıyorum:1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
1.) Matematik problemlerini çözmeye yardımcı olmak amacıyla şekil çizmek boşa zaman kaybıdır.	(5)	(4)	(3)	(2)	(1)
2.) Matematik problemlerini çözmeyi sıkıcı bulurum.	(5)	(4)	(3)	(2)	(1)
3.) Bulmaca çözmekten zevk alırım.	(5)	(4)	(3)	(2)	(1)
4.) Matematik problemlerinin sıkıcı ve ağır bir iş olduğunu düşünürüm.	(5)	(4)	(3)	(2)	(1)
5.) Çözümünü hemen göremediğim matematik problemleri karşısında pes etmem.	(5)	(4)	(3)	(2)	(1)
6.) Kişi matematik problemlerini çözerken, hata yapma olasılığını göze almalıdır.	(5)	(4)	(3)	(2)	(1)
7.) Matematik problemlerini çözerken öğrencilerimi deneme-yanılma yolunu kullanmaları için teşvik ederim.	(5)	(4)	(3)	(2)	(1)
8.) Matematik problemleri çok zevk aldığım bir uğraştır.	(5)	(4)	(3)	(2)	(1)
9.) Basit olanların dışındaki çoğu matematik problemini çözmek uzun zaman alır.	(5)	(4)	(3)	(2)	(1)
10.) Zihinsel merak uyandıran oyunları oynamaktan hoşlanırım.	(5)	(4)	(3)	(2)	(1)
11.) Matematik problemlerini çözmede, tanıdığım diğer öğretmenler kadar başarılı olduğuma inanırım.	(5)	(4)	(3)	(2)	(1)
12.) Öğrencilerin problem çözerken, en uygun olan çözüm yolunu kullanmaları için teşvik edilmeleri gerektiğini düşünürüm.	(5)	(4)	(3)	(2)	(1)
13.) Öğrencilerimi, problemlere verdikleri cevapların gerçekten mantıklı olup olmadığını görmeleri için, cevaplarını kontrol etmeye teşvik ederim.	(5)	(4)	(3)	(2)	(1)
14.) Matematik problemlerini zor bir işten öte oyun gibi düşünürüm.	(5)	(4)	(3)	(2)	(1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
15.) Matematik problemlerini çözmeye çalışırken kendimi sıklıkla net düşünemez bulurum.	(5)	(4)	(3)	(2)	(1)
16.) Zor bir problemin çözümünü kendim bulmak yerine, birisinin bana nasıl çözüleceğini anlatmasını tercih ederim.	(5)	(4)	(3)	(2)	(1)
17.) Yeni bir tür matematik probleminin çözüm yolunu keşfetmeye çalışmak heyecan verici bir deneyimdir.	(5)	(4)	(3)	(2)	(1)
18.) Öğrencilerime, bir sorunun birçok farklı çözüm yöntemi olabileceğini vurgularım.	(5)	(4)	(3)	(2)	(1)
19.) Matematik problemleri bana, "sanki sayılar ormanında kaybolmuş ve yolumu bulamamış" gibi hissettirir.	(5)	(4)	(3)	(2)	(1)
20.) Bir problemin nasıl çözüleceğini hemen anlamayan öğrenciler, bu probleme benzer başka bir problem üzerinde uğraşsın ve düşünsün diye teşvik edilmelidir.	(5)	(4)	(3)	(2)	(1)
