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Examination of the Mathematical Problem-Solving Beliefs and Success Levels of Primary School Teacher Candidates Through the Variables of Mathematical Success and Gender

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Abstract

The aim of this study is to examine the mathematical problem-solving beliefs and problem-solving success levels of primary school teacher candidates through the variables of academic success and gender. The research was designed according to the mixed methods technique in which qualitative and quantitative methods are used together. The working group, comprised of 138 freshman students studying in the Primary School Teaching Department at a state university formed the quantitative data of the research. Using criterion sampling, a purposeful sampling method technique, 36 students were identified for forming the qualitative data group. The Belief Scale Regarding Mathematical Problem Solving, as developed by Kloosterman and Stage; the Identifying Test of Problem-Solving Success Levels, written by the author; and a semi-structured interview form were used to collect the data. The data was analyzed by MANOVA and two-way ANOVA testing respectively for the quantitative dimensions of the study while qualitative data was analyzed through the descriptive analysis method. Research results concluded that there was not a significant difference between the belief levels of teacher candidates with high and low problem-solving success levels for the dimensions of mathematical skill, the place of mathematics, and problem-solving skills in the Belief Scale Regarding Mathematical Problem Solving. Significant differences were found, however, in the sub-dimensions of understanding the problem and the importance of mathematics, regarding teacher candidates with high problem-solving success levels. It was also clearly seen from the results of the research that the ideas of teacher candidates with low and high problem-solving success levels were similar to each other. Based on these results, it is suggested that importance be given to classroom activities that positively affect the beliefs of primary school teacher candidates in regard to problem solving and learning mathematics. Also, researches using experimental designs can be performed by controlling the interaction of variables that can affect problem-solving beliefs.

Keywords: Mathematical problem solving belief • Primary school teacher candidates • Problem solving success level • Mathematical belief • Mathematical success • Gender

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Since the 1970s, developments in the field of social psychology have brought the concepts of cognition and belief into question; research that had been performed on the concept of belief in the 1980s especially gained importance and were applied to different disciplines such as psychology, political science, anthropology, and educational sciences (Thompson, 1992). Belief can be defined as "a feeling that something is good, right, or valuable," (Merriam-Webster, 2014), or as "being bonded with an idea in the heart," (Türk Dil Kurumu, 2011, p. 1186). As in the scope of educational sciences, many researchers have defined the concept of belief in different ways. According to Pajares (1992) for example, belief means the choices and behaviors of people based on their life experiences. For Richardson (1996), beliefs are the assumptions and thought patterns that individuals develop due to conditions in their life. Thompson (1992) defined belief as a diagram of the emotions, value judgments, and past experiences of an individual. Schoenfeld (1998) defined belief as the experiences and understandings of individuals coded into mental diagrams. Deryakulu (2004, p. 260) defined belief as the internal acceptance or statements assumed to be right by an individual that determine how one perceives, intends, and acts towards every event, fact, person, or object. As can be gathered from these opinions, there is not a common, agreed-upon definition regarding the concept of belief in terms of the educational literature. In terms of mathematical education, it has been evaluated that many researchers point out mathematical belief and its importance with the concept of problem-solving (Bishaw, 2010; De Corte & Op't Eynde, 2002; Philipp, 2007; Raymond, 1997; Schoenfeld, 1992; Silver 1985; Thompson, 1985, 1992). In this scope, Raymond (1997) defines mathematical belief as value judgements towards mathematics that an individual has obtained from past experiences. Pehkonen and Törner (2003) define mathematical belief as an individual understanding of the mathematical world while identifying mathematical tasks alongside this. Again, Ernest (1989) defines mathematical belief as the concepts, ideologies, values, and philosophies of an individual on life and mathematics. Dede and Karakuş (2014) define it as the psychological understandings and mental structures of an individual that are shaped from past experiences. Mathematical belief is also handled as the sum of value judgments and subjective approaches that an individual has developed due to their past experiences in this study.

When evaluating the concept of "problem" in terms of words, many sources define problem as a condition that needs to be solved but whose solution is not known directly from daily life (Blum & Niss, 1991; Polya 1990, Van De Walle, Karp, & Bay-Williams, 2013). Mathematically, problems should need a solution; having made no preparations for finding the solution, there should be attempts at solving it (Jonassen, 2000; Reys, Suydam, Lindquist, & Smith, 1998; Schoenfeld, 1992; Van De Walle, 2007). Based on this, problem solving is the period of completing facts or complicated situations by checking over different ways of obtaining solutions (NCTM, 2000; Schoenfeld, 1992). Since problem solving is a basic part of mathematical learning, it is also an important area in the development of mathematical knowledge and thought processes of students (Ho, 2009; Lester, Garofalo, & Kroll, 1989; Malloy, 2002; NCTM, 2000; Reys et al., 1998; Schoenfeld, 1992; Thompson, 1985). The development of problem-solving skills is an important skill that needs to be developed slowly and continuously from kindergarten to higher education (Van De Walle, 2007). Many researchers that have examined the stages of problem solving emphasize the importance of internal and external factors in problem solving (Jonassen, 2000; Smith, 1991). In this scope, external problems are reasons that originate from the problem itself, such as the structure of the problem, its complexity, abstractness, and presentation. Internal factors, on the other hand, are reasons such as the solution seeker's familiarity with the problem, their knowledge in the field and about the process, cognitive control, upper cognitive skills, and beliefs that originate from the individual's self. Every student has different ways of thinking with multiple perspectives. According to this, not only do cognitive fields but affective fields such as attitudes and beliefs also affect the problem-solving stage (Barlow & Reddish, 2006; Jonassen 2000; Schoenfeld, 2012; Schommer-Aikins, Duell, & Hutter, 2005). According to Schoenfeld (2012), since students who believe solving problems in a short time tend to develop positive attitudes and beliefs towards problem solving and mathematics, problems having low mathematical success can cause negative attitudes and beliefs towards problem solving to develop. Again, according to Lerch (2004) and Jonassen (2000), the success of students in solving problems is directly proportional to their attitudes and beliefs toward problem solving.

The literature classifies problem solving into routine and non-routine problems (Anderson, 2009; Laterell, 2013; Lee & Kim, 2005; Reusser & Stebler, 1997; Verschaffel, De Corte, & Borghart, 1997; Verschaffel, De Corte, & Lasure, 1994). Routine problems are situations that require the adaptation of similar, previously-solved problems or learned formula to a new situation (Polya, 1990). In these problems, a true solution can be reached by solving mathematical operations in a certain order. Routine problems that are important for gaining arithmetic skills in mathematics education are separated from the non-routine problems in terms of doing mathematical operations mechanically (Laterell, 2013). On the other hand, non-routine problems attract attention as being factors that form problem situations that are based on daily life and guide students in developing unique ways and strategies for solving (Anderson, 2009; Elia, Van den Heuvel-Panhuizen, & Kolovou, 2009; Sahid, 2011).

