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A study on the relationship between reflective thinking skills towards problem solving and attitudes towards mathematics

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Abstract

The aim of this study is to examine the relationship between the 7th and 8th grade students' reflective thinking skills towards problem solving and their attitudes towards mathematics. In addition, during the research, whether there is a significant difference between the male and female students' reflective thinking skills towards problem solving and their attitudes towards mathematics has been analyzed. The study has been conducted with 300 students studying in the 7th and 8th grades in two private schools in Cankaya, Ankara. In the study "Reflective Thinking Skills towards Problem Solving Scale" (Kızılkaya & Askar, 2009) and "Mathematics Attitude Scale" (Onal, 2013) have been used. In order to determine the levels of students in terms of reflective thinking skills towards problem solving and their attitudes towards mathematics, the arithmetic mean and standard deviation values of the scores obtained via the scales have been calculated and to find out if there is a significant difference between these scores regarding gender, MANOVA has been used. Whether there is a significant difference between the scores of male and female students has been tested by using the scores the students got in total and in the sub-dimensions of the scales. It is found that there does not exist a significant difference between the students' reflective thinking skills towards problem solving and their gender. However, there is a significant difference in favor of the male students in terms of their attitudes towards mathematics. There is a moderate significant difference between the students' reflective thinking skills towards problem solving and their attitudes towards mathematics in the positive sense.

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Keywords: Problem solving; reflective thinking; reflective thinking skill scale towards problem solving; attitude; Mathematics attitude scale

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1. Introduction

General definition of thinking includes three basic ideas: (1) Thinking is cognitive, but is inferred from behavior. It occurs internally, in the mind or cognitive system, and must be inferred indirectly. (2) Thinking is a process that involves some manipulation of or set of operations on knowledge in the cognitive system. (3) Thinking is directed and results in behavior that "solves" a problem or is directed toward solution (Mayer, 1992:7). The act of thinking starts with a problem, the solution of the problem turns into a goal for the individual, and then this purpose directs the thinking of the individual (Kalaycı, 2001). In this sense, problem solving is a type of effective thinking (Adair, 2000). Helping students to become better thinkers and problem solvers is an old question in education (Nickerson, 1994: 440). The process of problem solving in which meaningful scenarios exist and thinking skills are used is regarded as a cornerstone in the 21th century. (Zanartu, Doerr & Portman, 2015; Bellanca, 2013). New technologies and globalisation make it possible to confront stronger and more sophisticated problems due to rapid changes. (Spector, Lockee, Smaldino, & Herring, 2013). For this reason, one of the basic aims of education is problem solving skills. (Spector et al., 2013; McGregor, 2007).

Problem solving is a cognitive behavioral process through which steps having a logical succession are followed to find a solution to a problem. Problems generally consist of conditions about whose uncertainity, accuracy and reality we cannot be sure, difficult problems and relations (Kalaycı, 2001). Problem solving is defined as the capacity of the individual to comprehend a problem not having a clear solution method and solve it in PISA 2012 (Bellanca, 2013). Any definition of "problem" should consist of the three ideas that (1) the problem is presently in some state, but (2) it is desired that it be in another state, and (3) there is no direct, obvious way to accomplish the change (Mayer, 1992: 5). According to most descriptions of mathematical problem solving, the first step is problem representation, converting the words (and pictures) of the problem into an internal mental representation; the second step is problem solution, going from mental representation of problem to a final answer. We can further break problem representation into two sub processes: problem translation, which involves converting each sentence or major clause into an internal mental representation, and problem integration, which involves combining the information into a coherent structure (Mayer, 1992: 459)