21.) Bir problemi çözmek için yeterince uzun düşünmekte zorlanırım.	(5)	(4)	(3)	(2)	(1)
22.) Bazı öğrencilerin neden matematik problemlerini eğlenceli olarak düşündüklerini anlamakta zorlanırım.	(5)	(4)	(3)	(2)	(1)
23.) Bir kişi "matematik problemlerini çözme korkum var" diyebilir.	(5)	(4)	(3)	(2)	(1)
24.) Öğrencilerime, matematik problemlerinin bazılarının birden fazla cevabının olduğunu bazılarının ise hiç cevabı olmadığını vurgularım.	(5)	(4)	(3)	(2)	(1)
25.) Matematik problemleri üzerinde uzun süre odaklanmakta zorlanırım.	(5)	(4)	(3)	(2)	(1)
26.) Eğer bir matematik problemini çözemezsem, çözene kadar onunla uğraşmak hoşuma gider.	(5)	(4)	(3)	(2)	(1)
27.) Zor matematik problemlerini çözmekten özellikle hoşlanmam.	(5)	(4)	(3)	(2)	(1)
28.) Çoğu matematik problemleri sinir bozucudur.	(5)	(4)	(3)	(2)	(1)
29.) Çeldirici matematik problemleri ile uğraşmak hoşuma gider.	(5)	(4)	(3)	(2)	(1)
30.) Matematik problemleri genellikle çok ilgi çekicidir.	(5)	(4)	(3)	(2)	(1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
31.) Matematik problemlerine karşı olumlu duygular barındırırım.	(5)	(4)	(3)	(2)	(1)
32.) Öğrencilerimi problem çözerken durup düşünme tutumunu edinmeleri için desteklerim.	(5)	(4)	(3)	(2)	(1)
33.) Okul dışında, matematik problemlerini düşünmekten hoşlanmam.	(5)	(4)	(3)	(2)	(1)
34.) Ne kadar çaba sarf etsem de, matematik problemlerini çözerken kafamın karıştığını hissederim.	(5)	(4)	(3)	(2)	(1)
35.) Bir matematik problemini hemen çözemezsem uğraşmayı bırakırım.	(5)	(4)	(3)	(2)	(1)
36.) Matematikte birisinin öğrenmesi gereken kuralların çokluğu problem çözmeyi zorlaştırır.	(5)	(4)	(3)	(2)	(1)
37.) Zor matematik problemlerini çözmek zorunda olduğumu düşünmek beni tedirgin eder.	(5)	(4)	(3)	(2)	(1)
38.) İlköğretim matematik öğretiminde; işlem becerilerinin gelişimi, problem çözme becerilerinin gelişiminden daha önce yer almalıdır.	(5)	(4)	(3)	(2)	(1)
39.) Yeterli zaman olursa, matematik problemlerinin çoğunu çözmede başarılı olabileceğime inanırım.	(5)	(4)	(3)	(2)	(1)
40.) İlköğretimde, öğrencilerin hesaplamayı nasıl yapacağını bilmesi, matematik problemlerinin hemen hemen çoğunu çözebilmek için gereklidir.	(5)	(4)	(3)	(2)	(1)