Many researchers that have carried out studies on the concept of problem solving emphasize that the evaluation of the problem-solving success of students is an important factor in understanding their mathematical beliefs; their beliefs towards problem solving also depend on their motivation towards mathematics, especially their mathematical beliefs (Charles & Lester, 1984; De Corte & Op't Eynde, 2002; Fennema, 1989; Grouws & Cramer, 1989; Kloosterman & Stage, 1992; Lester et al., 1989; McLead, 1989a, 1989b, 1992; Schoenfeld, 1985; Silver, 1985; Thompson, 1985, 1991). In this scope, the classification of mathematical belief especially by Ernest (1989), Thompson (1991) and Lindgren (1996) show great importance in terms of the problem-solving belief that forms the essence of this study. According to this, Ernest (1989) separates beliefs towards mathematics into three classes: operational, Platonist, and beliefs towards problem solving. In this context, operational beliefs perceive mathematical concepts as a useful collection of unrelated laws and realities. On the other hand, Platonist beliefs consider mathematics as a static structure that forms from the integration of absolute truths, that knowledge is formed more than produced. In the context of problem solving, mathematics is perceived as a dynamic structure that continuously renews itself. Ernest expressed that these beliefs stand on a linear system, starting from the operational level and ending with problem-solving. Again, Thompson (1991) and Lindgren (1996) also emphasized that mathematical beliefs develop in a hierarchical order, defining them in three categories. The first category, stage zero, consists of mathematical concepts and arithmetical operations that can be used in daily life. The second category, stage one, emphasizes how the concepts that form mathematical knowledge were arrived at as well as the relation between them. The last category, stage two, involves mathematical comparisons, ideas about mathematics and ways of solving, and beliefs towards problems. As was mentioned above, the current study addresses mathematical problem-solving beliefs by taking the mathematical belief classifications of Ernest (1989), Thompson (1991) and Lindgren (1996) into consideration.

In the literature, when studies that focus on mathematical beliefs or the importance of mathematical beliefs on mathematical success and problem-solving beliefs are examined, a general focus on students and teachers can be seen (Aksu, Demir, & Sümer, 2002; Al-Salouli, 2005; Callejo & Vila, 2009; Duatepe Paksu, 2008; Ford, 1994; Francisco, 2013; Higgins, 1997; Kayaaslan, 2006; Kloosterman & Stage, 1992; Lerch, 2004; Mason, 2003; Mason & Scrivani, 2004; Raymond, 1997; Schoenfeld, 1985, 1989; Schommer-Aikins et al., 2005; Stipek, Givvin, Salmon, & MacGyvers, 2001; Suthar & Tarmizi, 2010; Suthar, Tarmizi, Midi, & Adam, 2010; Taşkın, Aydın, Akşan, & Güven, 2012; Tompson, 1984; Uğurluoğlu, 2008; Xiao, Yu, & Yan, 2009). Studies addressing teacher candidates, however, are limited in number (Boz, 2008; Chen, Dooren, & Verschaffel, 2011; Dede & Karakuş, 2014; Dede & Uysal, 2012; Emenaker, 1996; Giovanni & Sangcap, 2010; Hacıömeroğlu, 2011a; Kayan & Çakıroğlu, 2008; Kayan, Haser, & Işıksal Bostan, 2013). In this scope, the interaction between problem solving and variables such as problem-solving level, academic success, and gender are handled in different dimensions than previous studies. For example, Kloosterman and Stage (1992), in their study examining the problem-solving beliefs of students, reached a conclusion that the mathematical beliefs of an individual affect learning and problem solving. In a study by Taşkın et al. (2012), they addressed the relationship between the beliefs of students with problem solving and their success in solving problems. At the end of study, a statistically significant relation between the problem-solving beliefs of students and their success with solving daily-life problems was seen. On the other hand, Giovanni and Sangcap's (2010) study in which they addressed mathematics and the mathematical problem-solving beliefs of university students concluded that beliefs towards mathematical problem solving represent a low level relationship involving basic arithmetical skills and simple solution strategies. Ford (1994), again in his study, examined the mathematical problem-solving beliefs of students and teachers. At the end of his research, he concluded that the participants view mathematical problem solving as the application of operational skills. Another important finding that was also obtained from the research is that both teachers and students perceive problem solving as just a mechanical problem-solving stage and that giving a true answer to a problem is enough of a criterion for success. In the research of Callejo and Vila (2009), they addressed the role of belief systems in the approach to mathematical problem solving. In their research, 61 students with high academic success rates participated. The relation between the approach of students in the problem-solving stage and to their beliefs was evaluated in terms of two variables. The first is the effect that the difficulty of a problem has on beliefs, and the other is the effect of students' school life on belief. At the end of the research, they concluded that there is complex relationship between the problem-solving levels of students and their beliefs. Chen et al. (2011), again in their research, examined the word-problem solving skills and beliefs of Chinese teacher candidates. At the end of their research, they concluded that there is a complex relationship between the problem-solving levels and beliefs of teacher candidates. Kayan and Çakıroğlu (2008) examined the beliefs of primary school mathematics teacher candidates towards mathematical problem solving. At the end of their research, they concluded that teacher candidates had some traditional opinions about using previously determined strategies and methods in problem solving.

On the other hand, in studies which address the interaction between academic success and problem-solving beliefs, it is clearly seen that the variable of academic success is an important factor for mathematics and problem-solving beliefs (Aksu et al., 2002; Emenaker, 1996; Lerch, 2004; Kayaaslan, 2006; Kloosterman & Stage, 1992; Mason, 2003; Mason & Scrivani, 2004; Muis, 2004; Schommer-Aikins et al., 2005; Suthar et al., 2010; Uğurluoğlu, 2008). For example, Mason (2003) examined the relation between the academic success of students and their beliefs towards mathematical problem solving; at the end of his research, he concluded that students with high mathematical success have positive beliefs towards mathematics and problem solving, whereas the ones that were unsuccessful viewed problem solving as difficult and mathematics as a useless collection of formulas that need to be memorized. Emenaker (1996) concluded in his study that academic success aimed at problem solving can play a positive or a negative role on the beliefs of students. In parallel with this, Suthar et al. (2010) found in their study that the beliefs of students towards mathematics changed depending on if they had low or high mathematical success. The study of Lerch (2004) researched how the beliefs of university students affected the stages of problem solving. At the end of that research, Lerch observed that students who could solve problems had positive beliefs towards mathematics and problem solving as well as high self-confidence. Schommer-Aikins et al. (2005) addressed the relationship between the beliefs of primary school students towards solving mathematical problems to their academic success in their study. At the end of their research that included 1200 students, the researchers discovered that the beliefs of primary school students towards solving mathematical problems affected their academic success both directly and indirectly. In the study by Suthar and Tarmizi (2010), they examined the relationship between mathematical success and the beliefs of university students. At the end of their research, they found a significant relation between student beliefs towards mathematics and their mathematical success. Uğurluoğlu (2008), at the end of his research, concluded that the scores for mathematical success for seventh and eighth grade students were directly proportional to their beliefs toward problem solving. Mason and Scrivani (2004) also examined the effect of beliefs regarding mathematics and mathematical problem solving on problem-solving success and problem-solving skills. According to their research results, they concluded that there was a significant and medium-level relation between mathematics, problem-solving beliefs, and problem-solving success.