Teaching problem solving, or skillful thinking toward given ends, important as it is, is surely not enough. It does not suffice to be able to bring effective strategies to bear on problems as given; one should be able also to make reasonable judgments about which problems worth solving and which are not. Similarly, it is not enough to be able to think logically and insightfully about given topics; rationality, in the most general sense, must include not only an ability to think but a willingness to give some thought to what to think about (Nickerson, 1994: 441) According to the principles and standards for school Mathematics, problem solving should be part of Mathematics instruction in all of the kindergarten through grade twelve levels. It should be used to help students build new knowledge, solve problems in a variety of contexts, develop a variety of strategies, and monitor and reflect on their learning. Through problem solving activities, students can develop habits of persistence and build confidence that will lead them to success in school, in life, and in the workplace. Problem solving in the classroom should incorporate significant Mathematics and integrate multiple topics, including each of the five content areas in the standards. Problem solving and problem solving strategies need to be taught to students, along with ways to organize their thinking and attack problems. Problem solving requires patience, persistence, risk taking, and cooperation, therefore a positive classroom climate must be provided (O'Connell, 2000; Cited in Rousseau, 2009). Problem solving can be defined as a focused sequence of cognitive operations utilized for the reason of adapting to internal/external demands or challenges (Heppner & Petersen, 1982). Heppner believes that applied problem solving skills are critical to solve real-life problems.

McGregor (2007: 240), stating that reflection is effective in the development of problem solving, lists the steps of problem solving with a general point of view. These steps, providing a psychological framework, can be summarized as follows: (1) clarifying the nature of the problem or task to be solved (2) identifying what is important to focus upon and decide what matters (3) consider alternative ways in which the problem could be solved (4) deciding which strategies or general tactics to use (5) detailed planning to achieve the strategy/tactics decided upon (in step 4): - identifying the steps needed; - sequence the steps (6) carry out the chosen approach. (7) part-way through the task reflects on whether the process of working toward the solution is working or not (8) at the perceived completion of the task, communicate the nature of the resolution (9) evaluate the quality of the resolution

developed by: -comparison with task intentions; -comparison with others' resolutions to same task; -consider how the process and product or outcome could be improved. (10) Connect the thinking process used to other real-life contexts for: - the product or outcome; and - the strategy or tactics developed.

A mathematical problem solver not only required cognitive abilities to understand and represent a problem situation, to create algorithms to the problem, to process different types of information, and to execute the computation, but also had to be able to identify and manage a set of appropriate strategies (heuristics, techniques, shortcuts etc.) to solve the problem (Zhu, 2007).

Dewey's definition of reflective thinking repeated over the years was: "Active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusion to which it tendsm" (Dewey, 1933). According to Taggart & Wilson (1998: 2) reflective thinking is the process of making informed and logical decisions on educational matters, then assessing the consequences of those decisions. Askar & Kızılkaya (2009), state reflective skills consisting of questioning, reasoning and evaluating can be best observed in the process of problem solving. Meisner (2006), on the other hand, expresses the development of reflective thinking is the centre of Mathematics education. Thus the mathematics classroom offers a sort of natural laboratory in which we can study how people acquire and use problem solving skills (Mayer, 1992: 456). In this context, it is seen that problem solving and reflective thinking skills are directly related to Mathematics course.

Like in many other countries' educational systems, the prior aim of Turkish National Educational System is to raise individuals able to cope with the problems they confront in an effective way and adapt to the rapid changes of the 21th century world. In Mathematics curriculum still being conducted in Turkey, it is stated that the aim is to raise students as good problem solvers having developed mathematical thinking skills (MoNE, 2014).

1.1 Literature Review

The aim of this study is to determine the relationship between the 7th and 8th grade students' reflective thinking skills towards problem solving and their attitudes towards Mathematics. For this reason, the studies about reflective thinking and problem solving, and the ones analyzing the relashionship between these skills and Mathematics in literature have been examined. Pimta, Tayruakham, & Nuangchalerm (2009) in their study related to the factors affecting the 6th grade students Mathematical problem solving skills, have concluded that attitude towards Mathematics directly affects problem solving skills.

