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AN INVESTIGATION OF THE MIDDLE SCHOOL STUDENTS' MATHEMATICS EXAM ANXIETY AND SELF-EFFICACY FOR PROBLEM-POSING

Research article

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Abstract

The aim of the study was to analyze the mathematics exam anxiety and problem-posing self-efficacy of middle school students in terms of their school, gender, and grade levels, as well as the relationship among these parameters. The research was conducted with 37 fifth grade students, 53 sixth grade students, 72 seventh grade students, and 77 eight grade students; in total 239 students in two middle schools in Kayseri province, Turkey in 2019. The data collection tools comprised the "Mathematics Exam Anxiety Scale", developed by Şan (2014) and revised by Dulkadir (2017), and the "Problem Posing Self-Efficacy Scale", which was developed by Özgen (2019). For the analysis of the data the SPSS 25 package program was used. In the study, the reliability coefficient of the mathematics exam anxiety scale was found to be 0.486, and the reliability coefficient of the problem-posing self-efficacy scale was 0.942. Mathematics anxiety and problem posing self-efficacy did not differ significantly according to gender. A significant difference in mathematics exam anxiety was detected and the difference was between the fifth and seventh grades. No significant difference was found in the self-efficacy for problem posing at the grade levels. While mathematics examination anxiety showed a significant difference in terms of the schools, the self-efficacy for problem-posing did not differ significantly between schools.

Keywords: Mathematics, exam anxiety, problem posing, self-efficacy, middle school

1. Introduction

"Anxiety, which is an emotion gained through conditioning the approaches to learning approaches, encourages people to be creative and constructive at times, and sometimes prevents such behaviors in daily life." (Dursun & Bindak, 2011). Anxiety is often considered a bad feeling, but it may not always produce bad results. It can be thought that it is an advantageous situation for us to have an average level of anxiety. For this reason, it may not be the right way to worry about every job we take on, to be alarmed or to be carefree and ignore the consequences that will happen to us. If we want to achieve success, it may be suggested that we manage to keep our anxiety at a normal level.

Mathematics anxiety has an important place in mathematics teaching. Students' anxiety about mathematics may also begin to emerge when they start taking mathematics lessons in primary school. If the student does not begin to learn to keep this anxiety of mathematics from a young age at a normal level, his / her anxiety towards mathematics lessons may start to affect his success and the student can create prejudice against mathematics. It may also be very difficult to break this bias in the future.

"Exam anxiety is that the student feels restless and fails constantly before, during or after any exam." (Dulkadir, 2017). A student with low exam anxiety may not pay due attention to the exam result, and the good or bad results obtained may not have much meaning. On the other hand, students who have high exam anxiety may have a chance to succeed because of the stress caused by this anxiety and may have the problem of not achieving the success they want by putting obstacles in front of themselves. The importance given to central exams in our education system is increasing day by day by both parents and students. Anxiety levels of students started to increase in time because this importance is given to the exams. It is thought that the effect of mathematics is high in the exams, so mathematics exam anxiety is higher than other courses. Anxiety about mathematics may increase when students who are engaged in mathematics under normal conditions and have an interest in mathematics do not succeed in the exam, and this may lead to a decrease in emotions such as interest and curiosity towards mathematics along with mathematics achievement.

One of the remarkable topics of research in the field of mathematics teaching in recent years is the problem-posing (Özgen, 2019). Silver (1994) defined as "problem-posing can occur as editing an existing problem or creating new problems" (cited by Özgen, 2019). Problem posing studies are classified in different ways by different people. Different methods have been used in these studies, but it has been noticed that most of these methods have been done by going through a previously seen problem. Middle school students have difficulty in solving routine problems (Özgen, Aydın, Geçici, & Bayram, 2017). The reason why the students have such difficulties in creating a problem is that they do not encounter the problem questions in the teaching environment too much, they do not have the level of readiness to present original ideas. Problem-posing is a limited area, but its importance has been noticed in recent years and the studies in this area have increased (Kırnap-Dönmez, 2014). According to Bandura (1977), "self-efficacy can be defined as one's belief in the ability to successfully organize and carry out the activities and processes required to achieve a specific goal.". Students' self-efficacy also affects problem-posing skills. If a person believes in self-efficacy, it may be thought that (s)he may be safer when establishing a problem and will not hesitate to establish original problems.

Delioğlu (2017) examined math anxiety, exam anxiety, mathematics self-efficacy of the middle school eighth-grade students in terms of gender, grade level, eighth year achievement level, parental income status, parental education status attending the classroom/study center, and private lesson status. As a result of the research, no significant mean difference was found in terms of gender, parental education level of students, anxiety status of the students in the classroom/study center, and private lesson variables. However, a significant mean difference was found between exam anxiety and eighth grade achievement level. Students' exam anxiety was lower in the schools with a high eighth grade achievement level. When exam anxiety was examined according to the family income level variable, a significant mean difference was found. Exam anxiety decreased as the income level increased. There was also a significant mean difference in terms of exam anxiety and mathematics perception. Exam anxiety decreases as mathematics achievement perception increases. Yıldırım and Ergene (2003) examined how high school senior students' exam anxiety and social support on this subject affect academic success. As a result, exam anxiety negatively affects academic success for high school senior students. However, social supports such as family, friends, and teachers had positive effects on the academic success of the student. It was suggested that directing students to the guidance service to reduce anxiety experienced during the exam period would positively affect academic success. Işık and Kar (2012) examined the problem-posing skills of prospective elementary teachers. The number of prospective elementary teachers to establish different problems was at a low level. Prospective teachers had