Studies where the interaction between gender and problem-solving beliefs are addressed point out that the variable of gender can have an effect on mathematics and problem-solving beliefs (Aksu et al., 2002; Duatepe Paksu, 2008; Giovanni & Sangcap, 2010; Mason, 2003; Pişkin Tunç & Haser, 2012; Sağlam & Dost, 2014; Schommer-Aikins et al., 2005; Soytürk, 2011; Taşkın et al., 2012; Uğurluoğlu, 2008). Giovanni and Sangcap (2010), for example, found a significant difference in favor of male students as a result of their study on mathematics and the mathematical problem-solving beliefs of university students. Pişkin Tunç and Haser (2012) examined the beliefs of primary school teacher candidates regarding mathematics education and concluded that the beliefs of teacher candidates regarding mathematics education differ according to gender. In the study of Soytürk (2011), he concluded that the beliefs of primary school teacher candidates regarding mathematical problem solving significantly differ in favor of female students. Aside from these studies, however, it is possible to find limited studies in the literature that indicate the variable of gender has no effect on mathematical or problem-solving beliefs. In this scope, Kayan (2008) concluded in his study that the beliefs of mathematics teacher candidates do not show any change according to gender. Again, Duatepe Paksu (2008) reached a conclusion that the variable of gender is not an effective factor on beliefs regarding mathematics.

As can be seen above, studies that emphasize mathematical beliefs and the importance of mathematical beliefs on mathematical success and problem solving are addressed in terms of problem-solving level, academic success, and gender under different dimensions. In this study, however, mathematical problem-solving beliefs are handled by looking at the interaction of mathematical success with the problem-solving levels of primary school teacher candidates. In this scope, the current study seeks to show that the importance of mathematical problem solving is considered to be important in terms of reflecting the points of view of primary school teacher candidates. In primary school mathematics education programs especially, schools aim to train students that can solve problems, share their solutions and ideas, and develop positive attitudes towards mathematics (Milli Eğitim Bakanlığı [MEB], 2009; Nantomah, 2010; NCTM, 2000). At this stage, primary school teachers should take on their most important responsibility. The mathematical beliefs of teachers can affect the success of students positively by guiding their behaviors in the learning and teaching process as well as with the activities they apply in class (Ayvaz & Dündar, 2012; Cross, 2009; Ford, 1994; Hart, 2002; Kayan & Çakıroğlu, 2008; Masal & Takunyacı, 2012, Pajares, 1992; Raymond, 1997, Silver, 1985; Thompson, 1984, 1992; Wilkins & Brand, 2004). Based on this fact, the basic aim of this research is to address in terms of the variables of mathematical success and gender the mathematical problem-solving beliefs and success levels of primary school teacher candidates, since they are expected to have a very important responsibility in developing and helping primary school students gain basic problem-solving skills. In the direction of this general aim, answers to the following questions were researched in this study.

1) Is there a significant difference between the mathematical problem-solving beliefs of teacher candidates with low and high problem-solving success?

2) Does the interaction of problem-solving success with gender create a significant difference in the mathematical problem-solving beliefs of teacher candidates?

3) Does the interaction of problem-solving success with the overall level of success create significant differences in the mathematical problem-solving beliefs of teacher candidates?

4) What are the opinions of teacher candidates with low and high problem-solving success about their mathematical problem-solving beliefs?

Method

Research Model

The aim of this study in which the mathematical problem-solving beliefs and problem-solving success levels of primary school teacher candidates is examined was designed according to the explanatory mixed-method research technique in which qualitative and quantitative methods are used together. In explanatory mixed-method research, the results are interpreted by first collecting quantitative data then qualitative data (Creswell, 2003; Fraenkel & Wallen, 2009). In this scope, all teacher candidates first completed the Problem-Solving Success Level Determination Test and Mathematical Problem-Solving Belief Scale in order to obtain quantitative data for the research. In the second stage, semi-structured interviews were performed with the teacher candidates in order to obtain data for the qualitative dimension of the research. With this research design method in which quantitative and qualitative data are used together, the researcher collected data by using different methods and strategies (Johnson & Onwuegbuzie, 2004); additionally, he increased the scope and reliability of the research by addressing the same fact from different perspectives (Creswell, 2003; Punch, 2005). *Mathematical problem-solving beliefs*, the dependent variable obtained from the Mathematical Problem-Solving Belief Scale, and *problem-solving success level*, the independent variable obtained from the Problem-Solving Success Level Determination Test, were taken into consideration during the research design.

Population and Sampling

During the 2013-2014 academic year, 138 freshman students studying in the Primary School Teaching Department of a large scale state university in southern Turkey formed the study population of this research.

Since the study population was accessible and partially limited, random sampling was not used and every student in the study population was reached. In this scope, participants' entrance scores between 328 and 399 according to their TM2 scores were accepted. Random sampling was not used to obtain the study group. A total of 138 freshman students who had answered both sets of data collection tools and completed the Basic Mathematics I course successfully were admitted into the study population. The most important factor for qualifying students who had completed the Basic Mathematics I course successfully into the study group was the idea that these students should have a pre-knowledge about subjects such as numbers, ratios, proportions, algebraic expressions, equations, and inequality that are necessary for problem-solving skills, the basic theme of the research.

Meanwhile, 36 freshman students were chosen from the study population for the study group using the criterion sampling method, one of the purposeful sampling techniques. Accordingly, the sampling method regarding a specific aim or focused topic is thought of and obtained beforehand (Punch, 2005). In this research, teacher candidates who had successfully completed the Basic Mathematics I course participated in the Mathematical Problem-Solving Beliefs Scale and Problem-Solving Success Level Determination Test. The results obtained from the Problem-Solving Success Level Determination Test placed them in either a low or high success group. These two volunteer groups, each consisting of 18 students, were chosen and semi-structured interviews were performed. The distribution of some personal characteristics of the participant teacher candidates is presented in Table 1.