Teşekkür ederim.

APPENDIX B

İLKÖĞRETİM MATEMATİK ÖĞRETMENLERİNİN MATEMATİKSEL PROBLEM ÇÖZME TUTUMLARI & İNANIŞLARI

AÇIKLAMA:

Bu anketin amacı ilköğretim matematik öğretmenlerinin matematiksel problem çözme hakkındaki tutumlarını ve inanışlarını araştırmaktır.

Ankete katılmak tercihe bağlıdır. Ankete katılırsanız sizinle ilgili kişisel bilgiler tamamen saklı tutulacaktır. Anketteki her bir maddeyi yanıtlamanız bu çalışma için çok faydalı olacaktır.

Katkılarınızdan dolayı şimdiden teşekkür ederim.

Hasan ÇOKÇALIŞKAN
ODTÜ İlköğretim Bölümü
Yüksek Lisans Öğrencisi
e-mail: e128388@metu.edu.tr
Tel: 0535 251 87 19

1. BÖLÜM : KİŞİSEL BİLGİLER

1. Cinsiyetiniz: Bay (1) Bayan (2)

2. Hangi sınıflara ders veriyorsunuz? (Gerekiyorsa birden fazla seçenek işaretleyiniz):

4.sınıf (1) 5.sınıf (2) 6.sınıf (3) 7.sınıf (4)
8.sınıf (5)

3. Öğretmenlik deneyiminiz?:

1-4 yıl (1) 5-9 yıl (2) 10-14 yıl (3) 14 yıl ve üzeri (4)

4. Öğrenim durumunuz (en son aldığınız diploma derecesi) nedir?