difficulties mostly in remaining partition questions. Prospective teachers mostly focused on simple, not well-structured problems that can be solved with easy operations. In line with the data obtained, prospective teachers' problem-posing skills should be improved. Before starting the task, it is recommended to do the necessary activities for problem posing. Oğuz (2017) examined the relationship between pre-school teachers' problem-solving skills and teacher self-efficacy perception. Pre-service teachers' problem-solving skills and self-efficacy perceptions were found to be above average. When the relationship between pre-school teachers' problem-solving skills and self-efficacy perception was examined, there was a moderately meaningful relationship in a positive direction. Based on this, as the pre-school teachers' perception of self-efficacy increases, their problem-solving skills would increase. For this reason, it should not be forgotten that the positive development of pre-school teachers' self-efficacy perceptions would affect their problem-posing skills positively and activities should be given as much as necessary regarding self-efficacy. Boyraz (2019) examined prospective middle school mathematics teachers' problem-posing skills in equations. Pre-service teachers were given two unstructured, 14 semi-structured, and two structured problem-posing activities. Prospective teachers were generally successful in problem posing. While prospective teachers established two equations with unknowns, they had more difficulty than equations with one unknown. As the number of unknowns increases within the framework of the data obtained, they have difficulty in establishing problems. While prospective teachers were successful in structured problems, they had difficulty in establishing semi-structured problems. Teachers failed to convert the given graphics into problem sentences. Prospective teachers had difficulties in establishing problems suitable for real life. In line with this information, prospective mathematics teachers should be directed to problem-posing activities in the pre-service period. Işık (2011) made a conceptual analysis of the problems that prospective elementary mathematics teachers had set on multiplication and division in fractions. Prospective middle school mathematics teachers had difficulty in dividing fractions more than multiplication. Prospective teachers had experienced difficulties in the conceptual dimension of fraction and operations with fractions. it was recommended to prospective teachers who will teach students in the future, to eliminate their deficiencies in problem-posing, and to work on problem-solving suitable for real life. When the studies in the field are examined, there are few studies on mathematics exam anxiety at the middle school level. Furthermore, more studies were conducted on teachers and prospective teachers for problem-posing self-efficacy and that problem-posing self-efficacy was not explored with middle school students.

1.1. Aim of the Study

The study aimed to examine middle school students' exam anxiety and self-efficacy towards problem posing. According to Dulkadir (2017), it is necessary to take necessary measures before it is too late to know which level of mathematics exam anxiety is affected by which variables and to prevent this anxiety from decreasing academic achievement. With this study, exam anxiety was analyzed in detail and the basis for examining its effect on mathematics achievement was established. According to Özgen (2019), the relationship between problem-posing self-efficacy beliefs and problem-posing skills, problem-solving self-efficacy beliefs and skills can be revealed through quantitative approaches. In this study, the main research question is ***"What is the level of mathematics exam anxiety and problem-posing self-efficacy of middle school students?"*** Based on this main research question the sub-research questions can be stated as follows:

- Do middle school students' math anxiety and problem-posing self-efficacy differ significantly by gender, grade levels, and schools?

- Is there a relationship between middle school students' mathematics test anxiety and problem-posing self-efficacy scales?

2. Method

2.1. Participants

The research was conducted with a total number of 239 middle school students in two middle schools in Kayseri in the 2019. The participants were selected via convenient sampling method. The distribution of the students constituting the participants of the research according to gender, grade level, and schools are given in Table 1.

Table 1. *Distribution of students participating in the study according to gender, grade level, and schools*

Variable		f	%
Gender	Girl	112	46.9
	Boy	127	53.1
Grade Level	Fifth Grade	37	15.5
	Sixth Grade	53	22.2
	Seventh grade	72	30.1
	Eight Grade	77	32.2
School	A	178	74.5
	B	61	25.5
Total		239	100

2.2. Instruments

2.2.1. The Mathematics Exam Anxiety Scale

Mathematics Exam Anxiety Scale was developed by Şan (2014) as 20 items (reported by Dulkadir, 2017). Dulkadir (2017) created a 15-item scale by deleting some items and calculating the validity and reliability of the scale. The reliability coefficient of the new version of the 15-item scale was found to be 0.83. Seven of the items were classified as facilitating anxiety and eight as annoying anxiety. In the scale Four-Likert type, “never (1), sometimes (2), often (3), always (4)” was used. The Cronbach Alpha value of the scale was found to be 0.448. Since the reliability coefficient was less than 0.6, the scale was moderately reliable.

