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An investigation, based on some variables, into the attitudes of middle school students towards mathematics and metacognitive skills

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Abstract. The aim of this study is to analyze the effects of gender and the education level of parents on students' attitudes towards mathematics and metacognitive skills. The second aim of the study is to analyze the relationship between previous mathematics grades with attitudes towards mathematics and metacognition skills. This research is a survey model within quantitative descriptive studies. The research was carried out in a middle school which is selected as a convenient sampling methodology in the Melikgazi district of Kayseri, Turkey during the fall semester of 2018-2019 academic year. The sample of the study was with a total of 122 students from different grades in middle school — 29 fifth graders, 31 sixth graders, 32 seventh graders, and 30 eighth graders. Metacognition Scale, Attitude Scale, and Demographics Scale were administered to students for collecting data. Independent samples t-test, one-way analysis of variance (ANOVA), and Pearson correlation analysis were run. In the analysis, there was no statistically significant mean difference between attitude towards mathematics and metacognitive skill scores of girls and boys. There was no statistically significant mean difference between attitudes towards mathematics and metacognitive skills of middle school students in terms of their parents' education level. In this study, a moderately positive relationship was found between the students' previous year-end mathematics scores and their attitude towards mathematics and metacognitive skill total score. Moreover, a moderate positive relationship was found between attitude towards mathematics scores and metacognition skill total scores. Mathematics activities for developing metacognition skills are suggested in the classrooms.

Keywords: Attitude towards mathematics, metacognitive skills, middle school students, gender, parents' education level, mathematics achievement scores

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INTRODUCTION

Students assign some meaning to the events that occur around them. In the following process, these meanings are turned into students' experiences (Ozturk, 2014; Unlu, 2015). As a result of these experiences, students' perspectives on their own beliefs and events are shaped. These perspectives are called attitudes (Yenilmez and Ozabacı, 2003). The concept of attitude is described in psychology as "susceptibility to reacting in a liked or unpleasant object"(Ural, 2007). According to Phillips (1973), the definition of attitude exists in the minds of individuals and explains it as directing their thoughts, movements, behavior, and emotions. From this perspective, emotion is very important in the attitude of people (Ruffell, Mason and Allen, 1998). The emotions of the students as a result of their learning experiences may cause them to develop positive or negative attitudes towards the lessons (Akdemir, 2006). In this context, the positive attitudes of students towards mathematics will give them the advantage to succeed in mathematics course by directing their thoughts and behaviors (Ma and Kishor, 1997).

Mathematics is basically at the core and center of life (MoNE, 2018). However, students think that mathematics seems to be extremely complex and frightening (Nazlicicek and Erktin, 2002). The reason for this situation may be that the students cannot fully understand what mathematics is and what it is used for. In this context, a good mathematics teacher and a student studying mathematics should start with this awareness and see mathematics as a

problem solver rather than as a complex problem and process (Baki, 2002). Zan and di Martino (2007) defined attitudes towards mathematics as students' beliefs, feelings and behaviors positively or negatively against mathematics. It is necessary to eliminate the negative feelings and attitudes of students towards mathematics (Kaya and Firat, 2011). These negative attitudes of the students will decrease their interest in the course and affect their achievement levels (Bursalioglu, 2010; Ozturk, 2014). It is seen that students' attitudes towards mathematics are important in mathematics learning in researches on learning mathematics (Dogan and Baris, 2010; Johnson, 2000; Katranci, 2009). In addition, students' attitudes towards mathematics are thought to be related to their ability to direct their own learning processes.

Metacognition is the awareness of one's own learning process. Flavell (1987) defined metacognition as the set of processes that individuals perform to monitor, control and regulate their own cognitive processes. Marzano, Brandt, Hughes, Jones, Rankin, and Suhor (1995) defined metacognition as the individuals' recognizing and controlling their own learning processes. All at once, metacognition is the expression of students' thoughts in any situation they encounter, associating the concepts they have learned with each other, organizing their own learning processes and evaluating their individual development (Chen, Gualberto, and Tameta, 2009). It occurs as a result of the interaction of the students with their own knowledge, experience, learning, life, and methods (Baykara, 2011). Students' recognition of what they know or not, taking control of their own cognitive and learning processes and taking responsibility, evaluating their learning, planning, monitoring and using their knowledge in problem situations express their metacognitive skills. Students who learn to learn by themselves can create and maintain a successful learning environment (Atay, 2014; Young and Fry, 2008). Through using their cognitive skills, students develop their cognitive knowledge and regulation skills by being aware of controlling, planning and organizing their learning strategies and reach a higher level than students who do not use their cognitive skills (Young and Fry, 2008).

In addition to addition, subtraction, multiplication and division skills in mathematics teaching, developing new ideas, critical and reflective thinking, reasoning skills, problem-solving skills are important nowadays (MoNE 2018; Baki, 2006; van de Walle, Karp, Bay-Williams, 2014). In order to develop these skills, it is important that students should have positive attitudes towards mathematics from their affective skills (Nazlıcicek and Erktin, 2006). Metacognition is divided into two: metacognitive skills and metacognitive knowledge. Metacognitive skills and metacognitive knowledge play a mediating and decisive role in mathematics achievement (Caglikose, 2019; Karamanoglu and Deniz, 2017). Therefore, it is possible to raise conscious levels of students, which is one of the aims of teaching activities, by being aware of the abilities of the students (Gurefe, 2015, Sevgi and Caglıkose, 2019). In order to ensure permanent and ambitious learning, students' metacognitive skills should be taken into consideration in the process of applying what they have learned to daily life (Yildiz, Akpinar, Tatar and Ergin, 2009). Bagceci, Dos and Sarica (2011) found a positive relationship between metacognitive awareness and seventh-grade students' final exam scores and year-end achievement scores. Gurefe (2015) found that cognitive awareness levels of the sixth, seventh and eighth-grade students attending middle school were moderately predictive of their mathematics achievement. Memis and Arican (2013) found that the mathematical metacognitive levels of fifth-grade female students were higher than male students. They also indicated that metacognitive knowledge and skills had important effects on mathematics achievement. Therefore, in order to increase the academic achievement of the students, it is necessary to develop their metacognitive skills.

