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The Relationship Between Middle School Students' Attitudes Towards Mathematical Problem-Posing, Attitudes Towards Mathematical Problem-Solving, and Attitudes Towards Mathematics

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Abstract

It was aimed to develop a scale for determining middle school students' attitudes towards mathematical problem-posing (First Study), and to present functionality of the developed scale and relationships between middle school students' mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics (Second Study). In the First Study, evidences regarding the reliability and validity of the scale were presented. It was proved that the scale is practicable. The Second Study which was designed according to relational scanning model. 444 middle school students participated in this study. "Mathematical Problem-Posing Attitude Scale", "Mathematical Problem-Solving Attitude Scale" and "Attitude Scale towards Mathematics" were used as data collection instruments. It was determined that middle school students' mathematical problem-posing attitudes, mathematical solving attitudes, and attitudes towards mathematics were positive and high level. In addition, high-level relationships were identified between such attitudes of students. Lastly, it was determined that the female students had higher attitudes than the male students and these attitudes get lower as grade level rises.

Keywords

Mathematics
Problem-posing
Problem-solving
Attitude
Validity
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Introduction

Today, raising individuals who are successful and capable of fighting against the difficulties of life and who developed self-confidence is closely related to problem-solving skill. Kabadayı (1992, as cited in Şahin, 2004) pointed out that the ability of problem-solving is an important method in education as well as being a mental skill. According to Korkut (2002) problem-solving does not only require using information learnt through previous experiences in a problem, but also requires the ability to find new solution methods as much as possible.

According to previous researches (Cankoy & Darbaz, 2010; Lowrie, 2002a; Stoyanova, 2005), problem-solving and problem-posing is inter-related. Problem-posing is re-shaping an existing problem and producing new problems (Cai & Hwang, 2002). Stoyanova and Ellerton (1996) define it as a process in which the interpretations based on concrete situations are turned into mathematical problems. Işık and Kar (2012b) think that problem-posing is a questioning process that shapes in-class communication.

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According to Akay, Soybaş, and Argün (2006), problem-posing is a problem-solving activity that involves producing new problems. Besides, Gonzales (1998) defines problem-posing as the fifth and a final step of the problem-solving.

In order to students to become a problem solver, many studies state that it is necessary to improve their problem-solving skills first (Akay, 2006; Perrin, 2007; Silver & Cai, 1996; Turhan & Güven, 2014). Because problem-posing contributes to development of problem-solving skills (Abu-Elwan, 2002; Cai & Hwang, 2002; Cankoy & Darbaz, 2010; Yuan & Sriraman, 2011). In this sense, individuals who have sufficient problem-posing skills can create problems on their own by discovering new conceptual structures under the light of their existent information.

In various studies (Akay et al., 2006; Cankoy & Darbaz, 2010; Toluk-Uçar, 2009; Turhan & Güven, 2014; Kojima, Miwa, & Matsui, 2015) it is pointed out that problem-posing activities provide important contributions to the students' development. Thanks to problem-posing processes, students can associate their experiences with mathematical operations and concepts. In this way, their conceptual understanding improves. They can establish links between the necessary steps for solution by ascribing a meaning to symbolic representations. Also, problem-posing allows them to develop a mathematical language (Abu-Elwan, 2002; Akay, 2006; Cai, 2003; Crespo & Sinclair, 2008; Demir, 2005; Işık, Işık, & Kar, 2011; Lowrie, 2002b; Toluk-Uçar, 2009). It is also stated that problem-posing activities improve students' creativity, critical thinking, communication, and problem-solving skills (Akay, 2006; Crespo & Sinclair, 2008; Cunningham, 2004; Knott, 2010; Yuan & Sriraman, 2011). In addition to this, it was stated that problem-posing activities positively affect academic achievement, problem-solving skill, and creativity (Akay, 2006). Jones (1993) stressed that problem-posing is a catalyser and it allows to students' creativity. Besides, it was found out that problem-posing is an opportunity to develop students' responsibility (Cunningham, 2004). Knott (2010) noted that cognitively challenging problem-posing and solving studies improve reflection, metacognition, and mathematical understanding. It was also found that it affects mathematical understanding and problem-solving achievement in positive way (Katrancı, 2014).

Nicolaou and Philippou (2007) highlight that there is a strong relationship between mathematical success and problem-posing. Problem-posing activities enable students increase their achievements in understanding problem and provide opportunities to improve their proportional reasoning skills. In addition to this, it helps students to improve their problem-solving skills, to understand mathematical concepts, to think differently and flexibly, to reveal teachers' and students' misconceptions and to improve their attitudes and beliefs towards mathematics (Akay & Boz, 2010; Cankoy & Darbaz, 2010; Lavy & Shriki, 2007). It is reported that the coverage of problem-posing activities by teachers in their classes contributes to students' understanding mathematics (Knott, 2010). Teachers deem problem-posing beneficial as it helps assessment and explains students' mathematical skills in depth (Whiten, 2004).

The middle school math curriculum in Turkey (Ministry of National Education (MoNE), 2017) has also turned out to contain statements like "*problem-posing studies are covered*". This may be indicating that there is awareness about the benefits of problem-posing. However, Çetinkaya and Soybaş (2018) stated that there is a few problem-posing activities in the current textbooks of our country. Similarly, Xie and Masingila (2017) specified that even though there are many studies to discover the nature as well as the strategies and process that problem, it is rarely seen to form a problem as part of curriculum. This view supports research results that Chapman (2012) and Leung (2013) had found that though students may be able to solve mathematical problems, they have problems with open-ended problems and certain mathematical concepts or difficulties not distinguishing between different kinds of problems. For this reason, it is important to start the problem-posing and teaching of the strategies from primary education. Türnüklü, Ergin, and Aydoğdu (2017) also recommended increasing the problem-posing activities in class for this situation. Thus, it is also thought that the importance of problem-posing could be revealed. In addition, it is important to examine the changes in the students with the increasing problem-posing work.