There are also several studies conducted about the reflective thinking skills with different grades of students. Sen (2013) has worked with primary school students; Bas & Kıvılcım (2013), Kaminski (2003), Hershkowitz & Schwarz (1999) and Porter (1998) with high school students; Crawford (1998) with undergraduate students; and Baki, Aydın Guc & Ozmen (2012), Gur Sahin & Dıkkartın Ovez (2012), Lee (2005) have worked with pre-service teachers. Hiebert, Carpenter, Fennema, Fuson, Human, Murray, Olivier & Wearne (1996), in their study about whether the reforms made in the field of curriculum and instruction let the students problematize the subjects or not, emphasize the importance of problem solving skills, the basis of Mathematics, and reflective skills being used in this process. The activities done in English (Bas & Beyhan 2012, Bayrak & Kocak Usluel 2011), Science (Bas, 2013; Tok, 2008) and Social Studies (Ersozlu & Kazu, 2011) courses are other studies about reflective thinking skills in literature. Bas (2013), has examined the relationship between primary school students' reflective thinking skills towards problem solving and their achievement in Science and Technology courses by using the structural equation modeling. As a result of this study, he has determined that reflective thinking skills towards problem solving is a precursor of achievement in Science and Technology course. Tok (2008), in his research, has studied the effect of reflective thinking activities on academic achievement and attitude in Science course. Findings show that reflective thinking activities increase students' academic achievement and affect their attitude towards the course in the positive way. Ersozlu & Kazu (2011), have worked on the effect of activities developing reflective thinking in Social Studies course on 5th grade primary school students. Writing a diary and questioning strategies used to develop reflective thinking skills have created a significant difference in students' achievement in terms of comprehension, practice and analysis. Demiralp & Kazu (2012) have examined the contribution of the primary school 1st grade curricula on developing students' reflective thinking in the light of the teachers' views. As a result of this study they have stated that the teachers' opinions are generally positive about the contribution of the primary school 1st grade curricula on

developing students' reflective thinking. Gur Sahin & Dıkkartın Ovez (2012) in their study in which they have studied the pre-service teachers' reflective thinking tendency, have found that the pre-service teacher studying primary school teaching have more tendency in reflective thinking than the ones studying primary school Mathematics, Science and Social Studies teaching. Phan (2009), in his study about the effects of reflective thinking activities on academic achievement have stated that reflecting thinking activities are effective on academic achievement and they do not create a significant difference in terms of gender. Lee (2005) in his study with pre-service teachers have examined reflection in the context of content and depth. While the findings related to content vary, it is seen that the depth of reflective thinking go back to the individual background. Related to reflective thinking, Basol & Evin Genc (2013), have done studies on the validity and reliability of Kember vd. (2000)'s "Questionnaire for Reflective Thinking" for undergraduate students; Semerci (2007) has developed Reflective Thinking Tendency Scale for Turkish Language teachers and pre-service teachers. Kızılkaya and Askar (2009), on the other hand, have developed Reflective Thinking Skills towards Problem Solving Scale for 7th and 8th grade students. As a result, when the findings of the studies in literature are examined, it can be said that reflective thinking skills have a positive relationship with metacognitve thinking skills (Sen 2013; Ersozlu & Kazu 2011; Porter 1998), academic achievement (Bas, 2013; Sen 2013; Bas & Kıvılcım 2011; Tok 2008; Phan 2009; Phan 2006, Kaminski 2003; Porter 1998; Crawford 1998) and attitudes towards the course (Phan, 2009; Tok 2008; Kaminski 2003). In the light of the studies examined, it can be expressed that reflective thinking skills are a significant tool in increasing the cognitive and affective skills of students.

On the other hand, the individual's achievement in a course and his attitude towards the course is considered in a close relationship in literature (Soylu & Soylu, 2006; Phan, 2006; Porter, 1998; Klausmeier, 1985). Soylu & Soylu (2006) in their study about determining the problems and mistakes of primary school students in problem solving emphasize the role of problem solving on the way through success in Mathematics. Phan (2006), in his study related to the relationship of the students' epistemological beliefs, learning approaches and reflective thinking with each other and their academic achievement, puts the effect of epistemological beliefs on students' thinking, learning approaches and academic performances forth. Furthermore, Adair (2000), states the more difficult the problem is, the more pleasure one can get when it is solved, and adds this pleasure encourages the individual to make more effort in this field and be more successful.