Sarpkaya, Arik and Kaplan (2011) examined metacognition awareness and attitudes towards mathematics in pre-service elementary mathematics teachers in terms of perceptions of academic achievement, parental education status, gender, type of high school graduated and family income level variables. The attitude of pre-service teachers towards mathematics and their metacognition awareness was found to be related to their perceptions of academic achievement, but they did not find a significant difference between the other variables. Atay (2014) determined metacognitive awareness levels of secondary school students towards

science learning and found statistically significant mean differences in gender, grade level, socioeconomic level, and parental education level. He found a positive relationship between academic achievement and metacognitive awareness of learning science. Kaya and Firat (2011) found a significant difference in metacognitive skill levels of fifth and sixth-grade students in primary school, grade level, gender, parents' education level, and academic achievement. On the other hand, Karamanoglu and Deniz (2017) found a positive weak correlation between the metacognitive skills and mathematics achievement of the seventh-grade students. They examined mathematics self-efficacy and mathematics achievement in terms of gender as well as metacognitive skills. In the literature, metacognitive skills and attitudes towards the mathematics of middle-school students were not examined together. Bas and Ozturan Sagirli (2017) indicated in their meta-analysis study that metacognition studies in Turkey have generally been at the university level and descriptive. For this reason, it is important to examine the variables of gender, parental education level, mathematics achievement scores that affect middle school students' attitudes towards mathematics and their metacognitive skills (Bas and Ozturan Sagirli, 2017).

The present study was conducted to investigate whether middle school students' attitudes towards mathematics and their metacognitive skills differ with respect to variables gender, end-of-year mathematics scores, and parents' education levels. In addition, an attempt was made to determine the relationship between attitudes towards mathematics and metacognitive skills. For this purpose, the research questions were:

1. Do attitudes and metacognitive skills of middle school students towards mathematics have a statistically significant difference according to gender?
2. Do middle school students' metacognitive skills and attitudes towards mathematics have a statistically significant mean difference according to the level of the mothers' education?
3. Do middle school students' metacognitive skills and attitudes towards mathematics have a statistically significant mean difference according to the fathers' education level?
4. What is the relationship between middle school students' 2017-2018 year-end mathematics achievement scores and attitudes towards mathematics and their metacognitive skills?
5. What is the relationship between middle school students' attitudes towards mathematics and their metacognitive skills?

METHODS

Research Model

In the research, the comparison type of the relational survey model, one of the quantitative research methods, was used. The relational survey model is defined as "a research model that aims to determine the presence and/or degree of change together between two and more variables" (Karasar, 2018, p. 114). The independent variables for the inferential analysis of this study were gender, mother and father education levels, and dependent variables were students' attitudes towards mathematics and their metacognitive skills. The variables used in the correlation analysis are the attitude towards mathematics, metacognitive skills, and mathematics achievement grades.

Sample of the Study

The population of the study consists of middle school students studying in a middle school in Melikgazi district of Kayseri, Turkey in the fall semester of the 2018-2019 academic year. There are village middle schools (urban schools) in the central district of Melikgazi. Study was conducted the study in a village middle school in the central district. Since there is no middle school in the village, the sample consists of one middle school. The participants in the study were selected by convenient sampling method because they were easily accessible by the researchers. Since all the students in Melikgazi district were not accessible, the school where the researcher was working was taken as the sample for the study. The study was conducted with

122 students (57 females, 65 males) attending middle school; 29 students from 5th grade, 31 students from 6th grade, 32 students from 7th grade and 30 students from 8th grade.

Instruments

In this study, the mathematics attitude scale of Nazlicicek and Erktin (2002), the meta-cognitive scale of Yıldız et al. (2009) and demographics which were added by the researchers were used as data collection tools. Nazlicicek and Erktin had designed the scale in a short format to be easy to administer to and filled in by middle school students. Since two scales were used in the research, it is short and designed for middle school students. All items in the scale are 5-point Likert type and the options are "Never (1), Rarely (2), Sometimes (3), Frequently (4)" and "Always (5)". Cronbach Alpha reliability coefficient of the Mathematics Attitude Scale developed by Nazlıcicek and Erktin (2002) was calculated as $\alpha = 0.841$. Cronbach's alpha reliability coefficient of this study was found to be $\alpha = 0.823$. There is a total of 20 items reporting 12 positive and 8 negative statements. The negative items were items 2, 5, 6, 9, 11, 12, 15, 17, and the scoring was reversed. The lowest score that can be obtained from the mathematics attitude scale was 20 (1x20) and the highest score was 100 (5x20). Students received scores ranging from a minimum of 55 to 100 points in the mathematics attitude scale. The average mathematics attitude of the students was 84.55 out of 100.

The metacognition scale is available to a researcher or a teacher who wants to measure the metacognitive awareness and skills of the middle school students in the classroom (Yıldız, et al., 2009). There were 30 positive items in the Likert type in total. The options are "None (1), Sometimes (2), Frequently (3)" and "Always (4)". The reliability coefficient of the scale developed by Yıldız et al. (2009) was found as $\alpha = 0.96$. Cronbach Alpha reliability coefficient of this study was as $\alpha = 0.835$. The lowest score on the Metacognition Scale was 30 (1x30) and the highest score was 120 (4x30). Students received scores ranging from a minimum of 54 to a maximum of 120 points on the Metacognitive Scale. The average of middle school students' metacognition skills was 93.54 out of 120.

Descriptive statistics of mathematics attitude and metacognitive scale are given in Table 1. Since skewness and kurtosis values are between +1 and -1, the total scores of mathematics attitude and metacognition skills show normal distribution.