According to previous paragraphs, some previous researches dealt with the effect of problem-posing on problem-solving and conceptual understanding (Cankoy & Darbaz, 2010; Turhan & Güven, 2014), the relationship between problem-posing and reasoning (Çelik & Yetkin-Özdemir, 2011), and the position of problem-posing in course books and mathematics curriculum (Kılıç, 2011). Another study explored fifth- and sixth-grade students' views of the benefits of problem-posing (Nicolaou & Philippou, 2007). Some others analyzed the mistakes in the problems posed (Işık & Kar, 2012a; Kar & Işık, 2014; Luo, 2009; McAllister & Beaver, 2012; Osana & Royea, 2011). The assessment dimension of problem-posing was also addressed, and the mathematical and language use-related complexity of the problems posed by sixth grade students was examined (Işık & Kar, 2015). A study determined sixth- and seventh-grade students' competencies of forming an equation and posing problems in accordance with arithmetic and algebraic equations (Akkan, Çakıroğlu, & Güven, 2009). Işık, Çiltaş, and Kar (2012) investigated the effect of teaching based on problem-posing on problem-solving success. The metaphorical representations of the students engaged in problem-posing processes were also examined (Arıkan & Ünal, 2014). It was seen that problem-solving and problem-posing skills of seventh grade students and problem-posing abilities of eighth grade students were examined (Arıkan & Ünal, 2015a, 2015b). Türnüklü et al. (2017) also examined the problem-posing studies of eight-graders in terms of geometry learning area. Similarly, Şengül-Akdemir and Türnüklü (2017) determined sixth-graders' problem-posing processes about triangles. Çetinkaya and Soybaş (2018) also investigated problem-posing skills of eighth grade students. Zakaria and Ngah (2011) attempted to reveal the relationship between problem-posing skills and attitudes towards problem-solving method. Özgen, Aydın, Geçici, and Bayram (2017) sought students' skills in the process of problem-posing. Also, students' problem-posing skills were tested in terms of attitude towards problem-solving, gender, and success. Kaba and Şengül (2017) investigated the relationship between problem-posing achievements and attitudes towards problem-solving in middle school students. It was seen that many studies have been made about this topic. Even though most of studies are related to middle school level, there is no a study which is investigated attitudes towards problem-posing at this level. In this context, it is considered that a study should be done about this topic.

According to Altun (2001) students who are able to pose problems can develop a positive attitude towards mathematics and this brings about a decrease in their worries. It is known that problem-posing helps to improve students' mathematical attitudes and beliefs (Akay & Boz, 2010; Cankoy & Darbaz, 2010; Lavy & Shriki, 2007). Problem-posing provides an insight into students' conceptual learning, skills, and attitudes concerning a given situation (Lavy & Shriki, 2007). Silver (1994) also states that problem-posing is important to improve attitude towards mathematics and problem-solving skill. As we consider the positive effects of problem-posing in mathematics, it becomes utmost important to raise students who have high skills in problem-posing. For this reason, it can be expected from students to be a good problem solver-poser as long as their negative attitudes and misbelieves do not change about both mathematics and problem-solving (Conlrey, 1984, as cited in Çanakçı & Özdemir, 2011). At this point, it is occurred that it is important to investigate attitudes towards problem-posing. This is because it is thought that determining the negative attitudes towards problem-posing would be helped to identify effects of mathematical success. It is foreseen that students with positive attitudes would be good problem solvers. In this case would bring the success in mathematics. In this context, questions such as "What is attitude?" and "What is attitude towards problem-posing?" should be answered.

When the studies about attitude are analyzed, it can be seen that the definition of the attitude vary according to field which is being studied. According to Turkish Language Institution [TLI] (2016) attitude is defined as "*the way preferred, manner*". When we look at general studies carried out for 'attitude', it is defined as the state of emotional and mental readiness which has a guiding effect to the behaviors of an individual and which is formed as a result of the experiences (Allport, 1935) or the tendency towards giving a positive or negative response to a psychological object (Thurstone, 1931). The attitude towards mathematics was defined by Neale (1969) as the state of whether to love mathematics or not, the belief about being good at or bad at mathematics, the tendency to deal with mathematical activities or to escape from these activities and the belief whether mathematics is useful or not (as cited in Akgün, 2002). Zan and Di Martino (2007) expressed attitudes towards mathematics as the beliefs, behaviors and emotions which shape the positive and negative tendencies towards mathematics. Attitudes towards problem-posing could be defined as the state of emotional and mental readiness to problem-posing, the state of whether to love problem-posing or not, the belief about being good or bad at problem-posing, and the tendency to deal with problem-posing activities or to escape them.

Education is an important tool to change attitudes. In this sense, the fact that teachers have information about students' attitudes and how to test them is seen as an important factor in increasing the quality of education. For this reason, it can be said that the studies conducted to test students' attitudes have become extremely important (Duatepe & Çilesiz, 1999). In mathematics education, various attitude scales have been developed. Some of them are as follows; Attitudes Scale towards Mathematics (Tapia & Marsh, 2004), Attitude Scale for Solving Mathematics Problems (Çanakçı & Özdemir, 2011), Mathematics Attitude Scale (Aşkar, 1986; Aydınlı, 1997; Erol, 1989; Duatepe & Çilesiz, 1999, Önal, 2013); Attitude Scale for Teaching Mathematics Lessons (Karakaş-Türker & Turanlı, 2008). However, as a result of the previously conducted studies, an attitude scale for problem-posing has not been encountered. This study was carried out by moving from this need to make a scientific contribution to mathematics education. This study was conducted in two stages (First Study and Second Study). The purpose of First Study, first stage of this study, is to develop a scale for determining middle school students' attitudes towards posing mathematical problems. In the Second Study, which was the second stage of the research, it was aimed to reveal both evidences regarding the functionality of the scale and the relationships between the middle school students' mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics.

One of the general objectives of the mathematics course is to raise students with developed problem-solving skills. This can be achieved by increasing the number of students who can pose and solve mathematical problems and like mathematics as of the early years of primary education. According to Aydoğdu and Ayaz (2008), those students who like and succeed in problem-solving and have gained problem-solving skill (i.e. who can solve problems in daily life as well) have high determination and self-confidence. It is emphasized that students' attitudes towards teachers and mathematics manifest themselves in problem-solving in a similar way, which shows the effect of psychological factors on learning. Therefore, having students who have high attitudes towards posing mathematical problems, solving mathematical problems and mathematics itself is one of the primary issues to be focused on by both national education authorities and teachers. It is thought that these points should be focused on with research. It could be shown what measures could be taken to increase the negative attitudes with research. For these reasons, Second Study aims to investigate the relationships between middle school students' attitudes towards mathematics, posing mathematical problems, and solving mathematical problems. Also, it is aimed to put forward evidence showing the functionality of the scale developed. This is taken up in terms of gender and grade level variables. The lack of a study of the attitudes towards problem-posing leads to the inability to reveal the context in terms of these variables. At the same time, with this study, it is expected that this point will be kept in the light and will be a reference for future studies. To this end, the Second Study seeks to answer the following problems. Accordingly, middle school students;

1. What are the middle school students' levels of attitudes towards mathematical problem-posing, towards mathematical problem-solving, and towards mathematics?
2. Are there any relationships between their mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics?
3. Do their mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics vary by gender and grade level?

Method

This study is a descriptive study which was carried out in two stages (First Study and Second Study). Findings and methods about these two stages were presented separately below.

First Study

Research Model and Study Group

The First Study was carried out in accordance with general scanning model and in 3 middle schools from Kocaeli city. The study group was composed of 1564 students who are studying at these schools. The distribution of the study group is given in Table 1.