Table 1
The Distribution Chart of Teacher Candidates From the Study Population According to Personal Characteristics

Variables		*N*	%
	Low	43	31.1
	Medium	44	31.8
	High	51	37.1
	Total	138	100
Gender	Female	82	59.4
	Make	56	40.6
	Total	138	100
High School Attended	General High School	76	55.1
	Anatolian High School	40	29
	Anatolian Teacher High School	13	9.4
	Others	9	6.5
	Total	138	100
Mathematical Success	Low	25	18.1
	Medium	93	65.9
	High	20	16
	Total	138	100
General Grade Point Average	1.00-1.99	42	30.4
	2.00-2.99	59	42.8
	3.00-4.00	37	26.6
	Total	138	100

As can be seen in Table 1 regarding teacher candidates in the study population, 31% had a low level of success, 32% had a medium level of success, and 37% had a high level success with problem solving. In terms of gender, the group was formed of 59% females and 41% males. In terms of high school attended, 55% of them were from a general high school, 29% of them from an Anatolian high school, 9% from an Anatolian teacher high school, and 7% are from other types of high schools. In terms of mathematical success, 18% of them had low, 66% of them had medium, and 16% of them had high levels of mathematical success. When the students' general grade point average for all courses of undergraduate study were considered, it is seen that on a four-point grading system, 30% of them were between 1.00 and 1.99, 43% were between 2.00 and 2.99, and 27% were between 3.00 and 4.00.

Data Collection Tools

To obtain quantitative data, the Mathematical Problem-Solving Belief Scale and the Problem-Solving Success Level Determination Test were used. For collection of the qualitative data, the Semi-Structured Interview Form Regarding Mathematical Problem-Solving Beliefs as developed by the researcher was used.

Mathematical Problem-Solving Beliefs Scale: In the current research, the Mathematical Problem-Solving Beliefs Scale, developed by Kloosterman and Stage (1992) and adapted to Turkish by Hacıömerlioğlu (2011b), was used. The scale as adapted by Hacıömerlioğlu was applied to exploratory and confirmatory factor analyses, and the obtained findings showed that the Turkish form of the scale is made up of five sub-dimensions and 24 items. These sub-dimensions were defined as follows: *Mathematical skill* (6 items) is the use of mathematical skills that are necessary in daily life. *The place of mathematics* (6 items) is the use of mathematics in daily life. *Understanding the problem* (5 items) is the dimension that shows understanding of a given mathematical problem is a necessary prerequisite for finding the solution. *Importance of mathematics* (3 items) is how important mathematics factors into daily life. *Problem-solving skill* (4 items) is the use of the necessary operational skills for problem solving. The Cronbach alpha values for the scale were calculated in order as .77, .67, .76, .54, and .84, for a total average of .73. In this study, the calculated internal consistency coefficients listed in order were .80, .64, .87, .85, and .69 for a total average of .76.

Using a 5-point Likert scale, the Mathematical Problem-Solving Beliefs Scale was scored from 5 (Totally Agree) to 1 (Totally disagree). In the scale, the 6th, 7th, 11th, 12th, 16th, 17th, and 18th items were reverse-scored. In the Mathematical Problem-Solving Belief Scale, the total score for a sub-scale was obtained by dividing the tallied score for the sub-scale by the number of items in that sub-scale. Accordingly, the highest and lowest score that could be achieved for a sub-dimension ranged from 5 to 1. High scores for a sub-dimension were interpreted as a high belief of the student related to that sub-dimension.

Problem-Solving Success Level Determination Test: In order to determine the problem-solving success levels of teacher candidates, the Problem-Solving Success Level Determination Test was developed by the researcher. In this scope, by taking content from the Basic Mathematics I lectures on numbers, ratios and proportions, algebraic expressions, equations, and inequality into consideration, a problem pool consisting of 15 items was formed involving routine problems that could be solved within four operations. In the next stage, the problems were shown to two academicians, specialists in the field of teaching mathematics with many years of experience. They were asked to examine the content validity of the problems in the draft form based on the aim of the research. In this scope, accordance between the opinions of the specialists was determined with a Cohen kappa coefficient of .84. This value being greater than .80 shows from the literature that accordance is near excellent (Landis & Koch, 1977). In a later stage based on feedback, five questions involving problem-solving skills that were similar to each other were decided to be taken out of the draft form and three questions were chosen to be reviewed again. Some examples can be shown, such as the numeric expressions in the 6th question of the draft form were chosen to be emphasized verbally; a vague statement in the 10th question, "…questions in this test did a student answer correctly who got 60 points and answered all of the questions?," was rewritten to say "…the student who got 60 points and answered all questions answered how many questions correctly?"; and the statement in the 5th question, "…if three times…," was decided to be rewritten as "…is three times. According to this…" In the last stage, a pilot application of the Problem-Solving Success Level Determination Test consisting of ten problems that had been successfully reordered based on the opinions of specialists was administered to five students in their sophomore year who had completed the Basic Mathematics I lecture. During the application stage, the students had been informed about the research and they were asked their opinion as to whether there was any expression that they did not understand. Based on this, no difficulty was found as far as understanding the expressions. For examples, questions 4 and 10 from the Problem-Solving Success Level Determination Test are shown as follows:

> "4) A man climbing a hill continues every 200 meters at half the speed of the previous 200 meters. If the length of the hill is one kilometer, how many times less is the average speed of the man than his initial speed?"

> "10) A teacher told his students that they would get 4 points for each correct answer and lose 2 points for each false answer in a test consisting of 30 questions that she would give in her mathematics class. How many questions from this test did a student answer correctly who got 60 points and had answered all of the questions?"

Also at the end of the application of the Problem-Solving Success Level Determination Test, item analysis was calculated and item difficulty level (IDL), standard deviation (SD), discrimination index (DI) and independent samples *t*-test for 27% from the lower and upper group samples were tested. Table 2 shows the data resulting from item analysis.

Table 2
*Item Difficulty Level (*IDL*), Standard Deviation (*SD*), Discrimination Index (*DI*),* t- *and* p- *Values for the Problem-Solving Success Level Determination Test*

Problem Number	*IDL*	*SD*	*DI*	*t*	*p*
1	.67	.47	.53	-7.174	.000
2	.28	.45	.40	-3.151	.002
3	.67	.47	.51	-6.586	.000
4	.49	.50	.59	-10.040	.000
5	.24	.43	.45	-6.164	.000
6	.72	.45	.58	-7.174	.000
7	.91	.29	.35	-3.402	.000
8	.86	.35	.49	-3.087	.002
9	.66	.48	.54	-8.135	.000
10	.78	.42	.51	-5.555	.000

When Table 2 is examined, it can be seen that item difficulty levels varied between .24 and .91, and the discrimination index varied between .35 and .59. It can also be seen that the mean average was 6, the median was 6, and the mode was 7, whereas the average difficulty was .61 for the evaluation instrument consisting of 10 questions for analyzing problem-solving success levels.. The KR-20 reliability value for the test was calculated at

.72, and since this value is over .70, test reliability is considered acceptable.

On the other hand, while grading the questions from the Problem-Solving Success Level Determination Test for determining the problem-solving levels of teacher candidates, teacher candidates' correct answers were graded as 1 whereas false or blank answers were graded as 0. After grading, the number of correct answers was converted into standard scores. Transforming raw scores to standard scores was performed using T-standard scoring with help from the literature (Baykul & Güzeller, 2013; Kan, 2006, 2008; Sezgin, 2008; Tekin, 1994; Yıldırım, 1999; Yılmaz, 2004). In this scope, the scores obtained from the Problem-Solving Success Level Determination Test were standardized and a T-score under 40 was classified as a low problem-solving success level, and a T-score over 60 was classified as a high problem-solving success level in order to obtain lower and upper groups.