Table 1. *Descriptive statistics of the sum of the items in mathematics attitude and metacognition scale*

	Mathematics Attitude	**Metacognition Scale**
Median	86	93
Mode	86	93
Standard Deviation	9.57	14.63
Skewness	-.738	-.127
Kurtosis	.386	-.365
Range	45	66

The theoretical framework of the Mathematics Attitude Scale was determined as four factors (Nazlicicek, Erktin, 2002). In order to determine whether the 4-factor theoretical framework of the mathematics attitude scale was the same for this sample, the principal factor extraction method was applied by using exploratory factor analysis using varimax rotation and with limitation of eigenvalues greater than one. Rotated factor loadings, items related to these factors, mean and standard deviation values are given in Table 2. Nazlicicek and Erktin (2002) named the four-factor structure given in the theoretical framework as "perceived mathematics achievement level", "perceived achievement level", "interest in mathematics" and "pleasure from mathematics". In the exploratory factor analysis conducted in the sample of the study, the items were not loaded on the factors as defined in the theoretical framework. For this reason, the factors were named according to the content of the items while adhering to the theoretical framework. The factors in the mathematics attitude scale consist of a four-factor structure: mathematics achievement level, interest in mathematics, benefits of mathematics and mathematics foresight. Since the four-factor structure did not fit the theoretical framework and

confirmatory factor analyses could not be performed, the average scores of the items were analyzed instead of the factor scores.

Table 2. *The Mathematic Attitude Scale's rotated factor loadings, means, and SD*

Items	Mean	SD	Factors			
			Mathematics achievement level	Interest in mathematics	Benefits of mathematics	Mathematics foresight
Attitude_7	3.8	1.08	.800			
Attitude_3	3.75	1.09	.792			
Attitude_13	3.93	1.12	.776			
Attitude_6	3.95	.99	.543			
Attitude_4	2.02	1.45	.491			
Attitude_12	4.66	.81		.727		
Attitude_9	4.47	1.1		.688		
Attitude_1	4.52	.77		.636		
Attitude_2	4.34	.82		.603		
Attitude_17	4.51	.81		.598		
Attitude_15	4.28	1.33		.502		
Attitude_8	4.08	1.26		.495		
Attitude_19	4.83	.54			.640	
Attitude_16	4.23	1.23			.630	
Attitude_5	4.74	.59			.589	
Attitude_11	4.67	.83			.528	
Attitude_10	4.65	.91			.462	
Attitude_20	4.91	.32				.611
Attitude_14	3.88	1.24				.596
Attitude_18	4.33	.94				.379
Total			3.310	3.150	1.984	1.409
% of Variance			16.548	15.750	9.921	7.045
Cumulative %			16.548	32.298	42.219	49.263

The scree plot of the items of the Mathematics Attitude Scale is given in Figure 1. When Figure 1 is examined according to the eigenvalues of the items, it was decided that the number of factors is four since the contribution of the factors after the fourth point to the variance is smaller than one and the eigenvalue of factor four approaches to one (Cokluk, Sekercioglu and Buyukozturk, 2010, p. 171). When the total variance explained in Table 2 in the Mathematics Attitude Scale were examined, it was seen that the first factor explained 16.548%, the second factor explained 15.75%, the third factor explained 9.921%, and the fourth factor explained 7.045% of the total variance. Accordingly, the cumulative variance explained by the eigenvalues

constitutes is 49.263% of the total variance. Since the total variance explained is approximately 50%, it is sufficient to decide the number of factors (Buyukozturk, 2002).

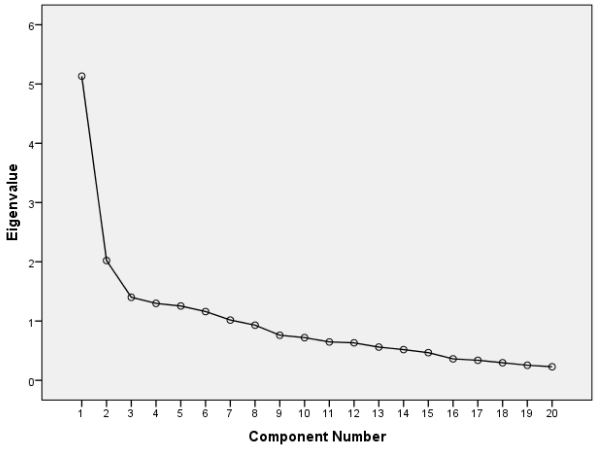

FIGURE 1. *Scree Plot of items in the mathematics attitude scale*

Table 3. *Metacognition Scale's rotated factor loadings, means, and SD*

Items	Mean	SD	Factors					
			Descriptive knowledge	Self-monitoring	Planning	Cognitive pathways	Methodological knowledge	Self-control
Metacognition_18	3.30	.84	.710					
Metacognition_10	3.20	.86	.568					
Metacognition_8	3.11	.92	.552					
Metacognition_11	3.20	.88	.547					
Metacognition_21	3.25	.90	.505					
Metacognition_9	2.89	1	.414					
Metacognition_15	2.54	.95		.727				
Metacognition_14	2.79	.93		.725				
Metacognition_13	2.85	.93		.532				
Metacognition_28	2.75	1.02		.498				
Metacognition_27	2.97	.94		.464				
Metacognition_6	3.34	.79			.647			
Metacognition_12	3.30	.85			.647			
Metacognition_19	2.76	1.04			.634			
Metacognition_5	3.56	.73			.555			
Metacognition_23	3.06	.93			.398			
Metacognition_30	3.12	.86				.608		
Metacognition_2	3.45	.75				.606		
Metacognition_26	3.25	1.93				.565		
Metacognition_1	3.33	.80				.474		
Metacognition_29	2.71	.99				.450		
Metacognition_25	2.95	.90				.449		
Metacognition_16	3.48	.85					.696	
Metacognition_4	3.20	.91					.526	
Metacognition_20	2.84	.92					.487	
Metacognition_22	3.36	2.83					.453	
Metacognition_17	3.04	.90					.451	
Metacognition_3	3.20	.86						.576
Metacognition_24	3.63	2.80						.530
Metacognition_7	3.11	.91						.483
Total			3.173	2.872	2.797	2.767	2.434	1.805
% of Variance			10.578	9.573	9.322	9.223	8.114	6.015
Cumulative %			10.578	20.151	29.473	38.696	46.809	52.825

Factor structures proposed in the theoretical framework were subject to change in different samples. Whether the theoretical framework could be applied to the sample was decided by exploratory factor analysis. Exploratory factor analysis was performed on the items forming the metacognitive scale and the principal factor extraction method was applied with varimax rotation and eigenvalue restriction being greater than one. Yildiz et al. (2009) proposed a nine-factor structure: exploratory information, methodological information, conditional information, cognitive information, cognitive strategies, self-monitoring, self-control, and self-assessment. The nine-factor structure does not fit in this sample according to exploratory factor analysis results. Rotated factor loads, items related to these factors, means, and standard deviations were given in Table 3. According to the factor structure given in Table 3, the metacognition scale of Yıldız et al. (2009) had been renamed in accordance with the theoretical framework. Factor names consist of a six-factor structure: descriptive knowledge, methodological knowledge, cognitive pathways, self-control, self-monitoring, and planning. Therefore, the theoretical framework proposed by Yildiz et al. (2009) could not be used. Since confirmatory factor analysis could not be performed based on the results of exploratory factor analysis, the analyzes were made by taking the average of the scores on the metacognitive scale.