Table 1. Distribution of the Study Group according to Gender and Grade Level

	5th Grade	6th Grade	7th Grade	8th Grade	Total
Female (F)	210	204	193	189	796 (%50.89
Male (M)	240	201	192	135	768 (%49.11)
Total	450 (%28.77)	405 (%25.89)	385 (%24.62)	324 (%20.72)	**1564**

Students of the study group were divided randomly into two to conduct analyses about the construct validity, reliability, and confirmatory factor analyses. The distribution of the students to groups is given in Table 2.

Table 2. Distribution of the Study Group to Groups

		5th Grade	6th Grade	7th Grade	8th Grade	Total
First Group	**Female (F)**	115	116	116	120	467 (%51.66)
	Male (M)	125	114	108	90	437 (%48.34)
	Total	240 (%26.55)	230 (%25.14)	224 (%24.78)	210 (%23.23)	**904**
Second Group	**Female (F)**	95	88	77	69	329 (%49.85)
	Male (M)	115	87	84	45	331 (%50.15)
	Total	201 (%31.82)	175 (%26.52)	161 (%24.39)	114 (%17.27)	**660**

The data obtained from the first group (904 students) were used in construct validity and reliability analysis. For the confirmatory factor analysis, the data obtained from the second group (660 students) was used.

The Development Process of the Scale

Mathematical Problem-Posing Attitude Scale (MPPAS): A Validity and Reliability

First of all studies which were carried out about problem-posing in (Akay et al., 2006; Akkan et al., 2009; Çelik & Yetkin-Özdemir, 2011; Işık et al., 2012; Işık & Kar, 2012a; Kılıç, 2013; Tertemiz (Işık) & Sulak, 2013) and outside (Cai, 1998; English, 1997; Lowrie, 2002a, 2002b; Mohd & Mahmood, 2011; Nicolaou & Xistouri, 2011; Rosli, Goldsby, & Capraro, 2013; Silver & Cai, 1996; Zakaria & Ngah, 2011) our country were analyzed. It was understood that there were no studies in terms of developing or adapting a scale for problem-posing either in or outside our country at the middle school level. Nevertheless, Kılıç and İncikabı (2013) determined that a scale development study was conducted to determine teachers' self-efficacy beliefs about problem-posing. Besides, it was determined in the literature that middle school students face with problems while posing problems (Işık & Kar, 2012a) and this can affect attitude toward problem-posing. At this point, 'Mathematical Problem-Solving Attitude Scale (MPSAS)' which was developed by Çanakçı and Özdemir (2011) and which is related to problem-solving was accepted as a reference in writing the items of the scale as it was determined that it is closely related to problem-posing and there are not any references about problem-posing.

In addition to this, three components of attitude; cognitive, affective, and behavioral were considered while writing the items of the scale. The cognitive components of the attitudes are composed of belief and information based on facts, the affective components are composed of positive or negative states or states as whether to like something or not and behavioral components are composed of actions or words. The cognitive element is the consistency of individuals' responses to different stimuli and involves our beliefs about the attitude objects. The affective component, which differs from person to person and cannot be explained by facts, is about individuals' values systems. Values are generalized moral principles and beliefs. What distinguishes attitude from belief and values is the existence of the affective component in it. The affective component gives continuity and shape to attitudes. When there is no behaviour towards an attitude object, the individual's attitude may not be observed and be ignored by the people around him/her. These three components are in mutual interaction. Any change in one of them affects other components as well (Tavşancıl, 2014). Considering each one of these components as a trivet, lack of any one of them will disrupt the balance. Hence, taking all components into consideration when developing an attitude scale is considered important to assure balance and perform needed measurements in all aspects.

In this sense, an item pool consisting of 70 items with equal number of positive and negative items was created by considering all the things stated above. In the pool, there are 34 items about cognitive dimension, 22 items about affective dimension and 14 items about behavioral dimension.

In order to get the opinions of the experts, the items in the pool were arranged through a pre-form in accordance with dual grading. In order for experts to decide whether written items used in the expert opinion form are suitable both in general and to attitude components, they were expected to choose one of the options stated as 'suitable' and 'not suitable' and to write whether items are positive or negative to the explanation part together with the thing that they want to add. This pre-form was given to 5 experts who have enough knowledge about the topic and teaching mathematics. All the collected expert forms were combined into one single form. Later on, the number of experts approving each item was specified. Finally, explanations made by the experts were analyzed. In terms of experts' opinions, construct validity of the items was calculated by using *"(The Number of Experts with Positive Answers/Total Number of Experts)-1"* (Veneziano & Hooper, 1997) formula. After the calculations, it was decided to omit some items whose validity ratio stayed below 0.80 and within this respect two items were omitted from the scale. Two items were edited by correcting spelling mistakes to make them more understandable. After that, when explanations regarding the positivity and negativity of the items were analyzed, the examiners agreed that 37 items are negative and 31 items are positive. All in all, the response set of the pilot/draft scale which concluded with 68 items was arranged in accordance with a five point likert scale. The response style is as in the following; *"Strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4)* and *strongly agree (5)"*. While the minimum score that can be obtained from the scale is 68, maximum score is 340.

The pilot/draft form which was finalized in this way was called as "Problem-Posing Attitude Scale (PPAS)". PPAS was carried out to 20 7th grade students who are studying in a public middle school in order to determine approximate response time, to control spelling mistakes and parts which students might have problems in understanding. During the application, it was observed that some of the students did not understand mathematics problem from the 'problem' expression. The fact that each problem expression used in the scale means mathematics problems was reminded to the students. At this point, according to the obtained data, it was relieved that there were spelling mistakes in pilot/draft form. 7th grade students completed the scale in about 20 minutes. It makes us think that there will be some changes in the reading speeds of the students while the scales is being carried out with 5th, 6th, and 8th grade students. For this reason, the approximate response time of the scale was determined as 25 minutes. The problem about not understanding the expression of problem as mathematics problems was solved through changing the name of the scale as "Mathematical Problem-Posing Attitude Scale (MPPAS)". Besides, it was added to the instructions that students should understand "mathematics problems" from the expression of "problem". Pilot/Draft form was carried out to study group in class environment and it lasted nearly 25 minutes. It should be kept in mind that completion time may vary according to the group.

Data Analysis

An exploratory and confirmatory factor analyses were conducted to determine the construct validity of the scale. The Cronbach Alpha analysis was executed in order to reveal the reliability of the scale. In item analysis, item analysis based on correlations and an item analyses based on the difference between bottom-up group average scores were conducted.

Results

Exploratory Factor Analysis of the MPPAS (MPPAS-EFA)

While deciding on the suitable sample size in factor analysis, it is suggested that we obtain a size which will meet at least two of the criterion stated in the literature (Çokluk, Şekercioğlu, & Büyüköztürk, 2010). It is stated that 1000 is perfect, 500 is very good and 300 is good for the sufficient sample size to conduct factor analysis (Comrey & Lee, 1992). Besides in order to reach the sufficient sample size, it is also recommended that it is necessary to obtain a number which will be find with the multiplication of the number of items with ten or five (Bryman & Cramer, 2001). The facts that the size of the first study group consisting of 904 students participating in First Study is close to 1000 and 13 times more than the number of items in the scale are the evidences that two criteria in the literature were met. For this reason, first study group was accepted as excellent for the factor analysis.