1.2 Purpose of the Research

The 7th and 8th grade students get prepared for their further education, and educational institutions direct these students to higher educational institutions regarding their interests and abilities. During that process it is significant to examine whether Mathematics curriculum help students reach the cognitive goals as well as the affective ones and the relationship between these two. In this sense, the aim of this study is to examine the relationship between the 7th and 8th grade students' reflective thinking skills towards problem solving and their attitudes towards mathematics. As mathematics is a major discipline for students' entire lives, determining the relationship between students' reflective thinking skills towards problem solving and their attitudes towards mathematics is informative in terms of the their performance at the end of their primary education and their preparedness for secondary education.

In the study answers to the following questions have been tried to be found out: (1) Is there a significant difference between the students' reflective thinking skills towards problem solving and their gender? (2) Is there a significant difference between the students' attitudes towards mathematics and their gender? (3) Is there a significant difference between reflective thinking skills towards problem solving and their attitudes towards mathematics?

2. Method

In this study the relationship between the 7th and 8th grade students' reflective thinking skills towards problem solving and their attitudes towards mathematics is examined. This study is a correrational research which aims at finding the relationship between two or more variables and clues about causes and effects (Fraenkel, Wallen & Hyun, 2012).

2.1. Study Group

The study group of the research consists of students studying in the 7th and 8th grades in two private schools subject to the Ministery of National Education in Yenimahalle, Ankara. While choosing the study group convenience sampling has been used (Gall, Gall & Borg, 2007). 48% (N=144) of the total study group is female and 52% (N=156) is male students. In addition, 39.7% (N=119) of the students are 7th grade and 60.3% (N=181) are 8th grade students. The students have taken part in the study voluntarily.

2.2. Instruments

The research data has been collected via two scales. One of these is "*Reflective Thinking Skill Scale towards Problem Solving*" developed by Kızılkaya & Askar (2009), and the other is "*Mathematics Attitude Scale*" developed by Onal (2013).

Reflective Thinking Skill Scale towards Problem Solving: In the study, "*Reflective Thinking Skill Scale towards Problem Solving*" developed by Kızılkaya & Askar (2009) has been used in order to analyze students' reflective thinking skills towards problem solving. The scale is composed of 14 items having three sub-dimensions in Questioning (5 items), Reasoning (4 items) and Evaluating (5 items) . The items of the scale are scored according to the 5 Point Likert Scale. (Always=5, Usually=4, Sometimes=3, Rarely=2, Never=1). The total score of the scale has been determined over the scores of the answers given to the 14 items. The size of the total score is interpreted in the level of possessing reflective thinking skills. Before the confirmatory factor analysis to determine the dimensions of the scale, Kaiser-Meyer-Olkin coefficient has been found 0.872 and Barlett's Test of Sphericity value has been found 1084.329 ($p<0.001$). At the end of the confirmatory factor analysis, there has been a bidirectional relationship between questioning and evaluating as 0.90, as 0.82 between evaluating and reasoning, and as 0.96 between questioning and reasoning. As a result of the confirmatory factor analysis done for the the validity studies of the scale the fit indices are GFI= 0.92, AGFI= 0.89, NNFI= 0.93, CFI= 0.95, RMSR= 0.08, RMSEA= 0.071. The Cronbach α is 0.73 for the questioning sub-dimension of the scale, 0.71 for reasoning, and 0.69 for evaluation, and 0.83 for the total of the scale. (Kızılkaya & Askar 2009: 89)

Cronbach α for the sub-dimensions of questioning, reasoning and evaluation of this study conducted with the 7th and 8th grade students is respectively 0.64, 0.69, 0.59, and the total Cronbach α is 0.84. Besides, the highest score that can be taken from the scale is 42, the lowest is 14.