The scree plot of the metacognition items is given in Figure 2. When Figure 2 was analyzed according to the eigenvalues of the items, since the contribution of variance after the sixth point is small and the eigenvalue component converges to 1, it was decided that the number of factors should be six (Cokluk, et al. 2010, p. 171).

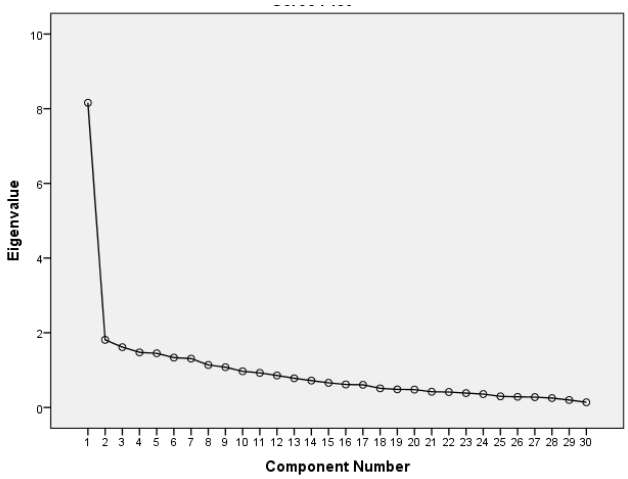

FIGURE 2. *Scree plot of items in metacognition scale*

When the total variance ratios explained for the six factors in the metacognitive scale given in Table 3 were analyzed, the first factor was 10.578% of the total variance, the second factor was 9.573%, the third factor was 9.332%, the fourth factor was 9.223%, the fifth factor was 8.111%. and the sixth factor explained by 6.015%. Accordingly, the cumulative variance explained by the eigenvalues constitutes 52.825% of the total variance. Since the total variance explained is approximately 50%, it was enough in deciding the number of factors (Buyukozturk, 2002).

Data Collection

Within the scope of the research, the content and importance of the research were explained to the students and their participation in the research was ensured. The students were informed that no personal identification information was required and that the data would not be shared with anyone. Mathematics Attitude Scale and Metacognitive Scale and personal information form were administered to the students by the first researcher in the course of mathematics for one hour. The mathematics achievement scores of the students a year ago were taken from the student report cards via e-school.

Data Analysis

The SPSS 21 package program was used to analyze the attitudes towards mathematics, metacognition skills, and personal information in the form of gender, parent education level and e-school system. First, attitudes towards mathematics and metacognition scores were obtained, and descriptive statistics were examined. As the descriptives showed normal distribution (Table 1), the variables of gender and attitude towards mathematics and metacognition were analyzed with independent groups t-test, and the variables of attitude towards mathematics and metacognition skills according to mothers' and fathers' education level were analyzed by one-way analysis of variance (ANOVA). When there was a significant difference between the groups, the Bonferonni Post Hoc test was used to determine which two groups the difference was between. The relationship between mathematics achievement score in the previous year, attitudes towards mathematics, and metacognition skills were examined by Pearson correlation analysis. The level of statistical significance was found to be 0.05 ($p < 0.05$).

RESULTS

In line with the aim of this study, the findings obtained from the analysis of whether the attitudes towards mathematics and metacognition skills variables differ in gender, parental education level and the relationship between previous year-end mathematics grade and attitudes towards mathematics and metacognition skills were included.

Gender Differences in Attitude Towards Mathematics and Metacognitive Skills

Whether the attitudes of middle school students towards mathematics and their metacognitive skills differed in terms of gender were analyzed. Descriptive statistics of the total scores obtained from the mathematics attitude scale and metacognitive scale of middle school students according to gender are given in Table 4.

Table 4. *Descriptive statistics of mathematics attitude scale and metacognitive scale*

	Gender	$\bar{X}$	SD
The total score of the mathematics attitude scale	Girl	85.54	9.68
	Boy	83.68	9.46
Total score of metacognition scale	Girl	94.49	15.34
	Boy	92.70	14.03

In order to analyze whether there is a statistically significant difference between the mean of the attitudes of female and male students towards mathematics and their metacognitive skills, an independent group t-test was applied to the total scores obtained from the mathematics attitude scale and the metacognitive scale. According to the results of the analysis, it was found that there was no statistically significant mean difference between [$t(120) = 1.075$, $p = 0.284$] and metacognition skill total scores [$t(120) = 0.67$, $p = 0.504$]. When Table 4 is examined, although the mean of the attitude of female students towards mathematics is slightly higher than male students, this does not make a statistically meaningful difference. Although the mean of the metacognitive skills of female students is slightly higher than male students, this does not make a statistical meaning.

Metacognitive Skills and Attitudes towards Mathematics According to the Mother's Education Level

It was investigated whether the metacognitive skills and attitudes towards the mathematics of middle school students vary according to their mothers' education levels. Table 5 interprets the mean and standard deviations of the metacognitive skills scores and attitudes towards the mathematics of middle school students according to their mothers' education levels.