However, it was not enough for the factor analysis. For this reason, in order to test the suitability of the sample size to factoring, Kaiser Meyer Olkin (KMO) and Bartlett tests were conducted KMO value was determined as 0.929 as a result of this analysis. According to this finding, it was seen that the sample size was 'perfectly sufficient' for conducting factor analysis (Şencan, 2005). Bartlett test results, chi-square value is significant at 0.01 levels, in short having p value which is smaller than 0.01 shows us that the data came from multi-variable normal distribution (Çokluk et al., 2010). It was seen that chi-square value was significant at ($X^2 = 19176.407; p < .01$) when Bartlett test results were analyzed. In this context, it was shown that the data set was suitable for factor analysis according to both KMO and Bartlett test results and sample size.

Basic components analysis was chosen in order to reveal factorial design of the MPPAS. In addition to this, varimax technique was chosen among right circular methods. Line graphic which is drawn according to eigenvalue of the factors, eigenvalue statistics, and variance rates explained by factors should be considered in order to determine the number of factors (Büyüköztürk, 2012). Factors whose eigenvalue is 1 or bigger than 1 are accepted as important (Köklü, 2002). In this study, at the beginning, there was no any restriction for the number of factors and it was determined that there were 14 factors that eigenvalue was bigger than 1. Then, line graphic which drawn according to eigenvalue of the factors was examined. Factors with a rapid decline in graphic were accepted as important. The graphic decreases the number of factors more successfully than eigenvalue (Thompson, 2004). It was seen that there was a rapid decline after the third factor. After that point the graphic reached a plateau when the graphic was analyzed. The rate of total variance explained is the another approach to determine the number of factors. In multiple factorial designs, 30% or more of the total variance explained is accepted as sufficient (Büyüköztürk, 2012). In this study, the communality of the first factor was found as 30.861% according to the results of the analysis from this perspective. Having many number of factors in multiple factorial designs increases explained variance, but this time, it causes difficulties such as naming factors and making them meaningful (Büyüköztürk, 2012). In this regard, the number of factors in this study was determined as 'three'.

It was necessary to pay attention to the size of the sample to decide on the factor loads (Şencan, 2005). It is recommeded that a particular sample size in order to decide on whether an item would be omitted or not (Kim-Yin, 2004, as cited in Şencan, 2005). In this study, the sample size (n= 904 students) for the explanatory factor analysis provides an opportunity to omit the items that factor loads below 0.30. Tabachnick and Fidell (2001) express that the factor loads should be 0.32 and more. However, Comrey and Lee (1992) indicate that when the load value is 0.32, the variance should be accepted as "weak" since 10% of the variance is explained. They stated that if it is 0.55, it should be evaluated as 'good' and if the load value is 0.45, it should be evaluated as 'average". In addition to this, they also explain that if the factor load value is 0.55, 30% of the variance would be explained. In this study by considering references stated above, factor load values' acceptance level was approved as 0.45. At this point, analyses were renewed as having the number factors as three and the acceptance value of factor load values as 0.45. Results were evaluated in terms of load values and overlapping items and it was observed that there were not any overlapping items; as a result 31 items were omitted from the scale. After omitting 31 items, it was determined in the factor analysis carried out on the remaining 37 items that a) first factor contributed to the variance at the ratio of 16.809%, b) second factor at 12.403% and c) third factor at 11.190%. In conclusion, it was seen that the total contribution of the three factors is 40.402%. This ratio is accepted as sufficient for the multiple-factorial designs (Tavşancıl, 2014). At this point items loaded on each factor were evaluated in terms of content/meaning. Accordingly, these three factors were named as; 1) Dislike, 2) Underestimate, and 3) Self-confidence. The items about this Dislike factor are as 2, 4, 11, 12, 13, 15, 16, 17, 19, 20, 22, 23, 25 and 26; the items about Underestimate are; 3, 6, 7, 8, 9, 28, 30, 33, 35 and 36; and the items about Self-confidence factor are; 1, 5, 10, 14, 18, 21, 24, 27, 29, 31, 32, 34 and 37. Here, while 13 items of the scale are positive, 24 of them are negative. While positive items are as; 1, 5, 10, 14, 18, 21, 24, 27, 29, 31, 32 34 and 37, negative items are as; 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 15, 16, 17, 19, 20, 22, 23, 25, 26, 28, 30, 33, 35 and 3. The results of the factor analysis were demonstrated in Table 3.

Table 3. The Factor Analysis Results of MPPAS

Dislike		**Underestimate**		**Self-confidence**	
Item Number	**Factor Load**	**Item Number**	**Factor Load**	**Item Number**	**Factor Load**
15	.749	09	.678	31	.640
16	.742	08	.673	29	.615
19	.720	30	.650	32	.614
13	.700	35	.642	27	.560
12	.680	28	.627	21	.544
25	.675	36	.622	24	.538
17	.669	06	.606	37	.509
26	.666	33	.581	10	.508
23	.641	03	.539	34	.500
04	.576	07	.496	18	.499
20	.571			01	.494
02	.475			14	.490
11	.472			05	.474
22	.456				
Explained variance: 16.809%		12.403%		11.190%	
Total variance explained =40.402%					

Item-Total Correlations and Discriminations of Items

Item-total correlation values give the validity coefficient of each item. First, they were calculated. Besides, in order to determine the discrimination power of the items in the scale, t-test is used (Balcı, 2009). Groups below 27% and above 27% were determined with this purpose. Independent samples t-test values were calculated by considering both groups' score. Findings obtained from calculations were given in Table 4.

Table 4. The Item Analysis Results of MPPAS

Item Number	Item Total Correlations	t*	Item Number	Item Total Correlations	t*
01	.251	-8.609	20	.540	-19.756
02	.429	-14.766	21	.267	-8.423
03	.325	-10.396	22	.524	-18.649
04	.454	-14.447	23	.561	-19.855
05	.371	-13.101	24	.267	-9.253
06	.416	-13.463	25	.514	-16.435
07	.421	-14.058	26	.505	-16.352
08	.438	-14.587	27	.277	-9.041
09	.439	-14.032	28	.533	-18.072
10	.366	-10.899	29	.451	-15.033
11	.446	-13.962	30	.539	-18.867
12	.525	-19.994	31	.387	-13.556
13	.529	-19.145	32	.420	-14.444
14	.347	-11.539	33	.532	-19.303
15	.529	-17.159	34	.311	-10.209
16	.603	-23.396	35	.531	-18.544
17	.477	-17.665	36	.492	-17.369
18	.396	-13.372	37	.235	-8.043
19	.569	-20.931			

p* < .01

When Table 4 is analyzed, there is a significant difference between upper and lower groups (p< .01). Items in the scale have satisfactory distinctive features according to this significant difference. All these findings were accepted as evidence that the validity regarding the items of the scale is high, they discriminate students in terms of methodological sufficiency and they measure the same structure. In Table 5, the correlations between the factors of MPPAS were given below.