Mathematics Attitude Scale: As another variable examined through the study, students' attitude towards the Mathematics has been determined by Mathematics Attitude Scale developed by Onal (2013). The scale is composed of 4 sub-dimensions including interest, anxiety, study and necessity and it has 22 sentences related to attitude, 11 of which are affirmative and 11of which are negative. Factor 1 with 10 items is 35.01%, factor 2 with 5 items is 7.71%, factor 3 with 4 items is 7.11%, and factor 4 with 3 items is 5.31% explanatory. The total variance is calculated as 55.12%. Cronbach α internal consistency coefficient related to the entire scale is 0.90; the one related to the interest sub-dimension is 0.89; the one related to the anxiety sub-dimension is 0.74; the one related to the study sub-dimension is 0.69 and the one related to the necessity sub-dimension is 0.70. In addition, when the relationship between the dimensions of the scale as a result of the confirmatory factor analysis is examined, there is a bi-directional relationship between the dimensions of interest and anxiety as 0.503, interest and study as 0.524, interest and necessity as 0.549, anxiety and study as 0.367, study and necessity as 0.445, anxiety and necessity as 0.424. As a result of the confirmatory factor analysis done fort he the validity studies of the scale the fit indices are GFI= 0.91, AGFI= 0.88, NFI=0.96, NNFI= 0.98, CFI= 0.98, RMSR= 0.050, RMSEA= 0.05. In the light of these values, it is stated that the items are in goodnes of fit. (Onal, 2013: 942-944).

Cronbach α for the sub-dimensions of interest, anxiety, study and necessity of this study conducted with the 7th and 8th grade students is respectively 0.91; 0.81; 0.65; 0.64, and the total Cronbach α is 0.92. Besides, the highest score that can be taken from the scale is 66, the lowest is 22.

2.4. Data Analysis

In order to obtain valid results from the findings, in other words to work with sufficient findings, first lost and extreme values have been examined (Cokluk, Sekercioglu, & Buyukozturk, 2012). An average value has been determined for the lost data in the data set. One directional and multi-directional values have been identified and omitted from the data set. After the examination of the lost ans extreme values, 300 data have been included in the analysis. In the analysis of the data, to decide whether to use parametric or non-parametric methods, the normality premices related to the dependent variables have been examined, and it has been decided that as the coefficient of skewness and kurtosis obtained via the two scales are between -1 ile +1, the scores do not have a deviation more than normal.

In the study to determine the arithmetic average and standard deviation of the scores of the students from Reflective Thinking Skills towards Problem Solving Scale and Mathematics Attitude Scale and if the difference between these scores is significant, MANOVA has ben used. (Gall, Gall & Borg). Using the scores students have gotten from the sub-dimensions of the scales and the total scores, whether there is a significant difference between the scores of male and female students has been tested.

Whether there is a significant difference between the students' reflective thinking skills towards problem solving and their atitude towards Mathematics has been determined by using Pearson Product-Moment Correlation.

3. Findings

3.1. Reflective Thinking Skills towards Problem Solving and Gender

The first sub-question of the study is stated as: Is there a significant difference between the students's reflective thinking skills towards problem solving and their gender?

In the context of this sub-problem, firstly, the students' levels of reflective thinking skills towards problem solving has been examined and the results related to the descriptive analysis are presented in Table 1.

Table 1. Descriptive statistics related to students' scores of reflective thinking skills towards problem solving

Reflective thinking skills towards problem solving	n	The lowest score	The highest score	$\overline{X}$	SD
Questioning	300	5	25	17.50	3.67
Evaluating	300	5	25	16.86	4.28
Reasoning	300	4	20	15.06	3.01
Entire Scale	300	18	70	49.42	9.40

As seen in Table 1, the average of the students' reflective thinking skills towards problem solving questioning sub-dimension is 17.50, it is 16.86 for evaluating and 15.06 for reasoning. The average of the students' reflective thinking skills towards problem solving is 49.42. If the average score gotten from the scale is closer to 70, this shows that the level of students' reflective thinking skills towards problem solving increases. On the other hand, if it is closer to 18, this means the level of students' reflective thinking skills towards problem solving decreases. When this value is compared to the highest score to be taken from the scale (70), it is seen that the level of students' reflective thinking skills towards problem solving is on a moderate level.