Öğretmen okulu – Yüksek öğretmen okulu	(1)
Ön lisans	(2)
Lisans	(3)
Yüksek lisans	(4)
Doktora	(5)

5. Mezun olduğunuz bölüm ve fakültenin adı nedir?

……

6. Mesleğinizi yapıyor olmaktan duyduğunuz memnuniyet dereceniz nedir?

Az (1) Orta (2) Çok (3)

7. Branşınız nedir?

Sınıf öğretmeni (1) Matematik öğretmeni (2)

2. BÖLÜM: MATEMATİKSEL PROBLEM ÇÖZMEYE YÖNELİK DAVRANIŞLAR

Lütfen aşağıdaki her madde için düşüncenizi en iyi yansıttığını düşündüğünüz tercihin karsısındaki rakamı işaretleyiniz.

(Tamamen Katılıyorum:5, Katılıyorum:4, Tarafsızım:3, Katılmıyorum:2, Hiç Katılmıyorum:1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
1.) Matematik problemlerini çözmeyi sıkıcı bulurum.	(5)	(4)	(3)	(2)	(1)
2.) Bulmaca çözmekten zevk alırım.	(5)	(4)	(3)	(2)	(1)
3.) Matematik problemlerinin sıkıcı ve ağır bir iş olduğunu düşünürüm.	(5)	(4)	(3)	(2)	(1)
4.) Çözümünü hemen göremediğim matematik problemleri karşısında pes etmem.	(5)	(4)	(3)	(2)	(1)
5.) Kişi matematik problemlerini çözerken, hata yapma olasılığını göze almalıdır.	(5)	(4)	(3)	(2)	(1)
6.) Matematik problemlerini çözerken öğrencilerimi deneme-yanılma yolunu kullanmaları için teşvik ederim.	(5)	(4)	(3)	(2)	(1)
7.) Matematik problemleri çok zevk aldığım bir uğraştır.	(5)	(4)	(3)	(2)	(1)
8.) Basit olanların dışındaki çoğu matematik problemini çözmek uzun zaman alır.	(5)	(4)	(3)	(2)	(1)
9.) Zihinsel merak uyandıran oyunları oynamaktan hoşlanırım.	(5)	(4)	(3)	(2)	(1)
10.) Öğrencilerin problem çözerken, en uygun olan çözüm yolunu kullanmaları için teşvik edilmeleri gerektiğini düşünürüm.	(5)	(4)	(3)	(2)	(1)
11.) Öğrencilerimi, problemlere verdikleri cevapların gerçekten mantıklı olup olmadığını görmeleri için, cevaplarını kontrol etmeye teşvik ederim.	(5)	(4)	(3)	(2)	(1)
12.) Matematik problemlerini zor bir işten öte oyun gibi düşünürüm.	(5)	(4)	(3)	(2)	(1)
13.) Matematik problemlerini çözmeye çalışırken kendimi sıklıkla net düşünemez bulurum.	(5)	(4)	(3)	(2)	(1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
14.) Zor bir problemin çözümünü kendim bulmak yerine, birisinin bana nasıl çözüleceğini anlatmasını tercih ederim.	(5)	(4)	(3)	(2)	(1)
15.) Yeni bir tür matematik probleminin çözüm yolunu keşfetmeye çalışmak heyecan verici bir deneyimdir.	(5)	(4)	(3)	(2)	(1)
16.) Öğrencilerime, bir sorunun birçok farklı çözüm yöntemi olabileceğini vurgularım.	(5)	(4)	(3)	(2)	(1)
17.) Matematik problemleri bana, "sanki sayılar ormanında kaybolmuş ve yolumu bulamamış" gibi hissettirir.	(5)	(4)	(3)	(2)	(1)
18.) Bir problemi çözmek için yeterince uzun düşünmekte zorlanırım.	(5)	(4)	(3)	(2)	(1)
19.) Bazı öğrencilerin neden matematik problemlerini eğlenceli olarak düşündüklerini anlamakta zorlanırım.	(5)	(4)	(3)	(2)	(1)
20.) Matematik problemleri üzerinde uzun süre odaklanmakta zorlanırım.	(5)	(4)	(3)	(2)	(1)
21.) Eğer bir matematik problemini çözemezsem, çözene kadar onunla uğraşmak hoşuma gider.	(5)	(4)	(3)	(2)	(1)
22.) Zor matematik problemlerini çözmekten özellikle hoşlanmam.	(5)	(4)	(3)	(2)	(1)
23.) Çoğu matematik problemleri sinir bozucudur.	(5)	(4)	(3)	(2)	(1)
24.) Çeldirici matematik problemleri ile uğraşmak hoşuma gider.	(5)	(4)	(3)	(2)	(1)
25.) Matematik problemleri genellikle çok ilgi çekicidir.	(5)	(4)	(3)	(2)	(1)
26.) Matematik problemlerine karşı olumlu duygular barındırırım.	(5)	(4)	(3)	(2)	(1)
27.) Öğrencilerimi problem çözerken durup düşünme tutumunu edinmeleri için desteklerim.	(5)	(4)	(3)	(2)	(1)
28.) Okul dışında, matematik problemlerini düşünmekten hoşlanmam.	(5)	(4)	(3)	(2)	(1)
29.) Ne kadar çaba sarf etsem de, matematik problemlerini çözerken kafamın karıştığını hissederim.	(5)	(4)	(3)	(2)	(1)
30.) Bir matematik problemini hemen çözemezsem uğraşmayı bırakırım.	(5)	(4)	(3)	(2)	(1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
31.) Matematikte birisinin öğrenmesi gereken kuralların çokluğu problem çözmeyi zorlaştırır.	(5)	(4)	(3)	(2)	(1)
32.) Zor matematik problemlerini çözmek zorunda olduğumu düşünmek beni tedirgin eder.	(5)	(4)	(3)	(2)	(1)
33.) İlköğretim matematik öğretiminde; işlem becerilerinin gelişimi, problem çözme becerilerinin gelişiminden daha önce yer almalıdır.	(5)	(4)	(3)	(2)	(1)
34.) Yeterli zaman olursa, matematik problemlerinin çoğunu çözmede başarılı olabileceğime inanırım.	(5)	(4)	(3)	(2)	(1)
35.) İlköğretimde, öğrencilerin hesaplamayı nasıl yapacağını bilmesi, matematik problemlerinin hemen hemen çoğunu çözebilmek için gereklidir.	(5)	(4)	(3)	(2)	(1)