Table 5. The Correlations between the Factor Scores of MPPAS

	Correlations		
Factors	**Dislike**	**Underestimate**	**Self-confidence**
Dislike	1		
Underestimate	.487*	1	
Self-confidence	.311*	.401*	1
MPPAS-Total	.817*	.714*	.703*

p* < .01

Having correlation coefficient between; 0.70-1.00 can be defined as a high level correlation; between 0.70-0.30 as medium; and between 0.30-0.00 as low level correlation (Büyüköztürk, 2012). In this sense, when Table 5 is examined, it is seen that there is a high level correlation between all the sub-factors and total of the scale. If the correlation coefficient between these factors is high (0.60 and over), it is assumed that factors are dependent and they all test the same structure. In this case, it is not true to have an evaluation as factors have a separate sub-scale (Engs, 1996). It is seen that there is mid-level correlation between all the sub-factors. This kind of correlation between sub-factors is an indicator that both three factors are independent structure from each other.

Confirmatory Factor Analysis of MPPAS (MPPAS-CFA)

In order to evaluate the validity of the scale whose 37 items were determined by explanatory factor analysis, confirmatory factor analysis was conducted. The results of this analysis were presented in Table 6.

Table 6. CFA of MPPAS

Indexes	Value	Model-Data Fit
X^2	1698.85	
sd	626	
X^2/sd	2.71	*Perfect Fit* (Kline, 2005; Sümer, 2000)
NFI	0.94	*Sufficient Fit* (Thompson, 2004)
NNFI	0.96	*Perfect Fit* (Sümer, 2000)
CFI	0.96	*Perfect Fit* (Thompson, 2004)
GFI	0.88	*Sufficient Fit* (Aydın, 2009)
AGFI	0.86	*Sufficient Fit* (Aydın, 2009)
RMR	0.09	*Medium Fit* (Kline, 2005)
SRMR	0.05	*Perfect Fit* (Brown, 2006)
RMSEA	0.05	*Perfect Fit* (Raykov & Marcoulides, 2008)
PGFI	0.78	*Plain and Simple* (Sümer, 2000)

As it can be seen from Table 6, it was found as; X^2= 1698.85 and sd=626 according to confirmatory factor analysis. The X^2 results which tested model and data fit show that the data are not fit to model ($p< .01$). Besides that X^2/sd ratio is used while deciding on the model-data fit since X^2 is affected by the sample size. Having this ratio as 3 or smaller than 3 represents perfect fit in big samples (Sümer, 2000). As X^2/sd ratio of the model given in Table 6 is 2.71, model-data fit was accepted as perfect.

It is expressed that having NFI and NNFI values as 0.90 or bigger reflects that model-data fit is good and 0.95 as perfect (Hu & Bentler, 1999; Sümer, 2000). In Table 6, NFI value is seen as 0.94 and it represents a good fit and NNFI value is seen as 0.96 and it represents a perfect fit. It is pointed out that when CFI value is equal to 0.95 or bigger, model-data fit is perfect (Hu & Bentler, 1999; Sümer, 2000). In Table 6, the CFI value is seen as 0.96 and it shows that the model-data fit is perfect.

For AGFI index 0.80 or more is accepted. For GFI fit, it is known that 0.90 and more means modal-data fit is good and 0.85 and more means that it is sufficient (Aydın, 2009). GFI value is 0.88 and AGFI value is 0.86 according to Table 6. In this case, both model-data fit indexes were accepted. RMR and SRMR fit values differ between 0 and 1 (Kline, 2005) and having the RMR and SRMR values equal to or less than 0.05 shows perfect fit (Brown, 2006). According to Table 6, RMR value (0.09) represents a sufficient fit and SRMR value represents a perfect fit (0.05).

In Table 6, it is seen that RMSEA value is smaller than 0.05. If RMSEA index is smaller than 0.05 or 0, it indicates that model-data fit is perfect and there is no difference between sample covariances and universe (Brown, 2006; Sümer, 2000). In this context, it is accepted that model-data fit is perfect for this study. PGFI value is seen as 0.75 according to Table 6. In this sense, it can be said that the model is plain enough and simple because PGFI gives us information about having PGFI value closer to 1 shows that the model is plain and simple and how plain the model is (Sümer, 2000). As a result of the confirmatory factor analysis, the items of the scale are verified.

Internal Consistency of MPPAS

Cronbach Alpha value was calculated to specify the reliability level of the scores obtained from MPPAS. Cronbach Alpha value for the prototype of the scale with 68 items was found as 0.909. After omitting 31 items, the internal consistencies obtained as result of the analysis conducted are displayed in Table 7 below.

Table 7. Internal Consistency of MPPAS

	Cronbach Alpha	**p**
Dislike	.901	p < .05
Underestimate	.853	p < .05
Self-confidence	.813	p < .05
MPPAS-Total	.910	p < .05

According to Table 7, it can be said that since all the internal consistency coefficients are over 0.80, the reliability of the scale is high (Kayış, 2009).

Second Study

Research Model and Study Group

In Second Study which was designed according to relational screening model. This model aims to determine the existence of joint variation between two or more variables (Karasar, 2003). In order to determine the study group, purposeful sampling was preferred. The purposeful sampling is a method which is non-random and probable (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz, & Demirel, 2011). There are also 14 different strategies about purposeful sampling (Patton, 1990). Convenience sampling among these strategies which is the most accessible and provides maximum savings was preferred (Ravid, 1994) in this tudy. In this context, 444 middle school students who are studying in a public school in Kocaeli participated in this study. The distribution of participating students can be seen in Table 8.

Table 8. Study Group of Second Study

	5th Grade	**6th Grade**	**7th Grade**	**8th Grade**	**Total**
Female (F)	69	63	28	56	216 (%48.65)
Male (M)	80	50	52	46	228 (%51.35)
Total	149 (%33.56)	113 (%25.45)	80 (%18.02)	102 (%22.97)	**444**

Data Collection Instruments and Collecting Data

Mathematical Problem-Posing Attitude Scale (MPPAS): Within the scope of the Second Study, first, for the reliability of the scale the Cronbach Alpha value was calculated. Cronbach Alpha value for the overall scale was found as 0.907, for dislike factor as 0.807, for underestimate factor as 0.790 and for self-confidence factor as 0.770. Since internal consistency was found more than 0.70, it is necessary to accept reliability of the scale as sufficient. Later on, confirmatory factor analysis was conducted to test the validity of the scales' factor structure. In this sense, the data obtained from these analyses were presented in Table 9.