Table 5. *Mean and SDs of metacognition skills and attitude towards mathematics according to the mother's education level*

Mother's Education Level	n	Metacognition Scale $\bar{X}$	Metacognition Scale SD	Mathematics Attitude Scale $\bar{X}$	Mathematics Attitude Scale SD
Elementary	70	91.91	14.32	83.80	9.40
Middle School	30	93.73	16.24	85.60	9.55
High School	22	98.45	12.67	85.50	10.35

When Table 5 was analyzed, the mean of metacognition of the middle school students whose mothers were elementary school graduates was the least; those students whose mothers were high school graduates were the highest. In addition, the mean attitude towards mathematics of the middle school students whose mother graduated from elementary school was the least; middle school graduates were the highest. One-way analysis of variance (ANOVA) was conducted to determine whether the metacognitive skills and attitudes towards mathematics of middle school students showed a significant mean difference in their mother's education levels and the results are given in Table 6.

Table 6. *Metacognitive skills and attitudes towards mathematics according to the mother's education level*

Source of Variance	Metacognition Scale			Mathematics Attitude Scale		
	Sum of Squares	Mean Square	Effect Size	Sum of Squares	Mean Square	Effect Size
Between Groups	717.49	358.74	0.028	92.31	46.15	0.008
Within groups	25166.81	211.49		10997.90	92.42	
Total	25884.30			11090.21		

There was no statistically significant difference between the metacognitive skill [F (2,119) = 1.696, p = 0.188] and the attitudes towards mathematics [F (2,119) = 0.499, p = 0.608] according to the mother's education levels. It can be said that the metacognitive skills and attitudes towards the mathematics of middle school students do not differ according to the mother's education level.

Metacognitive Skills and Attitudes towards Mathematics According to the Father's Education Level

Metacognitive skills and attitudes towards the mathematics of middle school students according to their father's education levels were analyzed. The mean and standard deviations of the metacognitive skills scores and attitudes towards mathematics of the middle school students according to the father's education level are given in Table 7.

Table 7. *Mean and SDs of metacognition skills and attitude towards mathematics according to the father's education level*

Father's Education Level	n	Metacognition Scale $\bar{X}$	Metacognition Scale SD	Mathematics Attitude Scale $\bar{X}$	Mathematics Attitude Scale SD
Elementary	40	91.78	14.86	85.45	9.71
Middle School	43	91.79	14.95	82.23	10.21
High School	39	97.28	13.65	86.18	8.38

When Table 7 was analyzed, the mean of metacognition of the middle school students whose fathers were elementary school graduates was the least; high school graduates were the highest. In addition, the mean attitude toward mathematics of the middle school students whose father was a middle school graduate was the least; high school graduates were the highest.

In order to determine whether there is a significant mean difference between middle school students' father's education levels and their metacognitive skills and attitudes towards mathematics, ANOVA was conducted, and the results are given in Table 8.

Table 8. *Metacognitive skills and attitudes towards mathematics according to the father's education level*

Source of Variance	Metacognition Scale			Mathematics Attitude Scale		
	Sum of Squares	Mean Square	Effect Size	Sum of Squares	Mean Square	Effect Size
Between Groups	802.31	401.15	0.031	366.89	183.44	0.033
Within groups	25081.99	210.77		10723.32	90.11	
Total	25884.30			11090.21		

There is no statistically significant mean difference between middle school students' level of metacognition skills [F (2,119) = 1.903, p = 0.154] and attitudes towards mathematics [F (2,119) = 2.036, p = 0.135]. It can be said that the metacognitive skills score and attitudes towards the mathematics of middle school students do not differ according to the father's education level.

Relationship between Attitude Towards Mathematics, Metacognitive Skills, and Mathematics Achievement Grades

The relationship between middle school students' previous year-end mathematics scores and their attitudes towards mathematics and their metacognitive skills were analyzed. Descriptive statistics of the mathematics scores of the middle school students are given in Table 9.

***Table* 9.** D*escriptives of mathematics achievement grades*

Descriptives	Mathematics Achievement Grades
Mean	67.44
Median	74.5
Mode	90
SD	22.307
Skewness	-.459
Kurtosis	-.995
Range	81

Mathematical achievement scores in Table 9 show normal distribution since skewness and kurtosis values are between +1 and -1 (Tabachnick and Fidell, 2015).

The Pearson correlation test was used to determine the relationship between the mathematics scores of the students at the end of the previous year and their attitude towards mathematics. Therefore, we can say that there is a significant relationship between mathematics scores and mathematics attitude total scores. Buyukozturk (2006) explained that there was a high correlation between the absolute value of the correlation value between 0.70–1, moderate when between 0.70–0.30, and a low relationship between 0.30–0. According to the results of the analysis, there is a moderate positive relationship between the mathematics achievement score of the students at the end of the previous year and the total score of attitude towards mathematics (r =.679). The relationship between scores obtained from the factors constituting the attitude toward the mathematics scale of the middle school students and the end-year mathematics scores were also analyzed. Accordingly, there was a moderate relationship between the mathematics achievement level (r =.691), interest in a mathematics course (r =.475) and the benefits of mathematics (r =.392). There was a low positive correlation with mathematics foresight (r =.158). The relationship between the factors obtained from the metacognitive scale and the mathematics achievement scores of the previous year were also

examined: for the end of the previous year with middle school students' mathematics scores and planning (r =.470), methodological information (r =.333), self-monitoring (r =.311), explanatory information (r =.382) and self-control (r =.306), and cognitive pathways (r =.214).

The Pearson correlation analysis was used to investigate whether there was a relationship between the mathematics scores of the students at the end of the previous year and the total metacognition scores of the middle school students. According to the results (p = 0.00), there is a significant relationship between the previous year-end mathematics achievement scores and the total metacognition scores. A moderate positive correlation was found between the mathematics score and the metacognition score (r =.470).

The Relationship Between Attitude Towards Mathematics and Metacognitive Skill Scores

The Pearson correlation analysis was used to investigate whether there is a relationship between middle school students' attitudes towards mathematics and metacognition skill scores. There was a significant relationship between attitudes towards mathematics and metacognition scores (p = 0.00). There was a moderate (r =.605) positive relationship between attitudes towards mathematics and metacognition skills scores.