3. BÖLÜM: MATEMATİKSEL PROBLEM ÇÖZMEYE YÖNELİK İNANIŞLAR

Lütfen aşağıdaki her madde için düşüncenizi en iyi yansıttığını düşündüğünüz tercihin karsısındaki rakamı işaretleyiniz.

(Tamamen Katılıyorum:5, Katılıyorum:4, Tarafsızım:3, Katılmıyorum:2, Hiç Katılmıyorum:1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
1.) Matematiksel problem çözmede bir yöntemin kişiyi doğru cevaba ulaştırması, nasıl veya niye ulaştırdığından daha önemlidir.	(5)	(4)	(3)	(2)	(1)
2.) Uygun çözüm yollarını bilmek bütün problemleri çözmek için yeterlidir.	(5)	(4)	(3)	(2)	(1)
3.) Bir matematik probleminin çözümünün uzun zaman alması rahatsız edici değildir.	(5)	(4)	(3)	(2)	(1)
4.) Bir problemi, öğretmenin kullandığı veya ders kitabında yer alanlar dışında yöntemler kullanarak çözmek mümkündür	(5)	(4)	(3)	(2)	(1)
5.) Matematik öğretiminde uygun teknolojik araçlar öğrenciler için her zaman erişilebilir olmalıdır.	(5)	(4)	(3)	(2)	(1)
6.) Bir problemin çözümünün niye doğru olduğunu anlamayan kişi sonucu bulsa da aslında tam olarak o problemi çözmüş sayılmaz.	(5)	(4)	(3)	(2)	(1)
7.) Matematikçiler problemleri çözerken önceden bilinen çözüm kalıplarını nadiren kullanırlar.	(5)	(4)	(3)	(2)	(1)
8.) Bir problemin nasıl çözüleceğini anlamak uzun zaman alıyorsa, o problem çözülemez.	(5)	(4)	(3)	(2)	(1)
9.) Bir problemi çözmenin sadece bir doğru yöntemi vardır.	(5)	(4)	(3)	(2)	(1)
10.) Problem çözme matematik müfredatının tamamına yansıtılmalıdır.	(5)	(4)	(3)	(2)	(1)
11.) Problem çözerken teknolojik araçlar kullanmak bir tür hiledir.	(5)	(4)	(3)	(2)	(1)
12.) Bir problemin çözümünü bulmak o problemi anlamaktan daha önemlidir.	(5)	(4)	(3)	(2)	(1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
13.) Problem çözmeyi öğrenmek problemin çözümüne yönelik doğru yolları akılda tutmakla ilgilidir.	(5)	(4)	(3)	(2)	(1)
14.) En zor matematik problemleri bile üzerinde ısrarla çalışıldığında çözülebilir.	(5)	(4)	(3)	(2)	(1)
15.) Öğretmenin çözüm yöntemini unutan bir öğrenci aynı cevaba ulaşacak başka yöntemler geliştirebilir..	(5)	(4)	(3)	(2)	(1)
16.) Problem çözme matematikte işlem becerileri ile doğrudan ilgilidir.	(5)	(4)	(3)	(2)	(1)
17.) Teknolojik araçlar, problem çözmede faydalıdır.	(5)	(4)	(3)	(2)	(1)
18.) Bir çözümü anlamaya çalışmak için kullanılan zaman çok iyi değerlendirilmiş bir zamandır.	(5)	(4)	(3)	(2)	(1)
19.) İlgili formülleri hatırlamadan da problemler çözülebilir.	(5)	(4)	(3)	(2)	(1)
20.) Matematikte iyi olmak, problemleri çabuk çözmeyi gerektirir.	(5)	(4)	(3)	(2)	(1)
21.) Verilen herhangi bir problemin çözümünde tüm matematikçiler aynı yöntemi kullanır.	(5)	(4)	(3)	(2)	(1)
22.) Öğrenciler, problem çözme yaklaşımlarını ve tekniklerini diğer öğrenciler ile paylaşmalıdır.	(5)	(4)	(3)	(2)	(1)
23.) Öğretmenler, teknolojiyi kullanarak öğrencilerine yeni öğrenme ortamları oluşturmalıdır	(5)	(4)	(3)	(2)	(1)
24.) Bir çözümde öğrencinin mantıksal yaklaşımı, çözümün doğru olmasına kıyasla daha çok takdir edilmelidir.	(5)	(4)	(3)	(2)	(1)
25.) Öğrencilerin matematik problemleri çözebilmeleri için çözüm yollarını önceden bilmesi gerekir.	(5)	(4)	(3)	(2)	(1)
26.) Bir öğrenci, problemi bir yoldan çözemiyorsa başka bir çözüm yolu mutlaka bulabilir.	(5)	(4)	(3)	(2)	(1)
27.) Öğrencilere problemlerin çözüm yollarını göstermek onların keşfetmesini beklemekten daha iyidir.	(5)	(4)	(3)	(2)	(1)
28.) Problem çözerken teknolojiyi kullanmak zaman kaybıdır.	(5)	(4)	(3)	(2)	(1)