Semi-Structured Interview Form Regarding Mathematical Problem-Solving Beliefs: A semi-structured interview form was prepared for this study in order to discern the mathematical problem-solving beliefs of teacher candidates. The questions on this form were structured by considering the sub-dimensions of the Mathematical Problem-Solving Beliefs Scale. In accordance with this, the semi-structured interview form consisting of twelve questions involved two questions regarding mathematical skill, three questions regarding the place of mathematics in life, one question regarding the importance of mathematics, three questions regarding understanding the problem, and three questions regarding problem-solving skills. In this scope, the questions on the form were as follows:

> "What do you think of mathematical skill? Can mathematical skill be gained through studying; if so, how? What place does mathematics have in your life? Is mathematics related to daily life; if so, can you give an example about this? What do you think about understanding a problem? What do you think about taking a long time struggling to solve a problem; do you think it is necessary, and if so, why? Is the result for the solution to a problem more important than how it is solved? What is your opinion on problem-solving skills? Is problem solving or performing operations more important; why? Do you think that solving problems means understanding mathematics; can you explain your answer?"

During preparation of the interview form, an academician from the field of qualitative research and another specialist from mathematics education were asked their opinions on the understandability of the prepared questions and the reliability of its scope. Accordance between the specialists' opinions was measured at .63 according to the Cohen's kappa coefficient. In the literature, a value between .61 and .80 shows substantial agreement between the specialists (Landis & Koch, 1977). Based on the feedback for the expressions in the question "Is mathematics related to daily life, if so, can you give an example about this?" were reworded to read "Is mathematics related to daily life; if so, can you give an example on this subject?" in order to clarify the reference. In the next stage, a pilot application of the semi-structured interview form was performed on four students who were studying in their sophomore year, and no difficulties were encountered.

Mathematical success is one of the independent variables from the research that shows the success score for the Basic Mathematics I lecture. According to a relative evaluation system, mathematical success scores were obtained by adding 40% of the midterm exam results to 60% of the final exam results from Basic Mathematics I. According to this, the mathematical success of participating students was classified in order as follows. Grades of DD or DC were considered low; CC or CB grades were considered medium; and BB, BA, or AA grades were considered high. In the university where the research was performed, the classification system uses DD and DC (50- 69) to denote low passing conditions; CC and CB (70-79) to show medium passing conditions; and BB, BA, and AA (80 and over) to show success with high passing conditions for a class.

The stage of data collection and analysis was conducted by the researcher. He applied the data collection tools (Mathematical Problem-Solving Belief Scale and the Problem-Solving Success Level Determination Test) every other week during the Basic Mathematics II lecture in the spring semester of the 2013-2014 academic year. Finishing the Mathematical Problem-Solving Belief Scale took 15 minutes and the Problem-Solving Success Level Determination Test lasted 40 minutes. During the collection process for qualitative data, interviews were performed on 36 participants and recorded on tape. The interviews were given in the seminar room and lasted approximately 10 to 15 minutes. The collected data was transferred to computer in Times New Roman font with 12-point font size; 45 pages of raw data were obtained in total.

Data Analysis

In this stage, all measuring instruments and quantitative data obtained at the end of the research were first analyzed using the SPSS 17.0 package program. Multi-factorial variance analysis (MANOVA) and two-way ANOVA testing were used to analyze the data. Before analysis, availability was tested for matrixes regarding the normality, linearity, and variance-covariance of data to homogenous conditions. The normality of distribution in terms of the variables in this scope was examined using the Kolmogorov-Smirnov test. On the other hand, the presence of linear relationships between dependent variables causes the expected relation to be at low or medium levels (Büyüköztürk, 2005; Çokluk, Şekercioğlu, & Büyüköztürk, 2010; Tabachnick & Fidell, 2001). As per the literature, the assumption was tested in this research by using a scatter diagram, and a medium-level relationship was observed. The correlation coefficient between dependent variables was also calculated using the Pearson correlation technique, concluding a medium level of positive relation between variables ($.38 < r < .60$). In order to test homogeneity of the variance-covariance matrixes regarding the dependent variable scores, Box's M statistic was used. The Levene test calculated again the equality of variances, and variances were seen to be equal in terms of the dependent variables. Additionally, the values of influence quantity (η^2) were also examined. Influence quantity can be calculated as small, medium, or large when returning values of .01, .06, and .14, respectively (Büyüköztürk, 2005).

In the second stage, data from the interviews was qualitatively analyzed using the descriptive analysis method. In descriptive analysis, data is summarized and interpreted according to previously obtained themes (Yıldırım & Şimşek, 2006). In this scope, codes were formed by considering themes from the sub-dimensions of the Mathematical Problem-Solving Beliefs Scale as developed by Kloosterman and Stage (1992), and then putting these codes into the same themes. During the formation of codes, written data obtained from the interviews was also read line by line; some specific codes were formed and marked in the text based directly from the data; other codes were based on generated meanings. The coded data was examined and grouped according to similarities and differences (Yıldırım & Şimşek, 2006). For example, teacher candidate HT17 replied with "… I use mathematics approximately every day in my life. As the simplest example, I use it in basic, daily calculations such as when the bus is coming, the speed of a car while crossing the street, the distance between us, and my speed," when he was asked the interview question "Is mathematics related to daily life; if so, can you give an example on this subject?" In the next stage, this response was placed under the code "mathematics is generally related with daily life" under the theme *the place of mathematics*. For this stage, direct quotations were provided where necessary. In accordance with the privacy policy, teacher candidates were also coded as LT1, HT1, LT2, and HT2 according to whether their problem solving levels were high (HT) or low (LT).

For reliability of the coding section, a second coder, who was an academician specializing in mathematics education, analyzed the interview texts of eight randomly chosen teacher candidates and the agreement rate between the two coders was found to be .92. The consistency of coding as done by the researcher on two different occasions was also examined. For this, the researcher tested consistency three weeks later by coding the interview forms of eight teacher candidates a second time. In this scope the researcher calculated the coding reliability coefficient at .98. In order to provide reliability for the qualitative dimension of the research, every attempt was made to firstly describe the data collection process. Close attention was paid to the objectivity of the codes that were placed into themes after consideration of the explanations obtained from the teacher candidates' interviews. Also, quotations supporting the findings were directly given to increase reliability.