DISCUSSION AND CONCLUSION

In this study, an analysis was given of whether the attitudes towards mathematics and metacognitive skills of middle school students differed according to gender, mathematics scores obtained in the previous year, and their parents' education levels. In addition, the relationship between attitudes towards mathematics and metacognitive skills was determined in the study. Students' positive attitude towards mathematics influences the success of students in mathematics (Nazlicicek and Erktin, 2002). In this study, the attitudes of female and male students towards mathematics were investigated. There is no statistically significant mean difference between female and male students' attitudes towards mathematics. When the results obtained from the mathematics attitude scale of female and male students were compared, it was found that the average attitude of female students towards mathematics was 85.54 and the average attitude of male students towards mathematics was 83.68. Although the mean attitude of female students towards mathematics is slightly higher than male students, this situation does not constitute a statistical meaning. Previous studies indicated that no statistically significant difference was found between attitudes towards mathematics and gender in many studies (Akdemir, 2006; Celik and Bindak, 2005; Ozkan, 2006; Ozturk, 2014; Ozyigit, 2004; Yucel and Koc, 2011).

In this study, the metacognitive skills of female and male middle school students were investigated. There was no statistically significant mean difference between the metacognitive skills scores of female and male middle school students. When the results obtained from the metacognitive skill scale of female and male students were compared, the mean of female middle school students was 94.49; the mean of male middle school students was found to be 92.7. Although the mean of the metacognitive skills of female middle school students is slightly higher than male middle school students, this situation does not make a statistical meaning. On the other hand, there was a statistically significant difference between the mean scores of the metacognitive skills of female girl and male middle school students in favor of female students (Gurefe, 2015; Memis and Arican, 2013).

There was no statistically significant mean difference between the education levels of the mother and father in terms of the mean of the metacognition skills scores of the students. The mean of the metacognition of the students whose mothers and/or fathers are primary school graduates is at the least; high school graduates are at the highest. These results are consistent with the results of Gurefe's (2015) research. Kaya and Firat (2011) concluded that the higher the education level of the mother and/or the father, the higher the cognitive awareness of the middle school students.

In the present study, it was concluded that the attitude scores of middle school students towards mathematics did not differ according to their parents' education levels. This result is

similar to that of Pehlivan (2010) and that of Tuncer and Yilmaz (2016). However, in some studies, it was concluded that there is a statistically significant difference between attitudes towards mathematics and the educational level of parents (Akdemir, 2006; Ozkan, 2006). In the study conducted by Ozkan (2006), the mothers' education level is mostly in the primary and middle-school categories, with a few high school graduate mothers and no university graduates. In the study of Akdemir (2006), none of the mothers with education-associate, undergraduate, graduate, and doctorate degrees are thought to cause different results. It is seen that the mean of the attitude of the middle school students whose mothers are elementary school graduates is the least and the highest among the highest middle school graduates. This result supports the findings of Ozkan (2006) and Akdemir (2006). Similarly, in the study of Ozkan, the education levels of the fathers were in the elementary, middle and high school categories; there were no university graduates. In the research conducted by Akdemir (2006), the fathers' education levels were found to be associate, bachelor, master, and doctoral degrees, and are thought to cause a difference. The mean of the attitude of the students toward mathematics whose father is a middle school graduate was the least; high school graduates were the highest. This result is similar to that of Ozkan (2006) and Akdemir (2006).

A moderate positive correlation was found between students' previous year-end mathematics grades and attitudes towards mathematics scores. There was a low positive correlation between previous year-end mathematics grade and mathematics foresight which is one of the sub-factors of attitude towards mathematics scale, and a moderate positive relationship between mathematics previous year-end grade and mathematics benefits and interest in mathematics. Research has shown that there is a mutual relationship between attitudes towards mathematics and success (Saracaloglu, 2000; Savas and Duru, 2005). However, in some studies, it was concluded that the academic achievement of students had no effect on their attitudes towards mathematics (Ekizoglu and Tezer, 2007; Ozturk, 2014; Peker and Mirasyedioglu, 2003). A moderate positive correlation was found between the students' previous year-end mathematics score and total metacognition skills score. In addition, there is a low level between the cognitive paths and mathematics previous year-end achievement score; a positive correlation was found between other factors and the previous year-end mathematics achievement grade. A similar result was found in the study of Memis and Arican (2013). Memis and Arican's (2013) revealed that there was a low level between cognitive pathways and mathematics achievement grades; they found a moderately positive relationship between planning, methodological information, self-monitoring, explanatory information, self-control factors and mathematics grade. Atay (2014) found a positive relationship between metacognitive awareness and academic achievement in science. In addition, some of the studies have concluded that there is a significant relationship between students' academic achievement and metacognitive skills (Asik and Erktin, 2019; Caliskan and Sunbul, 2011; Gurefe, 2015; Kahramanoglu and Deniz, 2017).

A moderate positive correlation was found between the students' attitudes towards mathematics and their total metacognition skills scores. Sarpkaya, Arik and Kaplan (2011) found similar results in their research. In this context, the development of students' attitudes towards mathematics will increase their interest in mathematics and increasing their interest in mathematics will improve their attitudes. Therefore, increasing the interest of middle school students in mathematics would contribute to the development of cognitive skills.

When the place of mathematics in real life is considered, it is seen that students' attitudes towards mathematics and their metacognitive skills are very important in mathematics teaching. Undoubtedly, the greatest task in the development of students' positive attitudes towards mathematics and the development of metacognitive skills belongs to mathematics teachers. At the same time, mathematics teachers should make use of technology in line with the opportunities of the school and connect mathematics to daily life and make the mathematics courses enjoyable and pleasurable. For this purpose, middle school mathematics teachers should create mathematical environments in the classroom where middle school students will be comfortable, provide middle school students with positive attitudes towards mathematics, and include activities that will reveal and develop their skills (Caglikose, 2019; Gurefe, 2015).

Thus, students' mathematics fear and anxiety will be reduced and students' positive attitudes toward mathematics and metacognitive skills related to mathematics will develop (Hannula, 2002). In the development of these attitudes toward mathematics and metacognition skills, the primary duty of the parents is to support the child. Moreover, this positive attitude towards mathematics can be seen in middle school students of families who have positive attitudes towards mathematics.