Table 9. The Results of CFA of MPPAS (Second Study)

Indexes	**Value**	**Model Data Fit**
N	444	
X^2/sd	2.36	*Perfect Fit* (Tabachnick & Fidell, 2001)
NNFI	0.97	*Perfect Fit* (Thompson, 2004)
CFI	0.97	*Perfect Fit* (Thompson, 2004)
SRMR	0.05	*Good Fit* (Brown, 2006)
RMSEA	0.05	*Good Fit* (Thompson, 2004)

After the analysis, there is a consensus to report X^2/sd (Mulaik et al., 1989) but the same situation is not suitable for other fit indexies. Brown (2006) suggested to report RMSEA, SRMR, CFI and NNFI fit indexes; Garver and Mentzer (1999), RMSEA, CFI and NNFI and Iacobucci (2010), CFI and SRMR. In this sense, X^2/sd, NNFI, CFI, SRMR and RMSEA fit indexes were reported in Table 9 and it was determined that fit indexes are at the desired level.

Mathematical Problem-Solving Attitude Scale (MPSAS): It was developed by Çanakçı and Özdemir (2011), the scale aims to identify middle school students' mathematical problem-solving attitudes. It contains 19 items, which fall under two dimensions: "Enjoyment" (MPSAS-E) and "Teaching" (MPSAS-T). Cronbach Alpha coefficients of internal consistency of the scale are as follows: 0.848 for the entire MPSAS, 0.869 for MPSAS-E, and 0.777 for MPSAS-T.

Cronbach Alpha reliability analyses were made for the entire MPSAS and its sub-dimensions for the present study in the first place. Accordingly, the coefficients of internal consistency were calculated to be 0.867 for the entire MPSAS, 0.896 for MPSAS-E, and 0.712 for MPSAS-T. Then CFA operations were performed for MPSAS. The following results were obtained for MPSAS: X^2/sd=3.21, NNFI=0.95, CFI=0.95, SRMR=0.081, and RMSEA=0.071. The obtained fit indexes were seen to be adequate, and the scale was concluded to be fit for the present study.

Attitude Scale towards Mathematics (ASTM): The scale developed by Önal (2013) aims to determine middle school students' attitudes towards mathematics. The scale consists of 22 items and four factors, which are interest, anxiety, study, and necessity. Cronbach Alpha coefficients of internal consistency of the scale are as follows: 0.90 for the entire scale, and 0.89, 0.74, 0.69, and 0.70 for the factors respectively. CFA confirmed the four-factor construct of the scale.

Cronbach Alpha reliability analyses were made for the entire ASTM and its sub-dimensions for the present study in the first place. Accordingly, the coefficients of internal consistency were calculated to be 0.916 for the scale, and 0.868, 0.819, 0.650, and 0.742 for the sub-dimensions respectively. Then CFA operations were performed for ASTM. The following results were obtained for ASTM: X^2/sd=0.38, NNFI=1.14, CFI=1.00, SRMR=0.064, and RMSEA=0.000. As the obtained fit indexes were seen to be adequate, the scale was concluded to be fit for the present study.

Data Analysis

The data of the second study were obtained in one course hour in the spring semester of the 2016-2017 academic year. A total of 462 data were collected. Prior to the analysis, the obtained data were examined by the researchers one by one. As a result, some data were excluded from the analysis process when one or more of the three scales had not been filled in; uniform answers had been given; the items had been answered by skipping one item at every turn; etc. In this regard, two data from the fifth-grade students, six data from the sixth-grade students, two data from the seventh-grade students, and eight data from the eighth-grade students were not included in the analysis. That is, a total of 18 data were excluded from the analysis. Consequently, it was decided to carry out data analyses over the remaining 444 data (MPPAS, MPSAS, and ASTM). Upon this decision, the data were transferred to the computer environment; the reverse items were graded in accordance with the analyses; and the data were made ready for analysis.

To get an answer to the first research problem, the arithmetic averages of the scores obtained from the scales were calculated. As all the scales consisted of five choices and four equal ranges, "4/5=0.8" evaluation was made, and the evaluation ranges of the averages was determined to be as Very poor (1): 1.00-1.80, Poor (2): 1.81-2.60, Medium (3): 2.61-3.40, High (4): 3.41-4.20, and Very high (5): 4.21-5.00.

To answer the second research problem, deciding on the analysis to be made required determining whether or not the data had a normal distribution. Thus, whether or not the data obtained from the scales and the sub-dimensions of the scales had a normal distribution was examined. As a sample size that is over 50 requires the use of Kolmogorov-Smirnov (K-S) test (Büyüköztürk, Çokluk, &

Köklü, 2010), K-S test was employed in the present study (N=444). If a p-value calculated is over 0.05, it is taken as an indicator of the fact that the scores have a normal distribution (Büyüköztürk, 2012). However, it was determined at the end of the analyses that the data obtained from the scales and the sub-dimensions of the scales did not have a normal distribution. Therefore, it was decided to compare the data by calculating Spearman' rank correlation coefficient.

To have an answer to the third research problem, it was needed to determine whether parametric or non-parametric techniques would be used in data analysis, which required normality analyses. The normality analyses made suggested data analysis through non-parametric techniques. In this sense, the analyses based on the variable of gender employed the Mann-Whitney U (MW-U) test, while the analyses based on grade level applied the Kruskal-Wallis (KW) test. The level of significance was taken as ".05" in the analyses, which were all carried out in SPSS 17.0 package. The effect size in the MW-U test was calculated by the $r = {}^{Z}/_{\sqrt{n}}$ (Field, 2009) formula. When interpreting the effect size, the following cutoffs were taken: r=0.1 low, r=0.3 medium, and r=0.5 high (Cohen, 1988, as cited in Kilmen, 2015). The directions of the results obtained from the KW test were determined through the calculation of the Std. J-T statistical value. If this value is positive, it is concluded that a rise occurs in the dependent variable as the level of variable rises; and vice versa if it is negative (Kilmen, 2015). The analyses results are shown below.

Results

The first sub-problem in the second study was "*What are the middle school students' levels of attitudes towards mathematical problem-posing, towards mathematical problem-solving, and towards mathematics?*" To answer this, the arithmetic averages of the scores obtained from the scales were calculated. The findings are presented below.

Table 10. Scores Obtained from Scales

	N	$\bar{X}$	sd
MPPAS	444	3.810	.659
MPSAS	444	3.732	.771
ASTM	444	3.769	.681

According to the Table 10, the middle school students' attitudes towards problem-posing, solving and mathematics are high level.

The second sub-problem in the second study was "*Are there any relationships between their mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics?*" To answer this, Spearman' rank correlation coefficients were calculated between the scores obtained from the scales. The obtained findings are presented below.