So as to determine whether the average scores of the questioning, evaluating and reasoning sub-dimensions of the Reflective Thinking Skills towards Problem Solving Scale depend on gender, MANOVA has been used. The arithmetic mean, standard deviation values and MANOVA results of the students' scores of their levels of reflective thinking skills towards problem solving according to their gender are given in Table 2.

Table 2. MANOVA results of the students' scores of their levels of reflective thinking skills towards problem solving according to their gender

Variable	Gender	N	$\overline{X}$	SD	Df	F	P
Questioning	Female	144	17.60	3.54	1-298	0.237	0.626
	Male	156	17.40	3.78			
Evaluating	Female	144	16.76	4.07	1-298	0.160	0.689
	Male	156	16.96	4.46			
Reasoning	Female	144	14.85	3.09	1-298	1.383	0.241
	Male	156	15.26	2.94			
Entire Scale	Female	144	49.21	9.45	3-296	1.129	0.337
	Male	156	49.61	9.37			

When Table 2 is examined, according to the MANOVA result, there is not a significant difference between the male and female students' reflective thinking skills towards problem solving [F(3-296)=1.129, p>0.05 Pillai's Trace=0.011, kısmi η2=0.011]. The students' reflective thinking skills towards problem solving do not indicate any significant difference according to their gender under the sub-dimensions of questioning (p=0.626, p>0.000), evaluating (p=0.689, p>0.000) and reasoning (p=0.241, p>0.000).

3.2. Attitudes towards Mathematics and Gender

The second sub-question of the study is stated as "Is there a significant difference between the attitudes of the students towards Mathematics and their gender?"

In the context of this sub-problem, firstly, the level of the students' attitudes towards Mathematics has been examined and the results related to the descriptive analysis are shown in Table 3.

Table 3. Descriptive statistics related to the scores of the students' attitudes towards Mathematics

Attitude towards Mathematics	N	The lowest score	The highest score	$\overline{X}$	SD
Interest	300	10	50	32.68	10.55
Anxiety	300	5	25	14.26	5.72
Necessity	300	3	15	9.90	3.40
Study	300	5	20	15.79	3.12
Entire Scale	300	26	110	72.62	19.02

As seen in Table 3, the average of the scores of the students' attitudes towards Mathematics in the interest sub-dimension is 32.68, the average for anxiety is 14.26, for necessity it is 9.90, and for study it is 15.79. The average score related to the students' attitudes towards Mathematics is 72.62. If the average score taken from the scale is closer to 110, this shows that the level of students' attitudes towards Mathematics increases. On the other hand, if it is closer to 26, this means the level of students' attitudes towards Mathematics decreases. When this value is compared to the highest score to be taken from the scale (110), it is seen that the level of students' is students' attitudes towards Mathematics on a moderate level.

To determine whether the average scores related to the sub-dimensions of interest, anxiety, necessity and study depend on gender, MANOVA has been used. The arithmetic mean, standard deviation values and MANOVA results of the students' scores of their levels of attitudes towards Mathematics according to their gender are given in Table4.

Table 4. MANOVA results of the students' scores of their attitudes towards Mathematics according to their gender

Variable	Gender	N	$\overline{X}$	SD	df	F	P
Interest	Female	144	31.02	10.46	1-298	7.041	0.008
	Male	156	34.22	10.44			
Anxiety	Female	144	12.40	5.13	1-298	31.828	0.000
	Male	156	15.96	5.72			
Necessity	Female	144	9.22	3.42	1-298	11.239	0.001
	Male	156	10.52	3.28			
Study	Female	144	15.78	3.15	1-298	0.002	0.962
	Male	156	15.79	3.10			
Entire Scale	Female	144	68.42	18.76	4-295	8.641	0.000
	Male	156	76.49	18.48			

When Table 4 is examined, according to the MANOVA result, there is a significant difference between the male and female students' attitudes towards Mathematics. [$F(4\text{-}295)=8.641$, $p<0.05$ Wilks'$\lambda=0.895$, partial $\eta 2=0.105$] The difference in favor of the male students is ($p=0.008$, $p<0.05$) for interest, ($p=0.000$, $p<0.05$) for anxiety, ($p=0.001$, $p<0.05$) for necessity and ($p=0.962$, $p>0.05$) for study.