Considering the findings of the study, it was concluded that the gender and the mother and father education levels of the students did not affect the students' metacognitive skills and attitudes. In addition, a positive relationship was found between the students' mathematics scores and attitudes towards mathematics and their metacognitive skills. From this point of view, it is thought that the activities and learning environments planned to improve the middle school students' metacognitive skills will increase student attitude towards mathematics and mathematics achievement. Learning environments and the mathematics curriculum can be prepared within this framework.

Attitudes are affected by achievement and attitudes in achievement (Askar and Erden, 1987). Middle school students' success or failure in mathematics would affect their attitude toward mathematics. For this purpose, middle school mathematics teachers should ensure the participation of each student and support the development of self-confidence against mathematics. The reasons that cause middle school students to have negative attitudes towards mathematics should be investigated. Finding solutions to these negative attitudes toward mathematics is an important task for the middle school mathematics teacher and the family. However, it is difficult to make a direct impact on the education level of parents in the classroom, but some guidance on the education of mothers and fathers can be made. In future researches, attitudes, metacognitive skills and the relationships between mathematics and elementary school students and pre-service mathematics teachers with more samples can be investigated. Research can be conducted into factors such as socioeconomic structure, class level, and self-efficacy that affect attitudes towards mathematics and cognitive skills.

REFERENCES

Akdemir, Ö. (2006). *İlköğretim öğrencilerinin matematik dersine yönelik tutumları ve başarı güdüsü* (Master's Thesis). Dokuz Eylul University, İzmir.

Asık, G. & Erktin, E. (2019). Metacognitive Experiences: Mediating the relationship between metacognitive knowledge and problem-solving. *Education and Science, 44*(197), 85-103.

Askar, P. & Erden, M. (1987). Öğretmenlik mesleğine yönelik tutum ölçeği. *Çağdaş Eğitim*, *121*(12), 8-11.

Atay, A. D. (2014). *Investigation on secondary school students' motivation levels and metacognitive awareness on learning science* (Master's Thesis). Adnan Menderes University, Aydın.

Bagceci, B., Doş, B. & Sarica, R. (2011). An analysis of metacognitive awareness levels and academic achievement of primary school students. *Mustafa Kemal University Journal of Social Sciences Institute, 8*(16), 551–566.

Baki, A. (2006). *Kuramdan uygulamaya matematik eğitimi*. Derya Publishing.

Bas, F. & Sagirli, M. O. (2017). A Content analysis of the articles on metacognition in education in turkey. *Education and Science*, *42*(192), 1-33.

Baykara, K. (2011). A study on "teacher efficacy perceptıons" and "metacognıtıve learnıng strategıes" of prospectıve teachers. *Hacettepe University Journal of Education*, *40*, 80-92.

Bursalıoglu, F. (2010). *The effects of pattern and tesselation activities by teaching method of analyses on sixth grade students' maths attitudes and their academic successes* (Master's Thesis). Eskisehir Osmangazi University, Eskisehir.

Buyukozturk, S. (2002). Factor analysis: basic concepts and using to development scale *Educational Administration: Theory and Practice, 8*(4), 470-483.

Buyukozturk, S. (2006). *Sosyal bilimler için veri analizi el kitabı*. Ankara: Pegem Publishing.

Chen, M. H., Gualberto, P. J. & Tameta, C. L. (2009). The development of metacognitive reading awareness inventory. *TESOL Journal*, *1*, 43-57.

Caliskan, M. & Sunbul, A. M. (2011). The effects of learning strategies instruction on metacognitive knowledge, using metacognitive skills and academic achievement (primary education sixth-grade Turkish course sample). *Educational Sciences: Theory & Practice, 11*(1), 148-153.

Çaglikose, M. (2019). *Analyze sixth-grade students' metacognition skills in the process of solving fraction problems* (Master's Thesis). Erciyes University, Kayseri.

Celik, H. C. & Bindak, R. (2005). Investigation of the primary school teacher students' attitudes towards mathematics by various variables. *Kastamonu Education Journal, 13*(2), 427-436.

Cokluk, O., Sekercioglu, G. & Buyukozturk, S. (2010). *Sosyal bilimler için çok değişkenli istatistik: SPSS ve Lisrel uygulamaları*. Ankara: Pegem Academy.

Dogan, N. & Barıs, F. (2010). Tutum, değer ve özyeterlik değişkenlerinin TIMSS-1999 ve TIMSS-2007 sınavlarında öğrencilerin matematik başarılarını yordama düzeyleri. *Journal of Measurement and Evaluation in Education and Psychology, 1*(1), 44-50.

Ekizoglu, N. & Tezer, M. (2007). İlköğretim öğrencilerinin matematik dersine karşı tutumları ile matematik başarı puanları arasındaki ilişki. *Cypriot Journal of Educational Sciences, 2*(1), 43-57.

Flavell, J. H. (1987). *Speculations about the nature and the development of metacognition.* In F. E. Weinert & R. H. Kluwe (Editors), Metacognition, motivation, and understanding (21-29). Hillsdale, NJ: Lawrance Erlbaum Associates, Publishers.

Gurefe, N. (2015). İlköğretim öğrencilerinin üstbilişsel farkındalıklarının bazı değişkenlere göre incelenmesi. *Uluslararası Eğitim Bilimleri Dergisi, 2* (5), 237-246.

Hannula, M. (2002). Attitude toward mathematics: Emotions, expectations, and values. *Educational Studies in Mathematics, 49,* 25-46.

Johnson, R. M. (2000). Gender differences in mathematics performance: Walberg's Educational Productivity Model and the NELS: 88 Database. *Annual Meeting of the American Educational Research Association*. New Orleans: LA, USA.

Kahramanoglu, R. & Deniz, T. (2017). An investigation of the relationship between middle school students' metacognitive skills, mathematics self-efficacy, and mathematics achievement. *Inonu University Journal of the Faculty of Education, 18*(3), 189-200.

Karasar, N. (2018). *Bilimsel araştırma yöntemleri,* (33. baskı). Ankara: Nobel Publishing.

Katranci, Y. (2009). Cinsiyet, yaşam standardı ve matematik başarısı ile matematiği yönelik tutum arasındaki ilişki. *XVIII. Ulusal Eğitim Bilimleri Kurultayı*, Ege University, Izmir.