	TAMAMEN KATILIYORUM	KATILIYORUM	TARAFSIZIM	KATILMIYORUM	HİÇ KATILMIYORUM
29.) Bir matematik problemini çözerken doğru cevabı bulmanın yanında bu cevabın niye doğru olduğunu anlamak da önemlidir.	(5)	(4)	(3)	(2)	(1)
30.) Çözüm yollarını akılda tutmak problem çözmede çok faydalı değildir.	(5)	(4)	(3)	(2)	(1)
31.) Bir matematik öğretmeni, problemlerin çözümlerini tam olarak sınavda isteyeceği şekilde öğrencilere göstermelidir.	(5)	(4)	(3)	(2)	(1)
32.) Matematik derslerinde öğrencilerin problem kurma becerileri geliştirilmelidir.	(5)	(4)	(3)	(2)	(1)
33.) Teknolojiyi kullanmak öğrencilere çalışmalarında daha çok seçenek sunar.	(5)	(4)	(3)	(2)	(1)
34.) Belirli bir çözüm yolunu kullanmadan bir matematik problemini çözmek mümkün değildir.	(5)	(4)	(3)	(2)	(1)
35.) Bir matematik öğretmeni, öğrencilerine bir soruyu çözdürürken çok çeşitli yönlerden bakabilmeyi de göstermelidir.	(5)	(4)	(3)	(2)	(1)
36.) Teknolojik araçlar, öğrencilerin matematik öğrenme becerilerine zarar verir.	(5)	(4)	(3)	(2)	(1)
37.) Her matematiksel problem önceden bilinen bir çözüm yolu takip edilerek çözülemeyebilir.	(5)	(4)	(3)	(2)	(1)
38.) Farklı çözüm yolları öğrenmek, öğrencilerin kafasını karıştırabilir.	(5)	(4)	(3)	(2)	(1)
39.) Öğrenciler, uygun bir şekilde teknolojiyi kullanırlarsa matematiği daha derinlemesine anlayabilirler.	(5)	(4)	(3)	(2)	(1)

Katıldığınız için teşekkür ederim.

APPENDIX C

	Agree		Neutral		Disagree		Mean**	SD
ITEMS	f	%	f	%	f	%	M	SD
1*.	10	7,1	5	3,5	126	89,4	1,65	0,878
2.	108	76,6	18	12,8	15	10,6	4,03	1,069
3*.	9	6,4	8	5,7	124	87,9	1,72	0,887
4.	115	81,6	12	8,5	14	9,9	4,08	1,029
5.	131	92,9	5	3,5	5	3,5	4,23	0,743
6.	118	83,7	10	7,1	13	9,2	4,01	0,866
7.	121	85,8	15	10,6	5	3,5	4,23	0,807
8*.	45	31,9	23	16,3	73	51,8	2,70	1,107
9.	122	86,5	10	7,1	9	6,4	4,12	0,824
10.	131	92,9	3	2,1	7	5	4,37	0,814
11.	138	97,9	1	0,7	2	1,4	4,48	0,593
12.	122	86,5	13	9,2	6	4,3	4,22	0,785
13*.	23	16,3	21	14,9	97	68,8	2,32	1,037
14*.	23	16,3	16	11,3	102	72,3	2,21	1,046
15.	121	85,8	12	8,5	8	5,7	4,22	0,854
16.	135	95,7	2	1,4	4	2,8	4,52	0,672
17*.	36	25,5	27	19,1	78	55,3	2,55	1,192
18*.	34	24,1	19	13,5	88	62,4	2,49	1,080
19*.	20	14,2	18	12,8	103	73	2,13	1,064
20*.	25	17,7	12	8,5	104	73,8	2,21	1,074
21.	113	80,1	13	9,2	15	10,6	4,03	0,948
22*.	28	19,9	20	14,2	93	66,0	2,43	1,155
23*.	26	18,4	23	16,3	92	65,2	2,30	1,177
24.	103	73,0	19	13,5	19	13,5	3,86	0,983
25.	118	83,7	13	9,2	10	7,1	4,05	0,814
26.	117	83,0	16	11,3	8	5,7	4,07	0,851
27.	136	96,5	4	2,8	1	0,7	4,35	0,575
28*.	26	18,4	24	17	91	64,5	2,35	1,090
29*.	37	26,2	21	14,9	83	58,9	2,50	1,138
30*.	18	12,8	7	5	116	82,3	2,04	0,933
31*.	63	44,7	15	10,6	63	44,7	2,97	1,189
32*.	32	22,7	23	16,3	86	61,0	2,48	1,131
33*.	96	68,1	14	9,9	31	22,0	3,71	1,257
34.	121	85,8	15	10,6	5	3,5	4,11	0,724
35*.	111	78,7	13	9,2	17	12,1	3,97	1,028

* These items are negatively stated. Items reversed in scoring. Therefore, a higher mean indicates participants disagree with the statements.