Table 11. Relationships between MPPAS, MPSAS and ASTM

		MPSAS	ASTM
MPPAS	Spearman's rho	.788	.776
	p	.000	.000
	r^2	.621	.602
MPSAS	Spearman's rho		.826
	p		.000
	r^2		.682

According to Table 11, there is a high level significant positive relationship between the middle school students' mathematical problem-posing attitudes and mathematical problem-solving attitudes and attitudes towards mathematics. Given the coefficients of determination, it can be said that 62.1% of the students' mathematical problem-posing attitudes can be explained by their mathematical problem-solving attitudes and 77.6% of it can be explained by their attitudes towards mathematics. Similarly, there is a significant positive relationship between the middle school students' mathematical problem-solving attitudes and attitudes towards mathematics. It is possible to say that 82.6% of the students' mathematical problem-solving attitudes can be explained by their attitudes towards mathematics.

The third sub-problem in the second study was "*Do their mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics vary by gender and grade level?*" The obtained data were evaluated by MW-U and KW tests. The obtained findings are presented below.

Table 12. Scores of MPPAS, MPSAS, ASTM, & Gender

MPPAS	N	Mean Rank	Sum of Ranks	U	Z	p
Female (F)	216	243.34	52561.00	20123.00	-3.331	.001
Male (M)	228	202.76	46229.00			
MPSAS	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**Z**	**p**
Female (F)	216	239.43	51717.50	20966.50	-2.707	.007
Male (M)	228	206.46	470720.50			
ASTM	**N**	**Mean Rank**	**Sum of Ranks**	**U**	**Z**	**p**
Female (F)	216	243.42	52578.50	20105.50	-3.344	.001
Male (M)	228	202.68	46211.50			

According to Table 12, it was seen that there is a significant difference in middle school students' attitudes by their gender. Given the mean ranks, it can be stated that the female students' all attitude scores are higher than the male students' attitude scores. All the effect sizes calculated are low.

Table 13. Scores of MPPAS, MPSAS, ASTM, & Grades

MPPAS	N	Mean Rank	df	X^2	p	Significant Differences
5	149	262.20	3	43.789	.000	5; 7-8 6; 7-8
6	113	246.94				
7	80	169.02				
8	102	179.38				
MPSAS	**N**	**Mean Rank**	**df**	**X^2**	**p**	**Significant Differences**
5	149	260.57	3	44.535	.000	5; 7-8 6; 7-8
6	113	250.12				
7	80	180.49				
8	102	169.24				
ASTM	**N**	**Mean Rank**	**df**	**X^2**	**p**	**Significant Differences**
5	149	267.77	3	49.572	.000	5; 7-8 6; 7-8
6	113	243.72				
7	80	171.14				
8	102	173.14				

According to Table 13, the middle school students' attitudes significantly differ by their grade levels. For all attitude scores, there are significant differences between 5; 7-8 and 6; 7-8. Std. J-T statistical values were also calculated for the values obtained. Negative values were found for all the attitude scores. This being the case, it is possible to state that "*as grade level rises, attitude scores fall*". This is clear in the mean ranks as well.

Discussion, Conclusion and Suggestions

This study was carried out in two stages (First Study and Second Study). In this sense, stages about the studies were presented separately below.

First Study

In accordance with the aim of this study, first of all an item pool was created by considering attitude components (cognitive, affective, and behavioral). The scale was made ready for the pre-test after the necessary adjustments in the scale. The scale was carried out to study group. After pilot/draft form was carried out with the study group, explanatory factor analysis was analyzed to determine the factor structure of the scale. In addition to this, the construct validity confirmatory factor analysis was conducted to test the scale. Then, reliability analysis were calculated. Later on reliability analyses were executed.

It was seen that the scale composed of three factors as a result of the exploratory factor analysis. It was seen that factor loads under dislike items differed between 0.456 and 0.748, for items under underestimate they differed between 0.496 and 0.678 and for the self-confidence; they differed between 0.474 and 0.640. The total variance explained by MPPAS was 40.402%. Item-total correlation values were seen as sufficient. Besides, it was seen that all the items in the scale had sufficient distinctive features at desired level. X^2/sd rate of the scale was 2.71 according to the results of confirmatory factor analyses which was conducted for construct validity of MPPAS consisted of 37 items. This value (2.71) shows that scale fits with the real data. It is seen that the other fit values are also in the accepted limits when Table 6 is analyzed, in this sense, it can be said that MPPAS is a valid and useful model.

Cronbach Alpha value of the whole scale was found as 0.910, and Cronbach Alpha value for the sub-factors of the scale was calculated as 0.901, 0.850 and 0.813, respectively. All the internal consistency coefficients of the scale were found over 0.80. These results show that the reliability of the scale is high. The data of this research were collected from middle school students. Therefore, it can be said that the scale is suitable for these students. Whether this scale is suitable for the upper or lower level students or not should be tested. At this point it can be suggested to develop a similar scale for different levels.

Second Study

The results of the study show that the middle school students have high mathematical problem-posing attitudes, high mathematical problem-solving attitudes, and high attitudes towards mathematics, and that there are high positive relationships between these attitudes. In this regard, it is possible to say that if the students' attitudes towards mathematics are high, their mathematical problem-posing and mathematical problem-solving attitudes are also high. Yücel and Koç (2011) found out that the middle school students have a high level of positive attitude towards mathematics. Özgen, Ay, Kılıç, Özsoy, and Alpay (2017) concluded that the students have high attitudes towards problem-solving. The results of these studies are parallel. In addition, Özgen et al. (2017) stated that these results may have stemmed from the students' belief in the usefulness of problem-solving. This is consistent with the findings of the research reporting that those students who have a high attitude towards mathematics have a higher perception regarding the usefulness of mathematics and can motivate themselves during their studies (Perry, 2011), have a better self-perception in mathematics (Hidalgo, Maroto, & Palacios, 2005), and can learn mathematics more safely (Mcleod, 1992). In this regard, the students' high attitudes towards mathematics, posing problems, and solving problems may be indicating that they believe that problem-solving is useful; they can motivate themselves; they have developed mathematical self-concepts; and they can learn mathematics. It is thought that all these bring along success in mathematics. This is why this study is suggested to cover the variable of success.

Mathematical problem-posing at any level involves more than doing mathematics and understanding mathematical concepts (Pirie, 2002). Silver (1994) states that mathematical problem-posing studies positively influence students' achievement and attitude levels. Given the fact that mathematics is one of the basic courses students encounter during their lives and has a great effect on success in many exams, it can be said that it is very important to develop positive mathematical problem-posing and solving attitudes among students. It is known that the mathematics curriculum implemented in Turkey (MoNE, 2017) contains acquisitions concerning problem-posing studies. This may be indicating the importance attached to problem-posing studies. It is thought that it is important to make efforts to determine attitudes towards this issue by increasing problem-posing studies and what measures could be taken against negative attitudes.

It is thought that taking into consideration students' needs and interests, including learning activities that can enjoy them in mathematics lessons, and making them experience the feeling of achievement may help to develop positive attitudes towards mathematics (Hannula, 2002; Malmivouri, 2006). It is also possible to enrich learning environment by adding problem-posing activities to these activities. Thus, attitudes towards mathematics could be increased in terms of attitudes towards problem-posing. The present study, on the other hand, only explores the students' attitudes towards problem-posing, problem-solving, and mathematics through the survey method. Future studies may investigate the effects of problem-posing and problem-solving studies on students' attitudes towards mathematics, problem-posing, and problem-solving.