Kaya, N. B. & Firat, T. (2011) İlköğretim 5. ve 6. sınıf öğrencilerinin öğrenme-öğretme sürecinde üstbilişsel becerilerinin incelenmesi. *Celal Bayar University Journal of Faculty of Education, (1),* 56- 70.

Kurt, V. (2015). *Problem kurma çalışmalarının 6. sınıf öğrencilerinin matematik kavramlarını öğrenme düzeylerine etkisi* (Master's Thesis). Marmara University, Istanbul.

Ma, X. & Kishor, N. (1997). Assessing the relationship between attitude toward mathematics and achievement in mathematics: a meta-analysis. *Journal for Research in Mathematics Education, 28,* 26-47.

Marzano, R. J., Brandt R. S., Hughes C. S., Jones B. F., Rankin S. C. & Suhor C. (1995). Düşünmenin boyutları: program ve öğretim için bir model (Doganay, A. and Kara, Z., Translated.), *Cukurova University Faculty of Education Journal, 1*(11), 25-38.

Ministry of National Education (MoNE) (2018). *Mathematics Curriculum.* Ankara.

Memis, A. & Arican, H. (2013). The Analysis of 5th-grade students' mathematical metacognition levels between the variables gender and achievement. *Karaelmas Journal of Educational Sciences, 1* (1), 76-93.

Nazlicicek, N. & Erktin, E. (2002). İlköğretim matematik öğretmenleri için kısaltılmış matematik tutum ölçeği. *Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*. Ankara.

Ozkan, F. (2006). *İlköğretim 8. sınıf öğrencilerinin matematik dersinde kullandıkları öğrenme stratejileri ile tutumları arasındaki ilişki* (Doctoral thesis). Dokuz Eylul University, Izmir.

Ozturk, A. Y. (2014). *The effects of alternative assessment and evaluation methods applied in fifth grade mathematics course on academic achievement, persistence of learning, self-efficacy perception and attitudes* (Doctoral Thesis) Canakkale 18 Mart University, Canakkale.

Ozyigit, E. N. (2004). *Köy devlet okulu, kent merkezi devlet okulu ve özel okullarda öğretimlerine devam eden ilköğretim 4. ve 8. sınıf öğrencilerinin matematik dersine yönelik tutumlarının çeşitli değişkenler açısından incelenmesi* (Master's Thesis). Dokuz Eylul University, Izmir.

Pehlivan, H. (2010). AN analysis of Ankara science high school students' attitudes towards math and their academic self-concepts in term of some family characteristics. *Kastamonu Education Journal, 18*(3), 805-818.

Phillips, R. B. (1973). Teacher attitude as related to student attitude and achievement in elementary school mathematics. *School Science and Mathematics, 73,* 501–507.
Peker, M. & Mirasyedioglu, Ş. (2003). Lise 2. sınıf öğrencilerinin matematik dersine yönelik tutumları ve başarıları arasındaki ilişki. *Pamukkale University Journal of Education, 14*(2), 157-166.
Ruffell, M., Mason, J., & Allen, B. (1998). Studying attitude to mathematics. Educational Studies in Mathematics, 35(1), 1-18.
Saracaloglu, A.S. (2000). The relationship between the academic achievement and attitudes about foreign language of the pre-service teachers. *Education and Science*, *25* (115), 65–72.
Sarpkaya, G., Arik, G. & Kaplan, H. A. (2011). The relationship between elementary mathematics teacher candidates' awareness of using the metacognitive strategies and their attitudes towards mathematics *Social Sciences Research Journal*, II, 107-122.
Savas, E. & Duru, A. (2005). Gender differences in mathematics achievement and attitude towards mathematics among first grade of high school. *Eurasian Journal of Educational Research*, *19*, 263–271.
Sevgi, S., & Caglıkose, M. (2019). Analyzing sixth grade students metacognition skills in process of solving fraction problems. *Hacettepe University Journal of Education*. Advance online publication. doi: 10.16986/HUJE.2019053981.
Tabachnick, B. G. & Fidell, L. S. (2015). *Çok değişkenli istatistiklerin kullanımı*. (Translated M. Baloglu). Ankara: Nobel Publishing.
Tuncer, M. & Yilmaz, Ö. (2016). An evaluation of the secondary school students' opinions on attitudes and anxieties towards mathematics class. *Kahramanmaraş Sutcu Imam University Sosyal Bilimler Dergisi, 13*(2), 47-64.
Ural, A. (2007). the effect of cooperative learning on mathematics academic achievement, retention, mathematics self efficacy and attitudes toward mathematics (Doctoral thesis). Gazi University, Ankara.
Unlu, V. (2015). *THE effects of writing activities in the field of "probability and statistics" on seventh grade math students' achievement, attitudes and metacognition* (Master's thesis). Gazi University, Ankara.
Van De Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2014). İlkokul ve ortaokul matematiği: gelişimsel yaklaşımla öğretim. Nobel Publishing.
Yenilmez, K. & Ozabaci, N. Ş. (2003). Yatılı öğretmen okulu öğrencilerinin matematik ile ilgili tutumları ve matematik kaygı düzeyleri arasındaki ilişki üzerine bir araştırma. *Pamukkale University Journal of Education, 14(*2), 132-146.
Yildiz, E., Akpinar, E., Tatar, N. & Ergin, Ö. (2009). Exploratory and confirmatory factor analysis of the metacognition scale for primary school students. *Educational Sciences: Theory & Practice, 9*(3), 1573-1604.
Young, A. & Fry, J. D. (2008). Metacognitive awareness and academic achievement in college students. *Journal of the Scholarship of Teaching and Learning*, *8(*2), 1-10.
Yucel, Z. & Koc, M. (2011). The Relationship between the prediction level of elementary school students' math achievement by their math attitudes and gender. *Elementary Education Online, 10(1),* 133-143.
Zan, R. & di Martino, P. (2007). Attitude toward mathematics: Overcoming the positive/negative dichotomy. *The Montana Mathematics Enthusiast*. *Monograph 3*, 157-168.