3.3. The Relationship between Reflective Thinking Skills and Attitudes towards Mathematics

The third sub-problem of the study is stated as Is there a meaningful relationship between the students reflective thinking skills towards problem solving and their attitudes towards Mathematics?

In order to determine the relationship between the students' reflective thinking skills towards problem solving and their attitudes towards Mathematics, Pearson Product-Moment Correlation has been used. In this sense, the result of the analysis is given in Table 5.

Table 5. Reflective thinking skills towards problem solving and attitude towards Mathematics correlation matrix

Variables		1.	2.	3.	*4.*	*5.*	*6.*	*7.*
Reflective thinking skills towards problem solving	1. Questioning	-	0.661**	0.547**	0.355**	0.179**	0.272**	0.282**
	2. Evaluating	0.661**	-	0.569**	0.400**	0.182**	0.314**	0.470**
	3. Reasoning	0.547**	0.569**	-	0.397**	0.227**	0.297**	0.325**
Attitude towards Mathematics	4. Interest	0.355**	0.400**	0.397**	-	0.667**	0.725**	0.367**
	5. Anxiety	0.179**	0.182**	0.227**	0.669**	-	0.644**	0.201**
	6. Necessity	0.272**	0.314**	0.297**	0.725**	0.644**	-	0.337**
	7. Study	0.282**	0.470**	0.325**	0.367**	0.201**	0.337**	-

**p< 0.01

When the relationship between the students' reflective thinking skills towards problem solving and their attitudes towards Mathematics given in Table 5 is examined, it is seen that all sub-dimensions have a meaningful relationship with each other. Questioning shows a moderate level meaningful relationship with interest in the positive sense (r=0.355), with anxiety in a low level meaningful in the positive sense (r=0.179), with necessity in a low level meaningful in the positive sense (r=0.272) and with study in a low level meaningful in the positive sense (r=0.282). Evaluating shows a moderate level meaningful relationship with interest in the positive sense (r=0.400), with anxiety in a low level meaningful in the positive sense (r=0.188), with necessity in a low level meaningful in the positive sense (r=0.314) and with study in a moderate level meaningful in the positive sense (0.470) ($p<0.01$). Reasoning shows a moderate level meaningful relationship with interest in the positive sense (r=0.397), with anxiety in a low level meaningful in the positive sense (r=0.229), with necessity in a low level meaningful in the positive sense (r=0.297) and with study in a moderate level meaningful in the positive sense (r=0.325) ($p<0.01$).

The relationship between the averages of the scores of students they have gotten from the Reflective Thinking Skills towards Problem Solving and Attitude towards Mathematics Scales are shown in Table 6.

Table 6. The relationship between the scores of reflective thinking skills towards problem solving and attitude towards Mathematics

Variables	n	R	p
Reflective thinking skills towards problem solving Attitude towards Mathematics	300	0.448**	0.000

**p< 0.01

When the relationship between reflective thinking skills towards problem solving and attitude towards Mathematics in Table 6 is examined over the total scores of the students, it is seen that there is a meaningful moderate level relationship between these in the positive sense (r=0.448) ($p<0.01$).