Findings

Findings obtained as related to the sub-aims of the research are given below. Accordingly, in order to discern if there was any significant difference between the mathematical problem-solving beliefs of teacher candidates with low and high problem-solving success levels, the MANOVA test was applied. Since covariance matrixes are not homogeneous in applied analyses, Pillai's trace value was used instead of Wilks' lambda test. In terms of teacher candidates' problem-solving success levels and all of the sub-dimensions of their mathematical problem-solving beliefs, it was seen that linear combinations pointed to a significant difference (Pillai's trace = .117, $F_{(5, 88)} = 2.330$, $p = .04$). MANOVA test results as applied to the sub-dimensions of mathematical problem-solving beliefs are seen in Table 3.

Table 3
MANOVA Results Regarding the Mathematical Problem-Solving Beliefs of Teacher Candidates With Low and High Problem-Solving Success Levels

Sub Dimensions	Problem Solving Success Level	*N*	$\overline{X}$	*S*	*sd*	*F*	*p*	Eta- square
Mathematical Skill	Low	43	17.33	4.29	1	.284	.595	.003
	High	51	17.73	2.95				
The Place of Mathematics	Low	43	16.40	5.63	1	.243	.624	.003
	High	51	16.90	4.34				
Understanding the Problem	Low	43	17.35	5.96	1	9.455	.003	.093
	High	51	20.59	4.22				
The Importance of Mathematics	Low	43	11.02	4.68	1	5.772	.018	.059
	High	51	13.02	3.36				
Problem Solving Skills	Low	43	12.44	3.67	1	.582	.447	.006
	High	51	12.96	2.91				

As can be seen in Table 3, a significant difference in terms of the sub-dimensions of *understanding the problem* and *the importance of mathematics* clearly exists between teacher candidates with low and high problem-solving success levels (understanding the problem: $F_{(1\text{-}92)} = 9.455$, $p < .01$; the importance of mathematics: $F_{(1\text{-}92)} = 5.772$, $p < .05$). It is clear that the scores of teacher candidates with high problem-solving success levels from the scales regarding *understanding the problem* and *the importance of mathematics* were significantly higher than the scores of teacher candidates with low problem-solving success levels. In the sub-dimensions of *mathematical skills*, *the place of mathematics*, and *problem-solving skills*, on the other hand, no significant difference between the beliefs of teacher candidates with high and low problem-solving success levels was discovered. Accordingly, it can be said that the belief levels of teacher candidates with different problem-solving skills are similar to each other. Also, from the quantitative analysis on influence, it can be seen that the values obtained that affect beliefs on *understanding the problem* and *the importance of mathematics* are at a medium level (Büyüköztürk, 2005).

Findings Regarding Effects of the Interaction of Problem-Solving Success Level and Gender on Mathematical Problem-Solving Beliefs

Regarding the interaction of problem-solving success levels and gender, two-way ANOVA (2x2) testing was applied in order to determine if there was a significant difference between the sub-dimensions of *mathematics skill*, *the place of mathematics*, *understanding mathematics*, *the importance of mathematics,* and *problem-solving skills* for the teacher candidates. Analysis results are given in Table 4.

As can be understood from Table 4, the interaction of problem-solving success levels and gender does not create a significant difference as far as the sub-dimensions of mathematical problem-solving beliefs (*mathematics skill* $F_{(1\text{-}90)} = .289$, $p > .05$; *the place of mathematics* $F_{(1\text{-}90)} = 1.512$, $p>.05$; *understanding*

Table 4
Two-Way ANOVA (2x2) Test Results Regarding the Interaction of Problem-Solving Success Levels and Gender on the Mathematical Problem-Solving Beliefs of Teacher Candidates

Sub-Dimension	Problem Solving Success Level (P)	Gender (G)						*sd*	*F* (PxG)	*p*	η^2
		Female			Male						
		N	$\overline{X}$	*S*	*N*	$\overline{X}$	*S*				
Mathematics Skill	Low	26	17.35	4.15	17	17.28	4.63	1	.289	.592	.003
	High	26	18.15	1.97	25	17.29	3.69				
The Place of Mathematics	Low	26	17.27	5.44	17	15.06	5.80	1	1.512	.222	.017
	High	26	16.73	3.46	25	17.08	5.16				
Understanding the Problem	Low	26	16.04	6.31	17	18.94	5.23	1	3.110	.081	.020
	High	26	21.00	2.76	25	20.16	5.36				
The Importance of Mathematics	Low	26	10.23	4.97	17	12.24	4.04	1	1.721	.193	.019
	High	26	13.12	3.13	25	12.92	3.64				
Problem-Solving Skills	Low	26	12.50	3.37	17	12.36	4.20	1	.109	.742	.001
	High	26	12.81	2.97	25	13.12	2.92				

Note. (PxG): Problem-solving success level; (P) X gender; (G) Interactional effect *the problem* $F_{(1\text{-}90)} = 3.110$, $p > .05$; *the importance of mathematics* $F_{(1\text{-}90)} = 1.721$, $p > .05$; *problem-solving skills* $F_{(1\text{-}90)} = .109$, $p > .05$). For all sub-dimensions of mathematical problem-solving beliefs, it can be said that the beliefs of male and female teacher candidates with different problem-solving success levels are similar to each other. On the other hand, when the influence-quantity values (η^2) that were obtained for these analyses were examined, it could instead be seen that the interaction of problem-solving success levels and gender affected the beliefs about *understanding the problem* and *the importance of mathematics* at a very low level (Büyüköztürk, 2005).

Findings Regarding the Interaction Effect of Problem-Solving Success Levels and Mathematical Success on Mathematical Problem-Solving Beliefs

The two-way ANOVA (2x2) test was applied in order to determine the interaction effect of problem-solving success levels and mathematical success on mathematical-problem solving beliefs. The results of this analysis are given in Table 5.

According to Table 5, it can be seen that the interaction of problem-solving success levels and mathematical success does not create a significant difference in the sub-dimensions of the mathematical problem-solving beliefs scale (*mathematical skill*: $F_{(2\text{-}88)} = .321$, $p > .05$; *the place of mathematics*: $F_{(2\text{-}88)} = 1.336$, $p > .05$; *understanding the problem*: $F_{(2\text{-}88)} = .578$, $p > .05$; *the importance of mathematics*: $F_{(2\text{-}88)} = .175$, $p > .05$; and *problem-solving skills*: $F_{(2\text{-}88)} = 1.417$, $p > .05$). Accordingly, it can be said that the beliefs of teacher candidates with different mathematical success levels do not change much regardless of their mathematical problem-solving skills. When influence quantity (η^2) values obtained from these analyses are examined, it can be seen that the interaction of mathematical problem-solving success levels and mathematical success affects the belief sub-dimensions of *the place of mathematics*, *understanding the problem,* and *problem-solving skills* at a very low level (Büyüköztürk, 2005).

Findings Regarding the Opinions on Mathematical Problem-Solving Beliefs of Teacher Candidates With High and Low Problem-Solving Success Levels

In the research, the opinions of teacher candidates towards problem-solving beliefs were descriptively analyzed on the basis of all sub-dimensions. The codes that were formed are presented in Table 6.