Kaiser-Olkin-Mayer (KMO) sampling adequacy scale was examined to see if the participants size of the mathematics exam anxiety scale was sufficient for factor analysis before analysis, and since KMO = 0.847> 0.6 condition was satisfied, the participants size was suitable for factor analysis (Bursal, 2019). Bartlett’s Sphericity Test was used to see if the participants showed a normal distribution. According to the Barlett Sphericity test of the mathematics test anxiety scale, the participants showed a normal distribution (X^2 = 139.569, df = 105, p = 0.000). Figure 1 interprets the scree plot of mathematics anxiety. The scree plot is used to determine the number of factors (Özgen & Bayram, 2019). There are two factors according to the scree plot which is given in Figure 1:

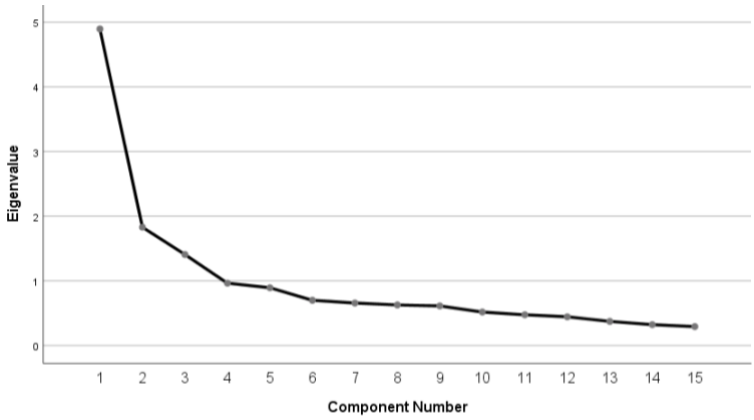


Figure 1. Scree plot of for mathematics exam anxiety scale

Factor analysis of the Mathematics Exam Anxiety Scale was run, and the rotated components matrix obtained from the analysis results are given in Table 2. According to the results of the factor analysis conducted on the mathematics anxiety scale, the scale had two factors. With the analysis, the 15-item scale was classified as seven items to facilitate anxiety and eight items to classify as difficult anxiety. Items containing facilitating anxiety were determined as items 6, 14, 9, 7, 8, 10, 15 of the scale. The items containing difficult anxiety were determined as items 5, 13, 11, 12, 1, 3, 2, 4.

Table 2. *Rotated components matrix results of mathematics exam anxiety scale (Turkish)*

Items	facilitate anxiety	difficult anxiety
"Matematik sınavlarına girmek beni mutlu eder."	0.792	
"Matematik sınavlarından zevk alırım."	0.780	
"Arkadaşlarımla matematik soruları çözme yarışması yapmaktan zevk alıyorum."	0.766	
"Matematik sınavlarına çalışmak bana zevk verir."	0.718	
"Matematik dersinin sınavları, matematiği daha iyi öğrenmemi sağlar."	0.688	
"Matematik sınavlarına hazırlanmaktan zevk alırım."	0.674	
"Sınavlarda ilk önce matematik testini çözmeye başlamak beni rahatlatıyor."	0.550	
"Matematik sınavı yaklaştıkça kendimi daha gergin hissederim."		0.682
"Matematik sınavlarında kendimi çok gergin hissederim."		0.678
"Matematik sınavlarında diğer sınavlardan daha fazla tedirgin olurum."		0.671
"Merkezi sınavlarda (TEOG, YGS, LYS) matematik testine bakmak bile istemem."		0.563
"Matematik sınavlarının geleceğim için çok önemli olmasını istemem."		0.528
"Matematik sınavlarında başarılı olabileceğimi düşünmüyorum."		0.513
"Matematik dersinden sınav olmayı tercih etmem."		0.489

"Merkezi sınavlarda (TEOG, YGS, LYS) matematik testi olmasa daha başarılı olurum."	0.355

2.2.2. Problem-Posing Self-Efficacy Scale

The problem-posing self-efficacy scale was created by Özgen (2019), consisting of 24 items in total, seven of which are negative (m1, m8, m12, m15, m17, m23, m24) and 17 of which are positive five-point Likert types. The items of the problem-posing self-efficacy scale include "strongly agree", "agree", "neutral", "disagree" and "strongly disagree" options. For this scale, Cronbach Alpha internal consistency reliability coefficient was determined as 0.942. In this study, Cronbach's Alpha value of the problem-posing self-efficacy scale was found to be 0.715. The scale is reliable because the Cronbach Alpha value is greater than 0.6. Factor analysis of the problem-posing self-efficacy scale firstly, KMO results were examined to see if our participants number was sufficient for factor analysis. Since the KMO sampling adequacy measure of the scale was met as 0.843> 0.6, the data obtained in the participants was suitable for factor analysis (Bursal, 2019). According to the Bartlett Sphericity test results (X^2 (276) = 1663.667, df = 276, p = 0.000), the participants satisfied normal distribution assumption. In Figure 2, four factor structure of the scree plot of problem-posing self-efficacy is examined to determine the number of graphs.