4. Conclusion and Discussion

In this study, the relationship between secondary school students' reflective thinking skills towards problem solving and their attitude towards Mathematics has been tried to be determined. In the light of the findings obtained for the first sub-problem of the study, it is generally understood that the students' reflective thinking skills towards problem solving are on a moderate level. Besides, the scores of male and female students in reflective thinking skills towards problem solving are of moderate level. However, as emphasized in literature, when that the development of thinking skills is one of the most important goals of education is considered, that a moderate level is not regarded as enough. Parallel to the results of this study, Kızılkaya & Askar (2009), in their study have found that the 7th grade female ($\overline{X}$=51.68) and male ($\overline{X}$=48.99) students have moderate level of reflective thinking skills towards problem solving. Likewise, Bayrak & Kocak Usluel (2011), have used the same scale among the students of the Department of English Language and the average scores obtained via the pre-test ($\overline{X}$=49.45) and the final test ($\overline{X}$=50.15) are very close to the ones obtained in this study. In addition, Baki, Aydın Guc & Ozmen (2012) have determined that the level of the pre-service Mathematics teachers' reflective thinking skills towards problem solving is not adequate. When the results of the analysis are examined to see whether gender creates a significant difference on the scores of the students' reflective thinking skills towards problem solving, it is seen that there is not a significant difference between the male and female students' reflective thinking skills towards problem solving. Sen (2013), Kızılkaya & Askar (2009) in their study in terms of reflective thinking skills towards problem solving; Yıldırım, Hacıhasanoglu, Karakurt & Turkles (2011) in terms of problem solving have found meaningful results in favor of female students. On the other hand, Tuncer & Ozeren (2012), Sahin (2011) and Korkmaz (2009) have expressed that students' reflective thinking skills towards problem solving do not indicate a significant difference regarding gender. Zhu (2007) in his study in which he deals with gender difference in mathematical problem solving states the literature is generally in favor of the male students; however, such a generalisation is not possible.

In the light of the findings for the second sub-question of the study, the attittudes of the students towards Mathematics is on a moderate level in general. Especially, in the study sub-dimension, the attitudes of the students are higher than in the other dimensions. Ekizoglu & Tezer (2007) in a similar way, in their study, have found that the attitudes of the primary school students towards Mathematics is on a moderate level. In the analysis made to find whether gender creates a significant difference on students' attitudes towards Mathematics, there is a significant difference in favor of male students in the interest, anxiety and necessity sub-dimensions. Except for study sub-dimension, the average scores of male students are higher than the girls in interest, anxiety and necessity sub-dimensions. Tocci & Engelhard (1991) and Odell & Schumacher (1998) also emphasize there is a significant difference in favor of male students in terms of attitude towards Mathematics; whereas Farooq & Shah (2008) and Ma & Kishor (1997) state attitude towards Mathematics does not depend on gender.

Finally, in the frame of the findings to the third sub-problem of the study, it is seen that the relationship between the students' reflective thinking skills towards problem solving and their attitude towards Mathematics is significant on a moderate level in the positive sense. Pimta, Tayruakham, & Nuangchalerm (2009) have concluded in their study that problem solving skills directly affect the attitude towards Mathematics in the positive way. Ayrıca Bas & Beyhan (2012), Phan (2009), Tok (2008), Phan (2006) point out a positive relationship in their study in which they have studied reflective thinking skills and attitudes towards different lessons. This significant relationship supports the findings of the findings of the previous studies.

When the correlation coefficients of the sub-dimensions in the attitude scale are considered, it can be said that reflective thinking skills towards problem solving show a higher correlation with interest and study sub-dimensions of attitudes towards Mathematics. Furthermore, evaluating sub-dimension of the reflective thinking skills towards problem solving has a stronger relationship with the dimensions of the attitude towards Mathematics compared to the other dimensions. Anxiety, a sub-dimension of the attitude towards Mathematics has a less meaningful relationship with reflective thinking skills towards problem solving when compared to the other dimensions.

The findings of this study indicate that there is a need for more effort to develop students' reflective thinking skills towards problem solving. Kalaycı (2001) also states that the researches done show teachers are aware that education has the goal of raising individuals who can think; however, there are several problems in achieving this aim. In this sense, the steps to develop studuents problem solving skills should be determined and solutions to help

teachers in following these steps should be found out. In addition, the number of course hours in which students are left in real life situations trying to solve probems and use their reflective thinking skills should be increased. In furhter studies, with new measurement tools, much deeper information can be gained about reflective thinking skills towards problem solving. Also by choosing samples from different grades and regions, similar studies can be made. In order to determine which variables affect the reflective thinking skills towards problem solving, qualitative researches can be made. In addition to this, similar studies can be repeated in different grades and the development of this skill can be observed.

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