As shown in Table 6, analyses of the interview data formed five themes. For the first theme, *mathematical skill*, most teacher candidates thought that it can be gained by studying. In this scope, teacher candidate HT16 stated his opinion on solving high-level problems by saying, "Mathematical skills are gained and developed through studying. Since every person, however, has different learning levels, some people should study more than others in order to gain this skill because developing this skill requires studying and making an effort." One teacher candidate that solves problem at a low level, LT5, expressed his opinion by saying, "Mathematical skill can be gained by studying. Continuous problem solving reinforces this subject. By studying and solving problems, each new solution enhances the subject and completes other questions. In fact each solution is a stage. As questions are solved, skills are

Table 5
Two-Way ANOVA (2x2) Test Results Regarding the Interaction of Problem-Solving Success Levels and Mathematical Success on Teacher Candidates' Mathematical Problem-Solving Beliefs

Sub Dimensions	Problem Solving Success Level (P)	Mathematical Success (M)									*Sd*	*F* (PXM)	*p*	η^2
		Low			Medium			High						
		N	$\bar{X}$	S	N	$\bar{X}$	S	N	$\bar{X}$	S				
Mathematical Skill	Low	11	16.29	5.06	21	17.24	1.13	11	18.36	2.73	2	.321	.726	.007
	High	14	16.45	5.59	28	18.28	1.46	9	18.22	1.64				
The Place of Mathematics	Low	11	14.27	7.27	21	16.76	4.56	11	17.82	4.05	2	1.336	.268	.029
	High	14	17.21	6.15	28	17.07	4.09	9	15.89	3.52				
Understanding the Problem	Low	11	16.00	7.36	21	17.19	5.43	11	19.00	5.57	2	.578	.563	.013
	High	14	20.07	6.21	28	21.00	3.54	9	20.11	2.15				
The Importance of Mathematics	Low	11	10.92	4.57	21	10.80	5.07	11	11.55	4.40	2	.175	.840	.004
	High	14	11.71	3.81	28	13.75	3.18	9	12.78	2.77				
Problem-Solving Skills	Low	11	12.45	2.95	21	11.80	4.54	11	13.64	2.69	2	1.417	.248	.031
	High	14	13.29	3.10	28	13.10	3.13	9	12.00	1.80				

Note. (PXM): Interaction Effect of Problem-solving success level; (P) X mathematical success (M)

Table 6
Themes, Codes, and Frequency Distributions for Problem-Solving Beliefs of Teacher Candidates With Low and High Problem-Solving Success Levels

Themes	Codes	Low level Problem-Solving Group (f)	High Level Problem-Solving Group(f)
Mathematical Skill	Mathematical skill is gained by studying.	14	12
	Mathematical skill is innate.		8
	Mathematical success is gained by studying.		5
	The most important factor in mathematical success is intelligence.		4
	Mathematics lectures need to be enjoyed in order to be successful.	4	
	Basic knowledge is important in the development of mathematical skill.	3	
	Different examples given in class activities develop mathematical skill.	2	
The Place of Mathematics	Mathematics generally relates to daily life.	12	14
	Mathematics is an abstract concept not connected to daily life.	3	5
	Mathematics is a very general science.	4	2
	Mathematics is very important to me.		2
	I can use mathematics in my life through technology.		2
Understanding the Problem	In order to solve a given problem it needs to be understood.	4	12
	Dealing with problems provides new ways to find solutions.	8	10
	It is unnecessary to deal with problems that take a long time to solve.	3	1
The Importance of Mathematics	Mathematics is worthwhile.	8	17
	As a science, mathematics is used in many professions.	3	10
	Mathematics is important in terms of making life easy.		8
	Mathematics is important developing intelligence.	2	2
	Mathematics has less importance in daily life.	2	1
	Mathematics in daily life only matters for making calculations.	1	
Problem-Solving Skills	Developing strategies for solving problems is more important than finding the solution.	10	12
	Both the result of a problem and method of solving are important.	8	10
	If given enough time and information, I can solve any problem.	4	6
	If I have enough prior knowledge, I can solve any problem.	2	4
	Reaching a solution is more important than developing strategies for the solution.	3	
Total		100	147

gained for solving new questions." Additionally, the eight teacher candidates with high problem-solving success levels expressed that mathematical skill is innate, five of them said mathematical success is gained by studying, and four of them expressed that intelligence is important. On the other hand, four of the teacher candidates with low problem-solving success levels expressed that lectures need to be enjoyed in order to be successful, three of them said basic skills are important, and two of them expressed that mathematical skill can be developed through the different examples given in class activities.

For the second theme, *the place of mathematics*, most teacher candidates thought that mathematics related to daily life; very few of them expressed that it was an abstract concept not connected to daily life. Additionally, four teacher candidates with low problem-solving success levels and two with high problem-solving success levels expressed that mathematics was a general science. In addition to this, two of the candidates with high problem-solving success levels said that mathematics was important for them, and the other two expressed that in daily life, they could use mathematics with technology. Regarding this aspect, teacher candidate HT17 stated his opinion as, "Mathematics is very important to me; it is the field in which I am most successful. The simplest examples are how I use it in basic daily calculations such as figuring out when the bus will come, the speed of an approaching car while crossing the street, the distance between me and another car, as well as my own speed."

In the scope of the third theme, *understanding the problem*, 12 teacher candidates with high problem-solving skill levels and four with low problem-solving skill levels thought it was necessary to understand the problem in order to solve it. For example, teacher candidate LT8 expressed his opinion by saying, "…

understanding the problem is the most important thing, then the steps leading to the solution are important…" On the other hand, approximately half of the candidates with high and low problem-solving skill levels expressed that dealing with the problem provides ways of finding new solutions. Lastly, very few teacher candidates with high or low problem-solving skill levels expressed that it wasn't necessary to deal with problems that take too much time to solve. On this subject, teacher candidate HT10 expressed his opinion by saying, "…dealing with problems that take too much time results in finding less solutions. This tires people…"

Regarding the theme, *the importance of mathematics*, approximately all of the teacher candidates with high problem-solving skill levels and approximately half of the ones with low problem-solving skill levels emphasized that mathematics was worthwhile. In this scope, teacher candidate LT7 said, "As the simplest example, you feel happy when you solve a problem you've been dealing with for a long time, so you receive a reward for your efforts. I think that makes everything worth it …" Additionally, about half of the teacher candidates with high problem-solving skill levels expressed using mathematics scientifically in their profession, thereby making their life easier. For example, teacher candidate HT7 expressed his opinion about this by saying, "…mathematics forms the basis of science. At the heart of space research, the health sector, and engineering, there lies mathematics. For example, in preparing to raise a building, the proportions of water, cement, and sand that are added to make concrete are always based on mathematical calculations." On the other hand, one of the teacher candidates with low problem-solving skill levels emphasized that mathematics is important in daily life only in terms of making calculations. From this opinion, teacher candidate LT2 expressed, "…I use mathematics in making calculations in daily life…"