Another result of the present study is that the female students have higher mathematical problem-posing attitudes, higher mathematical problem-solving attitudes, and higher attitudes towards mathematics compared to the male students. This result is important. Because it was mentioned that female students consider that they are not capable of mathematics and have a lower attitude than male students (McGraw, Lubienski, & Strutchens, 2006; Pierce, Stacey, & Barkatsas, 2007; Yenilmez & Özabacı, 2003). Çelik and Bindak (2005) and Güzel (2004) also report more positive attitudes towards mathematics among female students compared to male students. Their findings are consistent with the above-mentioned finding of the present study considering another finding of the study that attitudes towards mathematics have positive relationships with mathematical problem-posing attitudes and mathematical problem-solving attitudes. On the other hand, Çanakçı and Özdemir (2008) and Özgen et al. (2017) found no difference between the mathematical problem-solving attitudes of the students by gender. However, the average attitude scores of the female students were a little higher than those of the male students. Several other studies have also shown that there is no significant difference in attitudes towards problem-solving by gender (Effandi & Normah, 2009; Mohd & Mahmood, 2011). Some other studies also report no significant relationship between students' attitudes towards mathematics and gender (Mata, Monteiro, & Peixoto, 2012; Taşdemir, 2008; Yücel & Koç, 2011). This finding of the study supports some research findings (Çelik & Bindak, 2005; Güzel, 2004), but is inconsistent with some others (Çanakçı & Özdemir, 2011; Mata et al., 2012; Taşdemir, 2008; Yücel & Koç, 2011). Therefore, new research is needed to reveal the relationship between mathematical problem-posing and solving attitudes and gender. It can be stated that the components of attitude do not have the same effect by gender in the present study. The mathematics course has a significant weight in most success determination examinations and confronts all students regardless of gender. Considering that positive attitudes bring along success, it is important for all students to develop a positive attitude. In this sense, it is recommended to conduct new studies exploring the reasons for high attitudes among the female students. Based on the findings of such studies, the efforts that may be made to change the male students' attitudes positively may be organized.

Lastly, it was determined that as grade level rises, the middle school students' mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics fall. This supports the finding that there is a negative increase in attitude towards mathematics and mathematical problem-solving attitude as grade level rises (Çanakçı & Özdemir, 2011; Furner & Berman, 2003; Özgen et al., 2017; Taşdemir, 2008). This may be because as grade level rises, mathematical subjects get more and more difficult and abstract. For that reason, it is recommended that teachers concretize the subjects in their classes as much as they can. It is thought that they can concretize them by supporting their classes with materials. Mathematics groups in schools may decide on the materials to be used and prepare the needed materials through collaborative work. Further, experts in the faculties of education in Turkey may be consulted with regard to the concretization of subjects and the preparation of materials. The internet may also be of great use.

Özgen et al. (2017) detected a significant relationship between perceived use of mathematics in daily life and attitude towards problem-solving. They determined that increased perception of use of mathematics in daily life improves the attitude as well. In this regard, teachers are recommended to teach their classes by associating subjects with daily life in order to raise the level of attitude, which falls as grade rises. This may improve students' attitudes. However, teachers should note that students studying in big cities and students studying in villages or districts may experience different dynamics in daily life. There may even be differences between the experiences of students studying in different big cities. For example, crossing the Bosporus on a boat may not be meaningful to a student studying in Ankara. For that reason, teachers should know their environment well, observe daily life dynamics well, and organize their classes within this framework. All in all, it can be said that middle school students participating in this study;

1. The middle school students have high mathematical problem-posing attitudes, high mathematical problem-solving attitudes, and high attitudes towards mathematics.
2. Their mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics are interrelated. Such relationships are positive and high-level.
3. The female students have higher mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics compared to the male students.
4. As grade level rises, the middle school students' mathematical problem-posing attitudes, mathematical problem-solving attitudes, and attitudes towards mathematics fall.

This study is limited to students in a public school in the Kocaeli province. Thus, larger-scale studies are recommended. Attitudes towards problem-posing, problem-solving, and mathematics may be investigated among students from various regions. Moreover, research may be conducted to investigate how the integration of daily life dynamics in such regions with mathematics may change attitudes towards mathematics, problem-posing, and problem-solving.

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Appendix 1. Mathematical Problem-Posing Attitude Scale (MPPAS)

Dear students,

Please note that problem expressions in sentences in this scale are used for mathematical problems. Your answers are not going to affect your lecture notes in no way. After reading each item, mark the most appropriate one (X).

Thank you for your interest and cooperation.

		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	If I study harder, I am able to be more successful in problem-posing.					
2	I am unsuccessful in math topics that are difficult to pose problems.					
3	It is not important whether you understand math or not if you pose a problem.					
4	The math topics which take a long time to pose a problem make me bored.					
5	If I strive, I am able to pose a problem that is related to all the math topics.					
6	It is not important to have a solution to the problem.					
7	Posing problems is not helpful in solving problems.					
8	It is not important to know mathematical concepts to pose problems.					
9	It is not important to know mathematical operations to pose problems.					
10	If I learn the problem-solving, I am also able to pose a problem.					
11	I think that I will not be able to pose problems related to math topics which take a long time to pose a problem.					
12	I don't like posing problems.					
13	I don't relish posing problems related to difficult topics in math.					
14	When I pose a problem related to a math topic, I feel good.					
15	I don't like to pose a problem especially related to difficult math topics.					
16	Most of the math topics are unnerving, so I don't want to pose problems.					
17	In out of school, I don't like to think about posing problems related to math topics.					
18	I am able to pose problems related to every math topic when the enough time is given.					
19	Problem-posing is boring.					
20	Problem-posing is teacher's work.					
21	Posing a problem related to a math topic causes me to feel like being able to do the math.					
22	I think that I never know the math when I'm posing problems.					
23	Because math is a hard lecture, problem-posing is also hard.					
24	To posing problems, it is necessary to think creatively.					
25	Thinking about posing problems make me tired.					
26	Posing a problem related to a math topic is a tiring task.					
27	First, I need to think about what I know to pose problems.					
28	It doesn't matter what the expressions/concepts in the posed problem mean.					
29	When I understand a math topic literally, I am able to pose a problem related to this topic.					
30	I don't think about whether the problems that I posed are true.					
31	When I pose problems, I learn math topics better.					
32	Posing problems makes learning math easier.					
33	When posing problems, I don't pay attention using mathematical language.					
34	I like the fact that the problems that I posed are original.					
35	I don't check whether the problems that I posed can be solved.					
36	Before posing problems, I don't consider which mathematical operations I will use.					
37	The students who are successful in math are able to pose problems.					