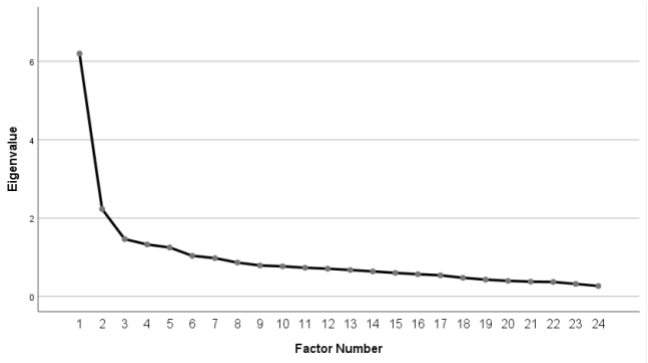


Figure 2. Scree plot of problem-posing self-efficacy scale

Table 3. *Rotated components matrix of problem-posing self-efficacy scale (Turkish)*

	Factors			
Items	1	2	3	4
"Problem kurma etkinlikleri ile matematik konularını daha kolay kavrarım."	0.642			
"Kurduğum problemlerin çözülebilir olmasını sağlayabilirim."	0.576			
"Bir matematiksel problemi çözmede başarılı olduğumdan, problem kurmada da başarılı olabilirim."	0.524			
"Problem kurma etkinlikleri sayesinde matematik derslerinde daha aktif olabilirim."	0.505			
"Matematik dersindeki yaratıcılık becerilerimi problem kurmada gösterebilirim."	0.434			
"Kapsamlı ve geniş bir matematik problemini daha küçük alt problemlere ayırabilirim."	0.349			
"Matematik derslerinde işlenen konu ile ilgili problemler kurabilirim."		0.614		
"Bir problemin sahip olması gereken niteliklere (verilen, istenen vb.) dikkat ederim."		0.597		
"Problem kurarken çözümünü düşünebilirim."		0.585		

“Yazacağım problemler için doğru matematiksel ifadeler, semboller, şekiller, birimler vb. kullanabilirim.”	0.561	
“Kendi yazdığım problemleri çözebilirim.”	0.499	
“Matematikte sözel/hikâye problemleri oluşturmada zorluklar çekerim.”		0.661
“Resim, geometrik şekil ve grafik içeren problemler kurmada güçlük yaşarım.”		0.580
“Çözümü verilen bir problemden yola çıkarak yeni ve farklı problemler oluşturamam.”		0.574
“Belirli bir durum ile ilgili birden fazla problem kuramam.”	0.546	
“Verilen matematiksel işlemlere (toplama çıkarma vb.) uygun problemler kuramam.”		0.424
“Öğretmenlerin ya da bir başkasının yardımı olmadan problem kuramam.”		0.387
“Birden fazla yolla çözülebilen problemler yazamam.”	0.323	
“Matematik dersinde bir kavram, resim, şekil vb. verildiğinde bununla ilişkili yeni problemler oluşturabilirim.”		0.645
“Bir problemdeki durumu değiştirerek yeni ve farklı bir problem geliştirebilirim.”		0.607
“Bir matematik problemi kurarken, matematiksel problem çözme aşamalarını zihnimde canlandırabilirim.”		0.472
“Yeni bir matematik konusunu öğrenirken problemler kurarak öğrenebilirim.”		0.438
“Matematik dersinde öğrendiklerimi pekiştirmek amacıyla farklı problemler kurabilirim.”		0.366
“Problem çözerken “Bu problem daha farklı olabilir miydi?” diye düşünüp problemi değiştirebilirim.”		0.117

The rotated matrix from the factor analysis results of the problem-posing self-efficacy scale is given in Table 3. According to the results of the factor analysis, the scale has four factors. First factor with six items were named as mathematics and problem-solving. Second factor was named as the problem of problem-solving in mathematics with five items. Third factor was called as the problem of problem-solving in mathematics with seven items. Lastly, the fourth factor with six items was named mathematics during the learning process. 16, 18, 19, 20, 21, 22 items in the first factor, 3, 4, 5, 6, 7 items in the second factor 1, 8, 12, 15, 17, 23, 24 items in the third factor and 2, 9, in the fourth factor 10, 11, 13, 14 items were included.

We run factor analysis for arranging factor scores to run the analysis. The items were not loaded as the original scale so we could not take the factor scores. We added all item responses and find the total score for each student to run the analysis.

2.2.3. Procedure

In this study, it was aimed to determine mathematics test anxiety and problem-posing self-efficacy at the level of gender, grade level, and school. For this reason, the general survey method of the quantitative research method was used in the research. The survey pattern is used to describe old or new events. It also determines the level of people's thoughts, beliefs, and perceptions (Ary, Jacobs, Sorensen & Razavieh, 2010). While the dependent variables in the research are mathematics exam anxiety and self-efficacy in problem-posing, the independent variables are gender, grade level, and school.

3. Results

The data collected for the research were entered into the SPSS program and analyzes were made with the help of this program. Kolmogorov-Smirnov normality analyzes of mathematics exam anxiety and problem-posing self-efficacy scales were examined. Mathematics test anxiety scale [D (239) = 0.096, p = 0.000 <0.05] and the problem-posing self-efficacy scale [D (239) = 0.064, p = 0.02 <0.05] was not normally distributed.

3.1. Investigation of Middle School Students' Mathematics Exam Anxiety and Problem-posing Self-Efficacy by Gender

Kolmogorov-Smirnov normality test analyzes of mathematics exam anxiety and problem-posing self-efficacy scales were performed at the gender level. Kolmogorov-Smirnov normality test was used because the participants of the study was 239 people (n≥50). Girl students on math exam anxiety scale [D (112) = 0.89, p = 0.029] and boy students [D (127) = 0.128, p = 0.000] were not normally distributed. In the problem-posing self-efficacy scale, girl students showed normal distribution [D (112) = 0.056, p = 0.200], boy students [D (127) = 0.088, p = 0.018] did not show normal distribution.

Table 4. *Descriptive statistics of mathematics exam anxiety and problem-posing self-efficacy scales by gender*

Scale	Gender	n	$\bar{X}$	SD	Skewness	Kurtosis
Math exam anxiety	Girl	112	35.1696	6.47920	-0.191	0.742
	Boy	127	35.3386	5.85163	-0.419	0.607
Problem-Posing Self-efficacy	Girl	112	79.7946	10.17694	-.179	-0.226
	Boy	127	80.9449	12.09572	-.646	2.796

In Table 4, the skewness value is -0.191 and the kurtosis value is 0.742 for girl students in mathematics exam anxiety scale. The skewness value is -0.419 and the kurtosis value is 0.607 for boy students. Since skewness and kurtosis values are between +1 and -1, they showed normal distribution. The problem-posing self-efficacy scale has a skewness value of 0.520 and a kurtosis value of 1.420 for girl students. The skewness value for boy students is -0.226 and the kurtosis value is 2.796. Since the data did not take values between -1 and +1, it did not show normal distribution. The mathematics test anxiety scale shows normal distribution in line with the skewness-kurtosis values obtained at the gender level. Independent samples t-test analysis was conducted to see if there is a significant mean difference between girls and boys. The mathematics exam anxiety scale of middle school students [t (237) = 0.212, p = 0.832> 0.05] so there was no statistically significant mean difference between the means of girl and boy students. When the mean of the middle school students' mathematics anxiety scale was examined, the mean of the girls was 37.15 and the mean of the boys was 35.34 and there was no statistically significant mean difference between the means. Since the problem-posing self-efficacy scale did not show a normal distribution according to the normality tests conducted at the gender level, and Mann-Whitney U analysis was performed to see whether there was a significant mean difference between girls and boys. Mann-Whitney U results confirmed no significant mean difference between girls and boys (Mann-Whitney U = 7040.000, z = -0.135, p = 0.892).

3.2. Analyzing Mathematics Exam Anxiety and Problem-posing Self-Efficacy at the Level of Middle School Students

The normality test analyzes of mathematics examination anxiety and problem-posing self-efficacy scales are given in Table 5. Shapiro-Wilk (n <50) test was performed for the fifth grades. Kolmogorov-Smirnov (n> 50) test was carried out for the sixth, seventh, and eighth

grades. Fifth grades show a normal distribution in mathematics exam anxiety scale since p = 0.111> 0.05 in math exam anxiety scale. The sixth grades (p = 0.009 <0.05) and the seventh grade (p = 0.036 <0.05) and eighth grades (p = 0.192> 0.05) showed the normal distribution in math exam anxiety scale.

Table 5. *Kolmogorov-Smirnov normality test according to grade levels of mathematics exam anxiety and problem-posing self-efficacy scales*

Scale	Grade Level	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistics	df	p	Statistics	df	p
Math exam anxiety	5. grade level				0.952	37	0.111
	6. grade level	0.143	53	0.009			
	7. grade level	0.108	72	0.036			
	8. grade level	0.090	77	0.192			
Problem posing self-efficacy	5. grade level				0.945	37	0.066
	6. grade level	0.102	53	0.200			
	7. grade level	0.081	72	0.200			
	8. grade level	0.098	77	0.063			

The problem-posing self-efficacy scale of the fifth grades showed a normal distribution p> 0.05. Sixth (p = 0.200> 0.05), seventh (p = 0.200> 0.05) and eighth (p = 0.063> 0.05) grades showed normal distribution on the problem-posing self-efficacy scale. The mathematics test anxiety scale was not distributed normally at the grade level and the skewness-kurtosis values are given in Table 6.

Table 6. *Descriptive statistics of mathematics exam anxiety scale at grade level*

Scale	Grade Level	n	$\bar{X}$	SD	Skewness	Kurtosis
Exam anxiety	5. grade level	37	33.54	6.453	-0.515	0.29
	6. grade level	53	35.98	7.487	-0.11	0.356
	7. grade level	72	36.74	5.004	-0.58	0.797
	8. grade level	77	34.21	5.625	-0.237	0.829

When Table 6 is examined, the skewness value of the fifth grades was found to be 0.515 and the kurtosis value was 0.29 in the mathematics anxiety scale. The skewness value of the sixth grades was found to be -0.11, and the kurtosis value was 0.365. The skewness value of the seventh grade was found to be -0.58 and the kurtosis value was found to be 0.797. The skewness value of the eighth grades was found to be -0.237 and the kurtosis value was 0.829. Since the skewness-kurtosis values are between -1 and +1, we can assume that the math exam anxiety scale was normally distributed at the grade level.

As a result of the analyzes carried out, ANOVA examined whether there was a differentiation at the grade level since the mathematics exam anxiety scale and the problem-posing self-efficacy scale showed normal distribution. The homogeneity of variances of the mathematics exam anxiety scale was significant (F_{Levene} (3, 235) = 1.807, p = 0.147> 0.05). In this case, one of the Turkey or Scheffe tests can be used in multiple comparisons. Since the math exam anxiety scale is the result of ANOVA, there was a statistically significant mean difference between the grades of math exam anxiety [F (3, 235) = 3.454, p = 0.017 <0.05].

Table 7. *Mathematics exam anxiety scale Tukey test results*

(I) Grade level	(J) Grade level	Mean difference	Standard Error	p
5. grade level	6. grade level	-2.441	1.296	0.238
	7. grade level	-3.196	1.223	0.047
	8. grade level	-0.667	1.210	0.946

6. grade level	7. grade level	-0.755	1.095	0.901
	8. grade level	1.773	1.080	0.357
7. grade level	8. grade level	2.528	0.992	0.055

In Table 7, when the Tukey test results are analyzed, there is no significant mean difference between the mean of the fifth and sixth grades (p = 0.283> 0.05). There is a significant mean difference between the mean of the fifth and seventh grades (p = 0.047 <0.05). There is no significant mean difference between the mean of the fifth and eighth grades (p = 0.946> 0.05), sixth and seventh (p = 0.901> 0.05), sixth and eighth (p = 0.357> 0.05), seventh and eighth (p = 0.055> 0, 05).

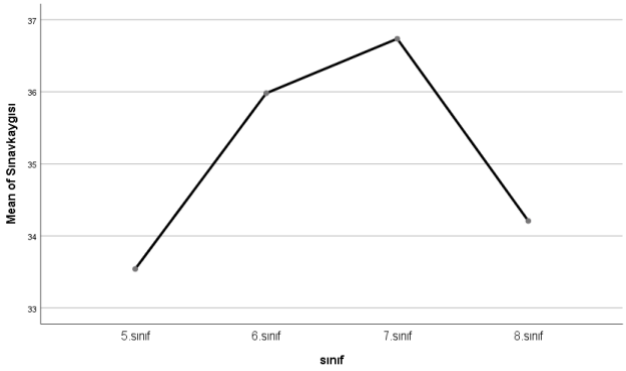


Figure 3. Math exam anxiety scale mean graph

Looking at the means of the fifth and sixth grades in Figure 3, although there seems to be a mathematical difference, there was no statistically significant mean difference according to the Tukey test result. Looking at the means of the sixth and seventh grades, there is no mathematically significant difference. Looking at the means of the seventh and eighth grades, there is a mean difference in mathematics, but according to the results of the Tukey test, there was no statistically mean difference. Looking at the mean of the fifth and seventh grades, there is a mathematical difference. At the mean of the fifth and eighth grades, there is no mathematical difference. At the means of the sixth and eighth grades, there is a mathematical difference, but there was no statistically significant mean difference in the Tukey test.

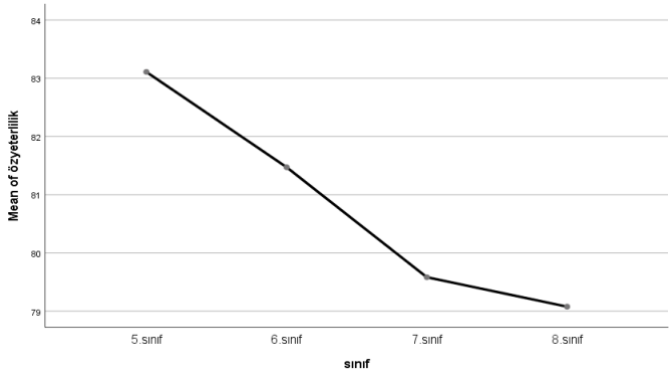
The homogeneity of variances of the Levene Test of the problem-posing the self-efficacy scale are homogeneous (F_{Levene} (3, 235) = 0.694, p = 0.557> 0.05). In this case, one of the Turkey or Scheffe tests can be used in multiple comparisons. There is no statistically significant mean difference between the means of the problem-posing self-efficacy of the classes in middle school [F (3, 235) = 1.365, p = 0.254 <0.05].

Table 8. *Problem posing self-efficacy scale Tukey HSD test results*

(I) Grade level	(J) Grade level	Mean difference	Standard Error	p
5. grade level	6. grade level	1.636	2.402	0.904
	7. grade level	3.525	2.268	0.407
	8. grade level	4.030	2.243	0.277
6. grade level	7. grade level	1.888	2.029	0.788
	8. grade level	2.394	2.001	0.630
7. grade level	8. grade level	0.505	1.838	0.993

According to Table 8, there is no statistically significant mean difference between the results of the Tukey HSD test, the means of the fifth and sixth grades (p = 0.904> 0.05), fifth and seventh grades (p = 0.407> 0.05), and the fifth and eighth grades (p = 0.27> 0.05). There is no statistically significant mean difference between the means of the sixth and seventh grades (p = 0.788> 0.05) and the sixth and eighth (p = 0.630> 0.05) and seventh and eighth (p = 0.93> 0.05) grades.

Figure 4. Problem-posing self-efficacy scale mean graph



Looking at the mean of the fifth and sixth grades in Figure 4, there is a mathematical difference, but there was no statistically significant mean difference according to the Tukey HSD test. Looking at the means of the sixth and seventh grades, there was a mathematically significant difference, but there was no statistically significant difference according to the Tukey HSD test. Looking at the means of the seventh and eighth grades, that there was no mathematical difference. Looking at the mean of the fifth and seventh grades, there is a mathematical difference, but according to the results of the Tukey HSD test, there was no statistically significant difference. Looking at the mean of the fifth and eighth grades, there was a mathematical difference, but according to the results of the Tukey HSD test, there was no statistically significant difference. Looking at the mean of the sixth and eighth grades, there was a mathematical difference, but according to the results of the Tukey HSD test, there was no statistically significant mean difference.

3.3. Analysis of Middle School Students' Mathematics Exam Anxiety and Problem-posing Self-Efficacy According to Schools

To examine the differentiation of mathematics exam anxiety and problem-posing self-efficacy according to schools, it was first examined whether mathematics exam anxiety and problem-posing self-efficacy were normally distributed according to schools. Kolmogorov-Smirnov normality test was used in the research since A Middle School was 178 people and B Middle School was 61 people (n≥50). A Middle School did not show normal distribution in mathematics test anxiety scale [D (178) = 0.09, p = 0.001] but B Middle School had a normal distribution [D (61) = 0.106), p = 0.085]. A middle school did not show normal distribution in the problem-posing self-efficacy scale D (178) = 0.071, p = 0.031]. Contrariwise, B Middle School showed a normal distribution D (61) = 0.096, p = 0.200]. Since the math exam anxiety scale and problem-posing self-efficacy scale did not show a normal distribution according to schools, the skewness-kurtosis values given in Table 9 were examined.

Table 9. *Descriptive statistics of mathematics exam anxiety and problem-posing self-efficacy scales according to school*

Scale	School	n	Mean	SD	Skewness	Kurtosis
Exam anxiety	A Middle School	178	36.17	5.908	-0.242	0.936
	B Middle School	61	32.59	6.076	-0.444	0.043

Problem posing self-efficacy	A Middle School	178	80.22	-0.357	2.286
	B Middle School	61	80.87	0.029	-0.005

Table 9 shows the skewness kurtosis values of mathematics exam anxiety and problem-posing self-efficacy scales according to schools. On the scale of the mathematics exam anxiety scale, the skewness value of A Middle School was found to be -0.242 and the kurtosis value was 0.936. In the mathematics exam anxiety scale, the skewness value of B Middle School was found to be -0.444 and the kurtosis value was 0.043. Since the skewness and kurtosis values range from -1 to +1 on the mathematics exam anxiety scale, we can assume that the mathematics exam anxiety scale was normally distributed according to schools. The problem-posing self-efficacy scale found that A Middle School had a skewness value of -0.357 and a kurtosis value of 2.286. The problem-posing self-efficacy scale found that B Middle School's skewness value was 0.029 and the kurtosis value was -0.005. The problem-posing self-efficacy scale did not normally disperse since the skewness and kurtosis values were not between -1 and +1. According to the analyzes, the mathematics exam test anxiety scale showed a normal distribution according to the schools in line with the skewness-kurtosis values. Independent samples t-test analysis was conducted to examine the differentiation of mathematics exam anxiety scale with respect to A Middle and B Middle Schools. Since the independent samples t-test results of the mathematics exam anxiety scale were analyzed, there was a statistically significant mean difference between the means of A Middle School and B Middle School [t (237) = 4.060, p = 0.000 <0.05]. The mean of A Middle School was 36.17 and the mean of B middle school was 32.59. When the means were analyzed, there was a mathematical difference between A Middle School and B Middle School.

The problem-posing self-efficacy scale was found not to show a normal distribution according to the normality tests conducted at the school level and the Mann-Whitney U test was applied to see if there was a significant mean difference between A Middle School and B Middle School. In the results of the Mann-Whitney U test, there was no significant mean difference between the means of A middle school and B middle school (Mann-Whitney U = 5287, z = -0.305, p = 0.760).

3.4. Relationship Between Mathematics Exam Anxiety and Problem-posing Self-efficacy

When the results of Spearman correlation analysis conducted to determine whether there was a significant relationship between middle school students' mathematics exam anxiety and problem-posing self-efficacy, the problem with the mathematics exam anxiety scale was calculated because the p-value was less than 0.05 in the direction of r = 0.135, p = 0.037. There was a significant relationship between establishing a self-efficacy scale. Since r value was 0.135 <0.3, there was a positive weak relationship (Büyüköztürk et al., 2011).

4. Discussion and Conclusion

The study examined the mathematics exam anxiety and problem-posing self-efficacy of middle school student in relation with their gender, grade level, and the school. As a result of analyzing in the research, the mean of mathematics exam anxiety of middle school students was found to be 37.15 for girls and 35.34 for boys. When the means were examined, there was a mathematical mean difference, but according to the results of the analysis, there was no statistically significant mean difference between the mathematics exam anxiety of boys and girls. Tuncer and Yılmaz (2016) found in their study with 225 middle school students in math anxiety did not differ significantly by gender. Poyraz (2012) determined that math anxiety was higher in the eighth-grade students than seventh-grade students, those who did not like mathematics, and parents with low education level had higher levels of anxiety than parents

who had higher education level, but found that there was no significant difference according to gender. Oksal, Durmaz, and Akın (2016) examined the exam and math concerns of 708 middle school students who prepared for the national exam at the gender level. According to the analysis, the exam anxiety of girl students was higher than boy students.

In the examination of the problem-posing self-efficacy scale according to the gender, there was no statistically significant mean difference between girls and boys. Özgen, Aydın, Ertürk-Geçici, and Bayram (2017) examined whether the problem-posing skills of the eighth-grade students differed by gender. The problem-posing skills of the eighth grades did not vary according to gender. Akkan, Çakıroğlu, and Güven (2009) examined the problem-posing skills of their sixth and seventh grade students according to gender. Girls' problem-posing skills are slightly better than boys (cited by Özgen, Aydın, Ertürk-Geçici, and Bayram, 2017). Semizoğlu (2013) examined the problem-posing skills of fifth graders according to gender. There was a significant mean difference between the problem-posing skills of girls and boys. The mean of the girls is found to be more than the boys and the problem posing skill differs in favor of the girls.

Another result of the research is that mathematics exam anxiety showed a statistically significant mean difference in middle school students according to the grade level. The means were examined to see at which grade levels the differentiation emerged because of the analyzes and the anxiety in mathematics showed a significant mean difference for the 5th and 7th grades. Looking at the mean of the grade levels, there was no differentiation at 5-6, 5-8, 6-8, 7-8 grades. Dursun and Bindak (2011) examined the mathematics exam anxiety of middle school students according to different variables. Mathematics exam anxiety showed a significant mean difference according to grade levels. With the multiple comparison test, the eighth-grade students who went to the last grade are more anxious than other students. Dede and Dursun (2008) examined the anxiety levels of elementary school students at the grade level, math anxiety did not show a statistically significant mean difference compared to the grade levels. However, even though there was no statistical mean difference in the direction of the means, anxiety increased as the grade level grew mathematically. Sapma (2013) wanted to examine the relationship between mathematics anxiety and mathematics achievement of high school students. He also included differentiation of math anxiety according to grade level. Mathematics anxiety showed a statistically significant mean difference according to the grade levels. In line with the examinations made at the grade level, the level of anxiety increases as the grade level increases.

Problem-posing self-efficacy did not show a significant mean difference at grade level by examining problem-posing self-efficacy according to gender. Studies on examining problem-posing self-efficacy at the gender level were generally conducted on prospective teachers. Yenice (2012) examined prospective teachers' self-efficacy levels and problem-solving skills. Self-efficacy did not show a significant mean difference at the grade level, while the problem-posing skill showed a significant difference at the grade level. Genç and Kalafat (2007) examined the prospective teachers' democratic attitude and problem-solving skills in terms of various variables. Problem-solving skill is a significant mean difference according to grade level. In the research, the problem-solving skill of the fourth-grade students was expected to be higher, while the problem-solving skill of the third-grade students was found to be higher. This result may be related to job anxiety and stress experienced by senior students.

Another finding of the research is that, according to the analyzes, mathematics exam anxiety showed a significant mean difference according to the schools. When the mean is analyzed, the mean of the A Middle School (state) was 36.17 and the mean of the B Middle

School (private) was 32.59. Analysis of the means confirmed that there was a mathematical mean difference between the two schools in favor of A Middle School. Yenilmez and Özbey (2006) examined the mathematics anxiety of elementary school students studying in private and public schools. Mathematics anxiety did not differ significantly in private and public schools. Savaş, Taş, and Duru (2010) investigated how mathematics achievement changed between schools. Students studying in private schools are more successful than students in public schools. Students at public school may experience more anxiety because of less success.

As a result of examining the problem-posing self-efficacy according to the schools, self-efficacy did not show a significant mean difference in private and public schools. Uysal (2007) examined the relationship between problem solving skills, anxiety, and attitudes. He investigated how the school factor affected his problem-solving skills. There is no significant mean difference between the problem-solving skills of the students studying in public school and private school. It is concluded that there was not much study on the examination of problem-posing self-efficacy according to the school variable.

Another subject of the research is to examine the relationship between mathematics exam anxiety and problem-posing self-efficacy. There was a significant relationship between mathematics exam anxiety and problem-posing self-efficacy. The relationship is a weak and positive relationship.

The research was limited to two middle schools in Kayseri, one private and one state. By expanding the research participants, more general results can be achieved. In the study, mathematics exam anxiety and problem-posing self-efficacy were examined according to gender, class, and school. Expanding the research can be provided by examining different variables. To reduce students' math exam anxiety, activities can be organized by teachers and the level of anxiety can be tested again. Furthermore, considering the importance of problem posing skills, problem-posing activities can be given more place in secondary school students.

5. Conflict of Interest

The authors declare that there is no conflict of interest.

6. Ethics Committee Approval

The ethics committee approval was received from Erciyes University (28.04.2020).

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