In terms of the last theme, *problem-solving skills*, more than half of the participant teacher candidates with high problem-solving skill levels as well as ten of those with low problem-solving skill levels emphasized that developing strategies for solving a problem is more important than finding the result. In this scope, teacher candidate LT4 expressed his opinion by sharing, "… it is more important to deal with solving a problem because in this process we use many methods that are related to each other and we understand its logic. But we can find the result by chance. That is why it is more important to deal with the solution than just find the result." However, approximately half of the teacher candidates in both groups expressed that both the result of and solution to a problem are important. In this scope, teacher candidate HT10 expressed, "…the way of solving a problem is important but since a result-less solution is useless, both of them are important." Aside from this, very few teacher candidates with high (6 of them) or low (4 of them) problem-solving skills expressed that they could solve any problem if given enough time and information. In this direction, teacher candidate LT1 expressed his opinion as follows, "…if I have the necessary pre-knowledge and no time limit, I think I can solve any problem." Lastly, three of the teacher candidates with low problem-solving skill levels expressed that reaching a result was more important than developing solution strategies. Teacher candidate LT6 expressed their opinion in this direction saying, "In a problem, it is important to find the result. If you cannot reach the solution, it is not worth it. Your whole effort will be useless…" Finally as can clearly be seen in Table 6, teacher candidates with high problem-solving skill levels were observed to have higher mathematical problem-solving belief scores for all sub-dimensions than those teacher candidates with low problem-solving skill levels.

Discussion, Result and Suggestions

The purpose of this study was to determine the problem-solving beliefs of teacher candidates with high and low problem-solving success levels. By the end of the research, a significant difference in favor of teacher candidates with high problem-solving success levels was observed in the sub-dimensions of *understanding the problem* and *the importance of mathematics*. This result was also supported by the data obtained from interviews. These research findings also show parallels with the research results of Aksu et al. (2002), Callejo and Vila (2009), Lerch (2004), Mason (2003), and Schommer-Aikins et al. (2005). For example, Mason (2003) examined mathematics and the mathematical problem-solving beliefs of high school students and at the end of his research, he concluded that students with high levels of problem-solving success had positive beliefs; ones with low levels of problem-solving success, however, found mathematics useless and thought of it as group of formulas that need to be memorized. Similarly Suthar et al. (2010) reached a conclusion that the beliefs towards mathematics of students with low and high mathematical success differ, and the beliefs of students with high levels of success are more positive.

As for the sub-dimensions of *mathematical skill*, *the place of mathematics*, and *problem-solving skills*, on the other hand, the opinions of teacher candidates successfully solving problems at low and high levels are positive and similar to each other. This result also shows parallels with the results of research done by Chen et al. (2011), Çokçalışkan (2012), Emenaker (1996), Giovanni and Sangcap (2010), Kayan and Çakıroğlu (2008), Kayan et al. (2013), Memnun, Hart, and Akkaya (2012), Taşkın et al. (2012), and White, Perry, Way, and Southwell (2005).

As a result, mathematical problem-solving beliefs as a dependent variable in the research can be seen to not significantly differ based on the interaction of problem-solving success levels or gender. In other words, mathematical problem-solving beliefs and the opinions of male and female teacher candidates with high or low levels of problem-solving success showed similarities to each other in this respect. When research which has been performed on gender, mathematics, and problem-solving beliefs are examined, some show differences with females (Kayan et al., 2013; Mason, 2003; Pişkin Tunç & Haser, 2012), others show differences with males (Giovanni & Sangcap, 2010), and even others reached the conclusion that the ideas of both two samplings are close in opinion (Aksu et al., 2002; Duatepe Paksu, 2008; Kayan & Çakıroğlu, 2008; Memnun et al., 2012; Sağlam & Dost, 2014). As can be clearly seen from these findings, previous studies have yet to reach common agreement on the variables of gender and problem-solving beliefs. From this, it can be said that the sub-levels of belief have no effect in terms of the interaction of problem-solving success levels and gender.

On the other hand, as a result of the interaction of problem-solving success levels and mathematical success in the research, it can be seen that teacher candidates' sub-dimensions of mathematical problem-solving do not significantly differ. In other words, the opinions regarding the mathematical problem-solving beliefs of teacher candidates are similar to each other, whether they can solve problems at a high or low level, or if they have different mathematical success levels . In this scope, some research (Aksu et al., 2002; Emenaker, 1996; Güven & Cabakcor, 2013; Lerch, 2004; Mason, 2003; Schommer-Aikins et al., 2005; Suthar & Tarmizi, 2010; Suthar et al., 2010) that has been done on mathematical success and beliefs emphasized that mathematical success affects beliefs in a positive way. Some other research (Memnun et al., 2012; Taşkın et al., 2012; White et al., 2005) has pointed out that there was not a significant relation between the concepts of mathematical success and belief. For example, Suthar and Tarmizi (2010) examined the relation between mathematical success and the beliefs of university students in their study. At the end of the research, they presented that students perceived mathematics as important, and there was a significant relation between mathematical skill beliefs and mathematical success. As there are study results in the literature that conflict with these results, this can be explained as belief being an affective factor, and that is why it shows change over time and by learner.

As a result of this study which was performed in order to obtain the problem-solving beliefs of teacher candidates with low and high problem-solving success levels, the opinions of these teacher candidates are seen to be similar to each other in the sub-dimensions of *mathematical skill*, *the place of mathematics*, and *problem-solving skills*. However, a significant difference is seen in favor of teacher candidates with high problem-solving success in the sub-dimensions of *understanding the problem* and *the importance of mathematics*. Also, it is clearly seen from the research that the opinions of both teacher candidates solving at high and low levels are close to each other in terms of gender and mathematical success. In this scope, it can be said that teacher candidates who can solve problems more successfully believe in the importance of mathematics and the necessity of understanding the problem. According to this result, it can be said that teacher candidates with high problem-solving skills have more positive beliefs. At the end of this research, the need for teacher candidates with low problem-solving success to gain experience in developing the quality of their beliefs came to the forefront. Primary school teacher candidates especially should have positive beliefs in their profession so as to understand the points of view of their students and be able to teach problem-solving abilities to them.

It is thought that this study, which points to the importance of the concept of mathematical belief on problem solving, is critical in reflecting the points of view of primary school teacher candidates. When considered from this aspect, it can be suggested that while primary school teacher candidates are taking the Basic Mathematics I lecture, an important part of their undergraduate mathematics education, they should give importance to in-class activities; their learning environment should be regulated so as to positively affect their beliefs towards problem solving and learning mathematics. This study was conducted on primary school teacher candidates and stayed only within the scope of routine problems. In similar future researches, the opinions of teacher candidates can be examined in the scope of non-routine problems. Also, experimental design research can be done by controlling the interaction of variables that can affect problem-solving belief.

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