APPENDIX D

	Agree		Neutral		Disagree		Mean**	Stand. Dev.
ITEMS	f	%	f	%	f	%	M	SD
1*.	44,00	31,20	25,00	17,70	72,00	51,10	2,72	1,116
2*.	40,00	28,40	19,00	13,50	82,00	58,20	3,39	1,061
3.	77,00	54,60	24,00	17,00	40,00	28,40	3,38	1,079
4.	132,00	93,60	7,00	5,00	2,00	1,40	4,25	0,645
5.	136,00	96,50	3,00	2,10	2,00	1,40	4,53	0,616
6.	134,00	95,00	5,00	3,50	2,00	1,40	4,40	0,631
7.	32,00	22,70	47,00	33,30	62,00	44,00	2,78	0,927
8*.	16,00	11,30	14,00	9,90	111,00	78,70	2,11	0,919
9*.	11,00	7,80	4,00	2,80	126,00	89,40	1,68	0,913
10.	110,00	78,00	20,00	14,20	11,00	7,80	3,97	0,853
11*.	21,00	14,90	20,00	14,20	100,00	70,90	2,21	1,048
12*.	19,00	13,50	13,00	9,20	109,00	77,30	2,08	1,063
13*.	97,00	68,80	12,00	8,50	32,00	22,70	3,50	1,067
14.	129,00	91,50	12,00	8,50	0,00	0,00	4,24	0,596
15.	134,00	95,00	5,00	3,50	2,00	1,40	4,32	0,613
16*.	126,00	89,40	7,00	5,00	8,00	5,70	4,13	0,800
17.	104,00	73,80	25,00	17,70	12,00	8,50	3,90	0,873
18.	129,00	91,50	9,00	6,40	3,00	2,10	4,21	0,649
19.	83,00	58,90	30,00	21,30	28,00	19,90	3,54	0,997
20*.	76,00	53,90	23,00	16,30	42,00	29,80	3,30	1,095
21*.	5,00	3,50	7,00	5,00	129,00	91,50	1,77	0,759
22.	138,00	97,90	3,00	2,10	0,00	0,00	4,43	0,538
23.	135,00	95,70	5,00	3,50	1,00	0,70	4,43	0,600
24.	128,00	90,80	11,00	7,80	2,00	1,40	4,27	0,664
25*.	79,00	56,00	27,00	19,10	35,00	24,80	3,39	0,991
26.	116,00	82,30	21,00	14,90	4,00	2,80	4,02	0,702
27*.	28,00	19,90	20,00	14,20	93,00	66,00	2,36	1,154
28*.	12,00	8,50	21,00	14,90	108,00	76,60	2,11	0,908
29.	133,00	94,30	7,00	5,00	1,00	0,70	4,44	0,625
30.	30,00	21,30	22,00	15,60	89,00	63,10	2,51	0,997
31*.	63,00	44,70	19,00	13,50	59,00	41,80	3,06	1,176
32.	139,00	98,60	2,00	1,40	0,00	0,00	4,57	0,524
33.	120,00	85,10	20,00	14,20	1,00	0,70	4,18	0,693

	Agree		Neutral		Disagree		Mean**	Stand. Dev.
ITEMS	f	%	f	%	f	%	M	SD
34*.	48,00	34,10	24,00	17,00	69,00	48,90	2,82	1,148
35.	132,00	93,60	7,00	5,00	2,00	1,40	4,55	0,660
36*.	16,00	11,30	27,00	19,10	98,00	69,50	2,22	0,986
37.	107,00	75,90	19,00	13,50	15,00	10,60	3,79	0,914
38*.	17,00	12,10	12,00	8,50	112,00	79,40	2,04	0,948
39.	119,00	84,40	18,00	12,80	4,00	2,80	4,11	0,757

* These items are negatively stated. Items reversed in scoring. Therefore, a higher mean indicates participants disagree with the statements.

APPENDIX E

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ☐

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı :
Adı :
Bölümü :

TEZİN ADI (İngilizce) :

TEZİN TÜRÜ : Yüksek Lisans ☐ Doktora ☐

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
3. Tezimden bir bir (1) yıl süreyle fotokopi alınamaz. ☐

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: