Investigating the Relationship Between Mathematics Anxiety and Mathematics Achievement of Primary School 4th Grade Students

İlkokul 4. Sınıf Öğrencilerinin Matematik Kaygıları ile Matematik Başarıları Arasındaki İlişkinin İncelenmesi[1]

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Abstract

Purpose: The aim of this study is to examine the relationship between the mathematics anxiety of primary school fourth-grade students and their mathematics achievement and to determine the factors that create mathematics anxiety.

Design/Methodology/Approach: Explanatory sequential design, one of the mixed-method designs, was employed in the study. The sample of the study consisted of 636 fourth-grade students studying at 14 schools in the central district of Erzincan in the 2018-2019 academic year and 27 students selected for semi-structured interviews. The data of the study were collected through the "Mathematics Anxiety Scale" and "Mathematics Anxiety Semi-Structured Interview Form" developed by the researcher. In the analysis of the data obtained within the scope of the research, descriptive statistics, multivariate analysis of variance (MANOVA), LSD test statistics, a pairwise comparison technique, Pearson moment multiplication correlation, multiple linear regression analysis and content analysis were used.

Findings: When the results of the study were examined, it was found that primary school fourth-grade students' scores on the math anxiety exam dimension are high, there is no significant difference between the mean scores of mathematics anxiety in terms of gender variable, there is a negative relationship between the mathematics anxiety levels of students and their mathematics lesson achievement, and the mathematics anxiety level of the students predicts the mathematics lesson achievement.

Highlights: It was determined that the factors that create the mathematics anxiety of primary school fourth-grade students are teacher-related, student-related, family and friend-related, lesson-related, and exam-related.

Öz

Çalışmanın amacı: Bu çalışmanın amacı ilkokul 4. sınıf öğrencilerinin matematik kaygıları ile Matematik başarıları arasındaki ilişkinin incelenmesi ve matematik kaygısını oluşturan etmenlerin belirlenmesidir.

Materyal ve Yöntem: Çalışmada karma yöntem desenlerinden biri olan açıklayıcı ardışık desen kullanılmıştır. Araştırmanın örneklemini 2018-2019 Eğitim-Öğretim yılında Erzincan ili Merkez ilçesindeki 14 okulda öğrenim görmekte olan 636 dördüncü sınıf öğrencisi ile yarı yapılandırılmış görüşmeler için belirlenen 27 öğrenciden oluşmuştur. Araştırmanın verileri araştırmacı tarafından geliştirilen "Matematik Kaygısı Ölçeği" ve "Matematik Kaygısı Yarı Yapılandırılmış Görüşme Formu" aracılığıyla toplanmıştır. Araştırma kapsamında elde edilen verilerin analizinde; betimsel istatistikler, çok değişkenli varyans analizi (MANOVA), ikili karşılaştırma tekniklerinden LSD testi istatistikleri, pearson moment çarpım korelasyonu, çoklu doğrusal regresyon analizi ve içerik analizi kullanılmıştır.

Bulgular: Araştırma sonuçları incelendiğinde; ilkokul dördüncü sınıf öğrencilerinin matematik kaygısı sınav boyutuna ait puanlarının yüksek olduğu, cinsiyet değişkeni açısından matematik kaygısına ait puan ortalamaları arasında anlamlı bir farklılığın olmadığı, öğrencilerinin matematik kaygı düzeyleri ile Matematik ders başarıları arasında negatif yönde bir ilişkinin olduğu, öğrencilerin matematik kaygı düzeyinin matematik ders başarısını yordamakta olduğu tespit edilmiştir.

Önemli Vurgular: İlkokul dördüncü sınıf öğrencilerinin matematik kaygısını oluşturan etmenlerin; öğretmen kaynaklı, öğrenci kaynaklı, aile- arkadaş kaynaklı, ders kaynaklı ve sınav kaynaklı olduğu saptanmıştır.

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INTRODUCTION

In our age, human life is differentiating day by day in the face of developing and changing scientific activities. Countries compete with each other in scientific developments and technology and make serious investments in scientific studies. This race in science and technology affects the educational policies of the countries, and scientific and technological contents have been making ground in the education programs of the countries. One of the lessons that come to mind concerning science and technology is undoubtedly mathematics.

Mathematics is one of the sciences that dates back to ancient times in terms of its origin. Erdem, Gürbüz & Duran (2011) stated that the science of mathematics emerged as a result of the daily life activities of ancient societies. In this context, Tuncer (1995) defined mathematics as "the branch of science that studies the properties of abstract entities such as numbers, shapes and operations and the relations between these entities."

Although the science of mathematics originated from only numbers and measurements in the early ages, today, it is seen as the fundamental building block of technological developments and other sciences (Douglas & LeFevre, 2017) and is described as a source of power in the development of people and societies (Tural, 2005). In this context, especially developed countries carry out activities to increase mathematical achievement by making arrangements in the mathematical education program.

When the literature is reviewed, it is seen that there are many factors affecting mathematical achievement. Mathematical achievement is influenced by factors linked to the structure of the mathematics lesson, educational reasons, student age, gender, development level, intelligence, family support, teacher factor, the environment factor, interests and needs, students' attitudes towards the mathematics lesson, self-efficacy perceptions, motivations, prior knowledge and their anxiety about the mathematics lesson (Mata, Monteiro, & Peixoto, 2012; Özdemir & Gür, 2011; Recber, 2011). It has been determined that anxiety, which is an affective concept, is highly correlated with mathematical achievement (Bozkurt, 2012; Gunderson, Park, Meloney, Beilock, & Levine, 2018; Henschela & Roick, 2017; Karlı Şentürk, 2016; Mata, Monteiro, & Peixoto, 2012). Besides, Taşdemir (2015) stated that students would not be successful unless anxiety, one of the factors affecting learning, is eliminated.

Anxiety and Mathematics Anxiety

When the literature is examined, it is seen that there is no consensus on the definitions of the concepts of anxiety, fear, and worry. Although it has been stated that there are differences between these concepts (Zebb & Beck, 1998), it is also stated that there is no clear line that distinguishes these concepts from each other (Namlu & Ceylan, 2000). In this context, Scovel (1978) defines anxiety as "uneasiness and anxiety emerging in the face of a threatening event."

When the definition of Mathematics Anxiety is examined, Dreger & Aiken (1957) described mathematics anxiety as " a syndrome of emotional reactions to mathematics and arithmetic," Richardson & Suuin (1972) as "feelings of tension and anxiety emotions that interfere with the manipulation of numbers and the solving of mathematical problems" and finally Fennema & Sherman (1976) as "feelings of fear, anxiety and nervousness towards mathematics and the physical symptoms associated with them."

When the literature is examined, it is seen that there are many factors that affect the development of mathematics anxiety. In this context, mathematics anxiety is influenced by the student characteristics, the school system, the teacher characteristics, friends circle, gender, socioeconomic structure, exams and familial characteristics (Alexandra & Cobb, 1984; Aydın & Keskin, 2017; Bekdemir, 2007; Devine, Fawcett, Szűcs & Dowker, 2012; Furner and Duffy, 2002; Mata, Monteiro, and Peixoto, 2012; Ramirez, Shaw, & Maloney, 2018; Şimşek, Çetinkaya, & Alptekin, 2017; Vukovic, Roberts, & Wright, 2013; Wood, McLeod, Sigman, Hwang, & Chu, 2003; Yenilmez & Özbey, 2006).

It is stated that mathematics anxiety has both positive and negative effects on students, contrary to the general tendency. Alpert & Haber (1960) stated that a low level of mathematics anxiety makes students more attentive and increases their motivation. Accordingly, it was determined that a low level of anxiety prompted students to study and positively affected the achievement (Alkan, 2011; Newstead, 1998). Also, it was observed that students displayed a positive attitude towards the mathematics lesson thanks to this positive effect (Karlı Şentürk, 2016). On the other hand, it was observed that students' negative mathematics anxiety makes learning difficult and decreases achievement (Scovel, 1978). Besides, studies reveal that the academic achievement of students with negative mathematics anxiety is low (Gunderson et al., 2018).

The Significance of the Study

Today, the most important aim of societies is to grow in information and technology and pioneer innovations. Mathematics science is of great importance in realizing the desired pioneering technological innovations in engineering, medicine, and science. Accordingly, countries strive for expanding mathematics science and increasing mathematical achievement and are trying to offer solutions by determining the factors that reduce mathematical achievement. In order to make sure that desired solutions are successful, it might be a good idea first to identify students who both approach mathematics with prejudice and develop negative anxiety. As a result of the negative anxiety, lack of motivation, withdrawal from the lesson and lack of self-

confidence develop in the students. In particular, the negative anxiety experienced by students towards the mathematics lesson in the first years of their school life affects the students' perspective towards the lesson and reduces their achievement. In this context, Uusimaki & Nason (2004) found in their study that mathematics anxiety and negative views of 66% of the participants developed during their primary school years. Therefore, beginning from the first degree of education, it is essential to take steps to enhance student achievement with measures to eliminate the negative mathematics anxiety of students. In order to take these steps, it is significant to describe the current situation in depth.

To this end, the study aims to examine the relationship between primary school fourth-grade students' mathematics anxiety and their mathematics lesson academic achievement and discover the factors that create mathematics anxiety. For this purpose, answers to the following questions were sought:

1. What are the mathematics anxiety levels of primary school fourth-grade students?

2. Do mathematics anxiety levels of primary school fourth-grade students differ significantly in terms of gender variable?

3. Is there a relationship between the mathematics anxiety levels of primary school fourth-grade students and their mathematics lesson academic achievement?

4. Do mathematics anxiety levels of primary school fourth-grade students predict mathematics lesson achievement?

5. What are the views on the factors that create mathematics anxiety of primary school fourth-grade students?

METHOD

Research Design

The mixed-method, in which quantitative and qualitative methods are used together, was employed in this study, which was conducted to examine the relationship between the mathematics anxiety of primary school fourth-grade students and their mathematics achievement and to determine the factors that create mathematics anxiety. The main reason for using the mixed method is to handle the research in quantitative and qualitative dimensions and minimize the limitations found in both approaches. Tashakkori & Creswell (2007) define the mixed method as the research where the researcher collects data, analyses the data, integrates the findings and makes prospective comments employing quantitative and qualitative methods and approaches in the same study. The sequential explanatory design, one of the mixed-method designs, was used in this study. In the sequential explanatory design, quantitative analysis comes first and in the light of the results obtained, the final result is found by applying the qualitative analysis (Creswell, 2017).

Research Group

In order to realize the aims determined in the study, 3 different research groups were formed. They are stated below, respectively.

1. Research Group

It is the group that is studied to develop the mathematics anxiety scale. In this context, in line with the data obtained from the Turkey Statistical Institute (TSI), it consists of 832 students (lower level: 252 students, middle level: 237 students, higher-level: 269 students) enrolled in 7 primary schools and 8 middle schools third, fourth, fifth, sixth and seventh grades, which were determined by means of the by stratification sampling according to socioeconomic level (lower, middle, higher).

2. Research Group

It is the group that is studied to apply the mathematics anxiety scale. In this context, in line with the data obtained from the Turkey Statistical Institute (TSI), it consists of 636 fourth-grade students enrolled in 14 primary schools, which were determined by means of the stratification sampling according to socioeconomic level (lower, middle, higher) in Erzincan province Central District for 2018-2019 academic year.

3. Research Group

It is the group studied to reveal the factors that cause mathematics anxiety in students by examining the causes of mathematics anxiety in more depth. In this context, within the scope of the mathematics anxiety scale data, it consists of 27 students chosen from among students with high mathematics anxiety scores and with low mathematics anxiety scores by means of the maximum diversity sampling.

Data Collection Tools

The mathematics anxiety scale and mathematics semi-structured interview form were used as data collection tools in the study. Besides, mathematics report card grades were taken as the academic achievement scores of primary school fourth-grade students.

Mathematics Anxiety Scale

"Mathematics Anxiety Scale" was developed by the researcher in order to determine the mathematics anxiety of the students. First, the studies in the relevant literature were reviewed (Alexander & Martray, 1989; Baloğlu & Koçak, 2006; Bindak, 2005; Dowker, Sarkar & Looi, 2016; Fennema & Sherman, 1976; Gierl & Bisanz, 1995; Ma, 1999; Plake & Parker, 1982; Resnick, Viehe, & Segal, 1982; Richardson & Suinn, 1972) and related dimensions were determined, and a pool of 38 items thought to cover these dimensions was created.

In order to evaluate if the items in the 38-item form covered the relevant criteria and the mathematics anxiety process, opinions were taken from a total of 7 field experts, including one assessment and evaluation field specialist, three curriculum development field specialist, two mathematics field specialist, and 1 Turkish education field specialist. In this context, expert opinions were obtained using the three-point scoring method (suitable, must-be-fixed and not suitable).

Yurdagül (2005) stated that the Content Validity Ratio (CVR) of the created items could be obtained by dividing the number of experts who say suitable (NG) for the items by half of the number of experts (N) who express their opinions for the items and minus 1. In this context, by analysing the data from expert opinions, it was decided that the draft scale would consist of 3 criteria and 22 items.

The scale created as a 3-point Likert was designed as "Always (3)", "Sometimes (2)" and "Never (1)" for positive items, "Always (1)", "Sometimes (2)" and "Never (3)" for negative items. Scales used in Likert type are used as 2-point, 3-point, 4-point, 5-point, 6-point and 7-point. However, the most practical of these is the 5-point Likert, but if the sample is a young age group, it is more appropriate to use a 3-point or even 2-point Likert (Köklü, 1995).

Normality Analysis of the Mathematics Anxiety Scale

74 students who gave incomplete and incorrect answers from the study group consisting of 832 students were excluded from the data analysis. Then, normality analysis was performed for the data obtained from 758 students. As a result of the analysis, it was seen that the skewness and kurtosis values were .324 (skewness) and -.159 (kurtosis). However, it was seen in the analysis that there were 14 outliers, and these outliers were removed from the data set, and normality analysis was performed again. Then, the skewness and kurtosis were re-analysed, and it was determined that skewness was 215 and kurtosis was -.481. When the analyses were carried out again, it was seen that there were not any outliers and the skewness and kurtosis coefficients showed a normal distribution between -1 and +1 again. (Büyüköztürk, 2019, Hair, Black, Babin, & Anderson, 2014).

Validity and Reliability Analysis of the Mathematics Anxiety Scale

Exploratory Factor Analysis (EFA) was conducted to test the validity of the mathematics anxiety scale. To this end, Kaiser-Meyer-Olkin (KMO) test was performed to determine whether the sample size studied was sufficient, and this value was found to be .785. It shows that the sample size found in this value is at a very good level. In addition, in order to test whether the relationships in the correlation matrix were significant or not, the result of Bartlett's Test of Sphericity was examined. Bartlett test result was found to be 1690.12 (p <0.05), and it was concluded that this value was significant (Bursal, 2017).

Examining the results of the exploratory factor (principal components) analysis carried out to make sure that the tool can measure the most features with the least number of items, it was observed that there were 6 factors with eigenvalues greater than 1 and the total variance explained by these factors was 54.28%. However, it was observed that some items in the draft scale were loaded on more than one factor. 11 items loaded on more than one factor and whose difference was higher than 0.10 were removed from the scale, and the factor loadings were analysed again. When looking at the results of the factor analysis performed after the specified items were removed, it was determined that there were 3 factors with an eigenvalue greater than 1, and the total variance explained by these factors was 51.64%. In this context, it was observed that the mathematics anxiety self-efficacy dimension factor loadings were between .816 and .518, factor loadings of the mathematics anxiety exam dimension were between .787 and .485, and factor loadings of the mathematics anxiety lesson dimension were between .807 and .493. As a result, the final version of the scale consisted of 11 items. 4 items were in the mathematics anxiety self-efficacy dimension, 4 were in the mathematics anxiety exam dimension, and 3 items were in the mathematics anxiety lesson dimension.

Based on the results of the reliability analysis of the mathematics anxiety scale, it was determined that the total internal consistency coefficient (Cronbach Alpha) was .72. This ratio indicates that the scale is reliable (Özdamar, 2004). When the reliability was examined based on dimensions, it was determined that the mathematics anxiety self-efficacy dimension was .69, the mathematics anxiety exam dimension was .60, and the mathematics anxiety lesson dimension was .58. There are two main reasons why the total internal consistency coefficient of the mathematics anxiety scale was not very high. The first of these stems from the fact that the scale is prepared as a three-point Likert. The fact that the items in the scales can be answered according to many options (likert) increases the internal consistency coefficient (Köklü, 1995). Another factor affecting the reliability is the number of items on the scale. As the number of items increases, the reliability of the scale increases (Thorndike, 1997, as cited in Uyumaz & Çokluk, 2016). If the number of items in each dimension in the scale is low, the inter-item correlation value should be examined. If this value is found between .15 and .50, the scale dimensions are said to be reliable (Clark & Watson, 1995). Accordingly, the inter-item correlation values (.319, .421, .426, respectively) examined for the three dimensions in the mathematics anxiety scale within the specified range prove that the dimensions of the scale are reliable.

Mathematics Anxiety Semi-Structured Interview Form

By the literature review, the characteristics of mathematics anxiety and the factors that may affect mathematics anxiety and the characteristics and scope of these factors were determined. A 15-question draft form was then created, and the researcher applied this draft form to 3 fourth-grade primary school students. As a result of the data obtained from student interviews, the draft form was revised and reduced to 12 questions. Later, the draft form was sent to three field experts, one Turkish field expert and one assessment and evaluation expert, and their opinions were taken. Necessary adjustments and changes were made on the draft form in line with the feedback. 6 students were interviewed again in order to measure if the draft form was serving the determined purpose and was understandable for students. In line with the students' feedback, the necessary corrections were made on the interview questions, and the 6-item interview form was finalized by re-interviewing with three field experts to finalize the draft form.

Data Analysis

Quantitative Data

In the study, descriptive statistics (mean, standard deviation) scores were calculated based on the mathematics anxiety scores of the students using the SPSS program. Tabachnick & Fidell (2013) stated that multivariate analysis of variance (MANOVA) must be used in data where the dependent variable is more than one and the independent variable is categorical. In this context, univariate and multivariate normality analyses of the data were performed initially. As a result of the analysis, it was determined that there were 5 outliers in the data set consisting of 594 participants and they were removed from the data set. In addition, in order to evaluate the homogeneity of variance-covariance matrices, the "Box's M" value was examined, and it was seen that the value was 371. Since this value is greater than .001, it can be said that the variance-covariance matrices are homogenous. In order to evaluate the equivalence of variances, the results of "Levene's Test" were examined. According to Levene's Test results, it is seen that none of the variables have significant values. Additionally, Pearson moment multiplication correlation was computed to determine whether there is a significant relationship between variables and Multiple Linear Regression Analysis was carried out to determine the predictive power.

Qualitative Data

Interviews were conducted with the students using a semi-structured interview form in order to determine the factors that create the mathematics anxiety of primary school fourth-grade students. Before the interviews started, consent of the school administration and the participants was obtained, and the interviews were recorded on a tape recorder. The recorded data were transcribed for an accurate and easy evaluation. Transcribed data were analysed using the content analysis technique. In this context, 3 researchers independently read 10% of the data to create codes and themes. Experts created themes based on codes and codes that are related to each other. The data were re-read and rearranged according to the codes and themes determined. In addition, to ensure internal validity, the data were continuously discussed and analysed with a field expert. In the qualitative part of the study, the "Reliability of Observational Data" method, which indicates if different field experts can measure an event or phenomenon in the same way using the same data set in the same time period, was applied in order to create internal reliability. In this context, internal reliability analysis was conducted with 3 field experts. In order to ensure external reliability in the study, the "Time-Dependent Reliability" method, which is used to measure cases that do not change over time, was applied. In this context, external reliability analysis was carried out with three field experts at intervals of fifteen days (Kirk & Miller, 1986 as cited in Yıldırım & Şimşek, 2008). Also, the reliability formula of Miles & Huberman (1994) was used to calculate the reliability of the study. As a result of the calculation, the reliability was calculated as 79%. Since this result is above 70%, the study is considered to be reliable (Miles & Huberman, 1994).

FINDINGS

In this part of the research, the findings will be dealt with sequentially in line with the determined sub-problems.

1. What ıs the Mathematics Anxiety Level of Primary School Fourth-Grade Students?

Descriptive statistics on the mathematics anxiety levels of primary school fourth-grade students are given in Table 1.

Table 1. The Arithmetic Mean and Standard Deviation Scores of Primary School Fourth-Grade Students Regarding the Mathematics Anxiety Level

Mathematics Anxiety Levels	n	x̄	sd
Mathematics Self-Efficacy Dimension	589	5.13	1.27
Mathematics Lesson Dimension	589	3.89	1.11
Mathematics Exam Dimension	589	9.17	2.37

When Table 1 was examined, it is seen that the mean score for the mathematics anxiety self-efficacy dimension (5.13) is below the middle score (8.00), the mean score for the mathematics anxiety lesson dimension (3.89) is below the middle score (6.00), and the mean score for the mathematics anxiety exam dimension (9.17) is above the middle score (8.00).

2. Do Mathematics Anxiety Levels of Primary School Fourth-Grade Students Differ Significantly ın Terms of Gender Variable?

MANOVA statistics are given in Table 2 to determine whether there is a significant difference between the mathematics anxiety levels of primary school fourth-grade students in terms of the gender variable.

Table 2. Arithmetic Mean and Standard Deviation Scores of Primary School Fourth-Grade Students' Mathematics Anxiety Levels in Terms of Gender Variable

	Gender	n	x̄	ss
Mathematics Self-Efficacy Dimension	Female	297	5.20	1.25
	Male	292	5.07	1.24
Mathematics Lesson Dimension	Female	297	3.38	1.05
	Male	292	3.94	1.17
Mathematics Exam Dimension	Female	297	9.29	2.36
	Male	292	9.05	2.39

When Table 2 is examined, it is seen that the female and male students' mean scores of the mathematics anxiety self-efficacy dimension (5.20 and 5.07, respectively) are below the middle score (8.00), the mean scores of the mathematics anxiety lesson dimension (3.38 and 3.94, respectively) are below the middle score (6.00), and the mean scores on the mathematics anxiety test dimension (9.29 and 9.05, respectively) are above the middle score (8.00).

The mathematics anxiety levels of primary school fourth-grade students according to the gender variable are given in Table 3.

Table 3. MANOVA Results Showing the Comparison of Primary School Fourth-Grade Students' Total Scores Regarding Mathematics Anxiety Levels in Terms of Gender Variable

Wilks' Lambda	F	Hypothesis sd	Error sd	p
,98	2.11	3	585	.98

When Table 3 is examined, it is found that the mean scores of the students regarding their mathematics anxiety levels in terms of gender variable does not show a significant difference at .05 level (Wilks' Lambda value, 989, F = 2.110, p> .05).

Statistics on the comparison of the mean scores of primary school fourth-grade students in terms of mathematics anxiety levels in terms of gender variable is given in Table 4.

Table 4. MANOVA Results Showing the Comparison of Primary School Fourth-Grade Students' Mathematics Anxiety Levels in Terms of Gender Variable

	Sum of Squares	Sd	Mean of Squares	F	p
Mathematics Self-Efficacy Anxiety	2.47	1	4.47	1.590	.208
Error	914.25	587	1,55		
Mathematics Lesson Anxiety	1.97	1	1.97	1.579	.209
Error	734.69	587	1,25		
Mathematics Exam Anxiety	8.57	1	8.57	1.516	.219
Error	3321.31	587	5.65		

When Table 4 is examined, no significant difference is seen between mathematics anxiety self-efficacy dimension (F = 1.590 p> 0.05), mathematics anxiety lesson dimension (F = 1.579 p> 0.05) and mathematics anxiety exam dimension (F = 1.516 p> 0.05) in terms of gender variable.

3. Is There A Relationship Between the Mathematics Anxiety Levels of Primary School Fourth-Grade Students and Their Academic Achievement in Mathematics Lesson?

In order to determine whether there is a relationship between the mathematics anxiety levels of primary school fourth-grade students and their academic achievement in mathematics lesson, Pearson Moments Multiplication Correlation is given in Table 5.

Table 5. Pearson's Moment Multiplication Correlation Results for Determining the Relationship Between the Mathematics Anxiety Levels of Primary School Fourth-Grade Students and their Mathematics Lesson Achievement

		Mathematics Anxiety Levels	Mathematics Lesson Achievement
Mathematics Anxiety Levels	Pearson Correlation	1	-.570**
	Sig. (2-tailed)		.000
	N	589	589

Considering the results of the Pearson moment multiplication correlation computed to determine whether there is a relationship between the mathematics anxiety levels of primary school fourth-grade students and their mathematics lesson achievement, it was found that there is a moderately negative correlation between students' mathematics anxiety levels and their mathematics lesson achievement ($p < 0.05$).

The Pearson moment multiplication correlation, which was computed to determine the relationship between the mathematics anxiety levels of primary school fourth-grade students and their mathematics lesson achievement, is given in Table 6.

Table 6. Pearson's Moment Multiplication Correlation Results for Determining the Relationship Between the Mathematics Anxiety Levels of Primary School Fourth-Grade Students and Their Mathematics Lesson Achievement

		Mathematics Self-Efficacy Dimension	Mathematics Lesson Achievement
Mathematics Self-Efficacy Dimension	Pearson Correlation	1	.252**
	Sig. (2-tailed)		.001
		589	589
	N		
Mathematics Lesson Dimension		Mathematics Lesson Dimension	Mathematics Lesson Achievement
	Pearson Correlation	1	-.132
	Sig. (2-tailed)		.001
	N	589	589
Mathematics Exam Dimension		Mathematics Exam Dimension	Mathematics Lesson Achievement
	Pearson Correlation	1	.057**
	Sig. (2-tailed)		.168
	N	589	589

When we look at the results of the Pearson moment multiplication correlation to determine whether there is a relationship between the mathematics self-efficacy dimension, mathematics course dimension and mathematics exam dimension of primary school fourth-grade students and their mathematics lesson achievement, it is seen that there is a weakly significant negative relationship between the mathematics self-efficacy dimension of the students and their mathematics lesson achievement. There is a weakly significant negative relationship between the mathematics lesson dimension and the mathematics lesson achievement. Finally, there is no significant relationship between the mathematics exam dimension and the mathematics lesson achievement.

4. Do Mathematics Anxiety Levels of Primary School Fourth-Grade Students Predict Mathematics Lesson Achievement?

"Multiple linear regression analysis" was used to determine whether there is an effect on the mathematics anxiety levels of primary school fourth-grade students on their academic achievement of the mathematics lesson. In order to obtain accurate and reliable results by the regression analysis, predictive variables (mathematics self-efficacy dimension, mathematics lesson dimension and mathematics exam dimension) should be independent from each other. In other words, variables should not have a high degree of correlation among themselves. As a result of the analysis, it was determined that the correlation level among the predictor variables was high.

Multiple linear regression analysis results showing to what extent mathematics anxiety level of primary school fourth-grade students predicts the mathematics lesson academic achievement are given in Table 7.

Table 7. Multiple Linear Regression Analysis Results for Primary School Students' Mathematics Anxiety Levels Predicting Mathematics Lesson Achievement

Predictor Variable	R	R^2	Corrected R^2	Standard Error
Mathematics Anxiety Levels	.025	.158	.120	14,970005

When Table 7 is examined, it is seen that the rate of the predictor variable (mathematics anxiety levels) to predict the change in mathematics lesson achievement, which is the predicted variable, is R2 = .158. In this context, the mathematics anxiety levels of primary school fourth-grade students (predictor variable) predicts 15.8% of the change in mathematics lesson achievement.

Multiple linear regression analysis results showing whether there is a significant relationship between the mathematics anxiety levels (predictor variable) of primary school fourth-grade students and their academic achievement in mathematics lesson (predicted variable) are shown in Table 8.

Table 8. Multiple Linear Regression Analysis Results Regarding Whether There is a Significant Relationship Between Primary School Students' Mathematics Anxiety Levels and their Mathematics Lesson Achievement

	Sum of Squares	Df	Mean of Squares	f	p
Regression	3368,576	3	1122,859	5,010	.000

When Table 8 is examined, it is seen that the p value analysed in order to test the relationship between the predictor value and the predicted value, in other words, whether the predictor variable's degree of predicting the change is significant or not, is smaller than 0.01 (p <0.01). In this context, it can be stated that there is a significant relationship between the predictor variable and the predicted variable.

The results of multiple linear regression analysis carried out to determine whether there is a significant relationship between the mathematics anxiety levels of primary school fourth-grade students (mathematics self-efficacy dimension, mathematics lesson dimension and mathematics exam dimension) and their mathematics lesson academic achievement are indicated in Table 9.

Table 9. Multiple Linear Regression Analysis Results Regarding Whether There is a Significant Relationship Between Primary School Students' Mathematics Anxiety Levels and their Mathematics Lesson Achievement

Variables	B	Standard Error	T	P
Mathematics Self-Efficacy Dimension	-.309	.559	-.552	.581
Mathematics Lesson Dimension	-1.889	.603	-3.134	.002
Mathematics Exam Dimension	.583	.274	2.214	.034

When Table 9 is examined, it is seen that the p-value of the mathematics anxiety lesson dimension and the mathematics anxiety exam dimension is smaller than 0.05 (p <0.05). However, the p-value of the mathematics anxiety self-efficacy dimension is seen to be greater than 0.05 (p> 0.05). In this context, it can be stated that the mathematics anxiety lesson dimension and mathematics anxiety exam dimension of primary school fourth-grade students significantly predict mathematics lesson achievement, but the mathematics anxiety self-efficacy dimension does not predict mathematics lesson achievement.

5. What are the Views on the Factors That Create Mathematics Anxiety of Primary School Fourth-Grade Students?

As a result of the content analysis of the data obtained from primary school fourth-grade students, the themes of "Teacher-Related Factors", "Student-Related Factors", "Lesson-Related Factors", "Family and Friend-Related Factors" and "Exam-Related Factors" were determined. Descriptions regarding the themes obtained from the primary school fourth-grade student interviews will be given under the sub-headings respectively.

5.1. Teacher-Related Factors Theme

Within the scope of the factors affecting mathematics anxiety, opinions of primary school fourth-grade students on the theme of "Teacher-Related Factors" and the frequency and percentages of these views are given in Table 10:

Table 10. Views of Primary School Fourth-Grade Students on Teacher-Related Factors and Their Frequency

Themes	Code	Sub-code	f(n:27)	%
Teacher-Related	Factors Increasing Anxiety	Negative Feedback	13	48
		Negative Attitude Towards Students	7	26
	Factors Decreasing Anxiety	Reward- Reinforcer	4	15
		Positive Attitude Towards Students	3	11
		Method-Techniques	4	15

When Table 10 is examined, out of 27 primary school fourth-grade students, 13 (48%) stated that negative feedback and 7 (26%) stated that negative attitude towards the student increased their anxiety, while 4 (15%) of the students stated that reward-reinforcer, 3 (11%) stated that the positive attitude towards the student and 4 (15%) stated that teaching methods and techniques applied reduced their anxiety.

In this context, regarding the factors increasing the mathematics anxiety, the S 10 participant said, "My teacher gets angry if I cannot answer the questions and says "study." Then I am more afraid of mathematics.", while participant S 16 said "For example, in primary school (2nd grade), my teacher asked me to come to the board, and I could answer the question. He/She asked me another question, and I couldn't answer it, too. Then he/she got angry at me for not studying. After that, I became afraid of mathematics". They stated that teachers' negative attitudes and feedback caused their mathematics anxiety to increase.

Regarding the factors that decrease mathematics anxiety, the participant S 17 said, "My teacher said "Well done" to me in the first mathematics lesson. After that, I now love mathematics, I study numbers, I solve problems when I am assigned homework. We also play games in the mathematics lesson". Similarly, S 4 participant stated that "I hear well done from the teacher, that's why I study." They stated that especially the positive attitude used by the teachers caused their math anxiety to decrease.

5.2. Student-Related Factors Theme

Within the scope of the factors affecting mathematics anxiety, opinions of primary school fourth-grade students on the theme of "Student-Related Factors" and the frequency and percentages of these views are given in Table 11:

Table 11. Views of Primary School Fourth-Grade Students on Student-Related Factors and Their Frequency

Themes	Code	Sub-Code	f(n:27)	%
Student-Related	Factors Increasing Anxiety	Nervousness – Stress	12	44
		Lack of Self-Confidence	8	30
		Not Studying	7	26
		Not Listening to the Lesson	6	22
		Absenteeism	3	11
		Not Finding Oneself Intelligent	4	15
	Factors Increasing Anxiety	Self-Confidence	3	11
		Positive Self-Efficacy Belief	2	7

When Table 11 is analysed, out of 27 primary school fourth-grade students, 12 (44%) stated that nervousness-stress, 8 (30%) stated that lack of self-confidence, 7 (26%) stated that not studying, 6 (22%) not listening to lessons, 3 (11%) stated that absenteeism and 4 (15%) stated that not finding themselves intelligent increased their anxiety. In addition, 3 (11%) of the students stated that having self-confidence and 2 (7%) positive self-efficacy beliefs reduced their anxiety.

In this context, regarding the factors that increase mathematics anxiety, the S 2 participant said, "I am very nervous thinking if I cannot do it. I am not very smart, and I do not understand mathematics, so I am afraid." Participant S 21 stated that "I do not study; it is difficult anyway. I do not like it, and I say that I cannot even do what I know; how am I supposed to do what I do not know". Besides, participant S 5 said, "I do not like mathematics. I am afraid because I do not study". They stated that they suffered from stress, particularly about the lesson and underlined that they did not study the lesson, which led to an increase in their mathematics anxiety.

Regarding the factors that reduce mathematics anxiety, participant S 12 said, "I trust myself, I study, and I also solve the questions. Therefore, I love mathematics.", while participant S 9 similarly stated that "I study so I am not afraid of mathematics, I do it easily." They expressed that students' self-confidence and positive self-efficacy beliefs cause their mathematics anxiety to decrease.

5.3. Family and Friends-Related Factors Theme

Within the scope of the reasons affecting mathematics anxiety, opinions of primary school fourth-grade students on the theme of "Family and Friend-Related Factors" and the frequency and percentages of these views are given in Table 12:

Table 12. Views of Primary School Fourth-Grade Students on Family and Friend-Related Factors and Their Frequency

Themes	Code	Sub-Code	F(n:27)	%
Family and Friends Related	Factors Increasing Anxiety	Indifference	10	37
		Excessive Expectations	12	44
		Being a Subject of Ridicule	8	30
	Factors Decreasing Anxiety	Family Support	3	11
		Friend Support	2	7

When Table 12 is examined, it is seen that out of 27 primary school fourth-grade students 10 (37%) stated that indifference, 12 (44%) stated that excessive expectations, and 8 (30%) stated that being a subject of ridicule increased their anxiety. In addition, 3 (11%) of the students stated that family support and 2 (7%) stated that friend support decreased their anxiety.

In this context, regarding the code of the factors that increase mathematics anxiety, participant S 8 said, "My mother's favourite subject is mathematics, so she told me to get a high grade. That's why I study, but I am afraid that I won't get a high grade". Similarly, participant S11 said, "If I cannot solve the question when I come to the whiteboard, I am afraid that my friends

will laugh at me and I will feel sad. That's why I do come to the whiteboard". Participant S 3 said, "My mother does not know mathematics, and my father does not help me, so I cannot do it, and I do not understand it." The participants underlined that indifference, excessive expectations and being a subject of ridicule increased their anxiety.

Regarding the code of the factors that decrease mathematics anxiety, participant S 25 said, "We study together with my friend X and do it. I get along well with him/her. We both do it together, and we help each other out. We sometimes explain the questions and homework to each other and understand better". Participant S 17 said, "If I can't do it, I will ask my mother. If I cannot do it, she will help so I will not be afraid". The participants stated that students' family support and friend support led to a decrease in mathematics anxiety.

5.4. Exam-Related Factors Theme

Within the scope of the reasons affecting mathematics anxiety, opinions of primary school fourth-grade students on the theme of "Exam-Related Factors" and the frequency and percentages of these views are given in Table 17:

Table 13. Views of Primary School Fourth-Grade Students on Exam-Related Factors and Their Frequency

Themes	Code	Sub-Code	f(n:27)	%
Exam Related	Factors Increasing Anxiety	Fear of Exam	15	55
		Exam Nervousness- Stress	13	48
		Low Grade Anxiety	16	59

When Table 13 is examined, out of 27 primary school fourth-grade students, 15 (55%) stated that fear of exams, 13 (48%) stated that exam nervousness-stress, and 16 (59%) stated that low grade anxiety increased their anxiety.

In this context, regarding the factors that increase mathematics anxiety, participant S 22 said, "I study to get a high grade in mathematics, but sometimes I get low grades. That's why I'm afraid. I sometimes study, but I still forget during the exam.", while the participant S19 stated, "I do not know how to say. Sometimes the questions are difficult, so I also have exam stress on me, so sometimes I feel nervous." Participant S 18 said, "My grades are good, but I still get nervous in the exams thinking I will get low grades," and also, participant S 1 said, "I got nervous thinking I will get a low grade during the exam and I got a low grade". They stated fear of exams, exam nervousness-stress and low-grade anxiety caused their mathematics anxiety to increase.

DISCUSSION

When the findings of the mathematics anxiety levels of primary school fourth-grade students were considered, it was seen that the mean score for the mathematics anxiety exam dimension was the highest (9.17), and the mean score for the mathematics anxiety lesson dimension (3.89) was the lowest. When the literature is reviewed, it is seen that there are findings that both support and do not support this finding. In this context, similarly, in the study conducted by İpek (2019) on the mathematics anxiety of middle school students, it was found that the highest mean score belongs to exam anxiety, and the lowest mean score belongs to mathematics lesson anxiety. In the study conducted by Doğan (2018), it was determined that the highest frequency of the factors that increase mathematics anxiety belongs to exam anxiety. Additionally, Uusimaki & Nason (2004) stated in their study that 48% of the participants stated that the situations that created the highest mathematics anxiety were written and oral exams.

It was determined that the mean score of primary school fourth-grade students in terms of gender variable for their math anxiety levels did not show a significant difference. This finding is supported by Aydın & Keskin (2017), Dede & Dursun (2008), Gunderson, et al. (2018), Sorvo, Koponen, Viholainen, Aro, Raikkonen, Peura, Dowker, & Aro (2017), Şimşek, et al. (2017), Zakaria, Zain, Ahmad, and Erlina (2012), whereas it is not supported by the studies conducted by Bozkurt (2012), Eldemir (2006), Gündem (2017) and Konca (2008).

When the findings regarding the relationship between the mathematics anxiety levels of primary school fourth-grade students and their mathematics lesson academic achievement were examined, it was found that there was a moderately negative relationship between mathematics anxiety and mathematics lesson academic achievement. When the literature is examined, the studies carried out by Arslan, Güler & Gürbüz (2017), Cargneluttia, Tomasettob & Passolunghia (2017), Devine, Fawcett, Szűcs & Dowker (2012), İlhan & Öner Sünkür (2012), İpek (2019), Kesici (2015), Kılıç (2011), Richardson & Suinn (1972), Yenilmez & Özabacı (2003) and Zakaria, et al. (2012) seem to support this finding.

When the findings regarding whether or not mathematics anxiety levels of primary school fourth-grade students affect their academic achievement in the mathematics lesson, it was determined that mathematics anxiety predicted the academic achievement in mathematics lesson by 15.8%. When the literature is reviewed, studies supporting this finding are available. In this context, Pekdemir (2015) found this rate as 7% in their study carried out with ninth and tenth-grade students, and İlhan & Öner Sünkür (2012) found the predictive rate of mathematics anxiety for mathematics lesson as 18%. Finally, Bozkurt (2012) found in his study with secondary school students that 23% of mathematics anxiety variance was associated with mathematics grade.

When the findings of the interviews conducted to determine the factors that create students' mathematics anxiety were examined, it was seen that teachers could have increasing or decreasing effects on students' mathematics anxiety. In this context, it is seen that the factors of "Negative Feedback" and "Negative Attitude Towards Students" increase mathematics

anxiety in students. On the other hand, it is observed that factors such as "Reward-Reinforcer", "Positive Attitude Towards Students," and "Method-Technique" decrease mathematics anxiety in students. When the results obtained are examined in the literature, it is seen that these findings are supported by many researchers. In this context, Karlı Şentürk (2016) stated that the teacher-student relationship is a predictor of mathematics anxiety. Elçi (2002) stated that the behaviors and attitudes of mathematics teachers can affect students positively or negatively. Bekdemir, Işık & Çıkılı (2004) stated that the most important factor in the development of mathematics anxiety is the negative behaviours of teachers. On the other hand, it is known that teachers' positive attitudes towards students help students love the teacher, and thus loving the teacher encourages students to love the lesson and their anxiety towards the declines (Alkan, 2011; Baban, 2018; Furner & Berman, 2003; Öztürk, 2016). Harper & Daanne (1998) stated in their study that the inflexible and strict classroom environment and the method and techniques used by teachers were effective in the development of mathematics anxiety. Finally, Newstead (1998) stated that students who are taught with traditional methods have higher mathematics anxiety levels than students who are taught with alternative methods.

Another finding is that the factors of "Nervousness - Stress", "Lack of Self-Confidence", "Not Studying", "Not Listening to the Lesson", "Absenteeism" and "Not Finding Oneself Intelligent" increase students' mathematics anxiety, whereas "Self-confidence", "Positive Self-Efficacy Belief," and "Studying Enough" decreased mathematics anxiety. It is determined that these findings are supported in the literature. In this context, Aydın & Keskin (2017) stated in their study that there was a significant relationship between students' feeling self-confident or self-efficacious in a mathematics lesson and their mathematics anxiety levels and feeling self-confident or self- efficacious reduced their anxiety levels. Sapma (2013), on the other hand, stated that lack of self-confidence, forgetting, fear, not finding oneself intelligent, and hopelessness lead to mathematics anxiety. In addition, Gündem (2017) stated in their study that there was a significant relationship between the mathematics levels at which students saw themselves and their mathematics anxiety levels and the anxiety scores of the students who considered themselves inefficacious in mathematics class were found to be the highest. Finally, Kalın (2010) stated that as the positive self-efficacy belief increases, anxiety decreases.

When the findings of the study are examined, it is seen that one of the factors that increase or decrease mathematics anxiety is family and friend-related. In this context, it is observed that the factors of "Indifference," "Excessive Expectations," and "Being a Subject of Ridicule" increase students' mathematics anxiety. On the other hand, it is seen that the factors of "Family Support" and "Friend Support" are factors that decrease mathematics anxiety in students. When the results obtained are compared with the literature, it is seen that they are supported by many researchers. In this context, Şimşek et al. (2017) stated that the most important reason for mathematics anxiety in students is students' friends. In addition, Yenilmez & Midilli (2006) found a significant relationship between parents and students' mathematics anxiety levels. In this context, Varol (1990) stated that the high academic achievement expected by parents from their children causes the fear of not achieving a high level of success in children, and this fear results in anxiety in children and therefore negatively affects their academic success. On the other hand, Baban (2018) stated that there are differences between the students who receive support from the family and those who do not and that the mathematics anxiety levels of the students who receive support from their families are lower than the students who do not receive support from their families. Finally, Öztürk (2016) stated that family support increases motivation, and thus, mathematics anxiety decreases and mathematics achievement rises.

When the study findings are examined, it is seen that one of the factors increasing or decreasing mathematics anxiety is exam-related. In this context, it is seen that the factors of "Exam Fear," "Exam Nervousness-Stress," and "Low-Grade Anxiety" increase students' mathematics anxiety. When the obtained results are compared with the literature, it is seen that they are supported by many researchers. In this context, Şan & Akdağ (2017) stated that exam anxiety affects exam performance, and there is a negative relationship between exam anxiety and exam performance. On the other hand, Karadağ & Karadeniz (2014) stated that high-grade expectation causes students to make mistakes, resulting in mathematics anxiety. Besides, Yenilmez & Midilli (2006) stated that students with low mathematics grades have a high mathematics anxiety level.

When the research findings are examined, it is seen that one of the factors increasing or decreasing mathematics anxiety is lesson-related. In this context, it is seen that the factors of "Difficulty Level of the Lesson," "Complexity of the Subjects," and "Disliking Lesson" increase the students' mathematics anxiety. On the other hand, it is seen that the factor of "Liking the Lesson" is a factor that decreases the mathematics anxiety in students. When the results obtained are compared with the literature, it is seen that they are supported by many researchers. In this context, Yenilmez, Girginer, & Uzun (2004) stated that the difficulty level of the mathematics lesson perceived by the students causes them to have negative feelings towards the reading. Also, Türkmenoğlu, Aytekin, & Arıkan (2019) found that the anxiety levels of pre-service teachers who liked the subject were lower than those who did not like the subject. In their study with middle school students, Taşdemir (2015) found a significant relationship between liking or disliking the mathematics lesson and mathematics anxiety levels, and those who loved the mathematics lesson had lower anxiety levels than those who did not. Finally, Baban (2018) stated that there is a significant relationship between mathematics anxiety level and liking the mathematics lesson, and the more the student likes the lesson, the lesser level of anxiety towards the lesson.

CONCLUSION AND RECOMMENDATIONS

In the study, it is seen that there is not a single factor that causes mathematics anxiety. Different factors come together and lead to math anxiety in students. In this context, by considering the factors that cause mathematics anxiety as a whole, studies for cooperation between teachers, students and parents can be carried out.

In the study, it is seen that the parents' approach to the student affects the level of math anxiety in the student. In this context, guidance studies can be carried out for families on how to approach students.

It is observed that there is a significant negative relationship between the mathematics anxiety self-efficacy dimension of students and their mathematics lesson achievement. In this context, face-to-face guidance services, seminars or courses can be provided to increase students' self-efficacy levels.

It is seen in the present study that one of the reasons for mathematics anxiety is related to the teacher. In this context, practical in-service training activities can be conducted to help teachers adopt approaches in their attitudes and behaviours towards students in the classroom. In addition, considering that the positive reinforcers given to the students reflect positively on the students, it can be suggested to conduct studies on how to give positive reinforces in the classroom.

The study determined that the factors that create mathematics anxiety are teachers, students, lessons, and exams. In this context, researchers may be suggested to work on these themes.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

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