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An Evaluation of Mathematics Achievement of High School Students with Mathematics Anxiety

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Abstract: In this study, we evaluate the relationship between anxiety and success regarding math classes by measuring, through Mathematics Anxiety Scale, the anxiety levels of first, second, and third grade public high schoolers for math classes. This study has been applied to the students of 9-A, 10-B, 11-A classes in the 75th Year Anatolian High School and the students of FL9-C, FL10-F, FL11-A classes in the Ayseabla College Science High School. During the collection of data, the scale that has been used to measure the anxiety of students is Erol's "Mathematics Anxiety Scale", [1]. The collected data has been inspected by t-testing, analysis of variance and especially correlation analysis. The purpose of the analysis is a contrast and comparison of the math anxiety and the success of the students based on their grade levels. The sample of the research consists of 30 female and 33 male students of 9-C, 10-F, 11-A classes in 75th Year Anatolian High School and 31 female and 27 male students of FL-9A, FL-10B, FL-11A in Ayseabla College Science High School. As a consequence, the sample consists of 121 students. The *Math Anxiety Scale* has been implemented to 121 of these students. The Math Anxiety scale, which has been implemented during this study, has a Cronbach Alpha coefficient of 0.91, [2]. The scale consists of 4 questions; each question has 4 Likert type answers. The highest attainable score is 180 whereas the lowest attainable score is 45. According to this standard, the scores between 45-68 is considered to be low, 69-109 is normal, 109-128 is anxious, and 129-180 is very anxious [3]. The results of this study show that there is not a noticeable difference between the grade type and the anxiety levels. However, a correlation has been discovered between the anxiety levels and success rates of the students in general. Consequently, as a result of the conclusions that have been reached through the evaluation of this correlation, certain proposals have been developed.

Keywords: Math anxiety scale, Interest in Math.

1 Introduction

In the realization of learning, besides individual characteristics such as age, intelligence, motivation, past experiences, internal communication, the state of anxiety is one of the most important factors affecting learning. Learner [4] concluded that, as a result of his research on mathematics, the fear and anxiety of mathematics makes the child think clearly, make an organization among the information and make relationships difficult and hamper. The state of anxiety at the intellectual, behavioral and physiological levels will decrease the attention of the students on the course and this will make learning difficult. In order for learning to take place, a permanent and effective communication between the billions of cells in the brain is needed. Anxiety prevents the establishment of this communication within the brain and adversely affects the mental activities of reasoning and abstract thinking. Anxiety level may affect the concentration and interest of the student who is constantly working in the classroom because of the fear of being successful in the exam and cannot provide the concentration of the student who is tired of studying, and cannot spend the duration of the study effectively [5]. Thus, various sizes of anxiety; future concerns, reading anxiety, test anxiety, math anxiety, and so on occurs. Mathematics Anxiety, the main theme of this study, is an important sensory factor that affects students negatively and causes negative attitudes towards mathematics [6]. Attitude refers to a person's positive or negative feelings about showing certain behavior. According to Tavşancıl [7], the tendency to react positively or negatively on learned against certain objects, situations, institutions, concepts or other people is called attitude. The information learned on any subject, even if they have fallen over time, is easily unforgettable [8]. Cognitive factors causing math anxiety through affective factors are related to lack of knowledge of teachers and authoritarian instructors, lack of mathematical background of students, necessity of memorizing of formulas, the prevalence of non-real-life problem applications, strict, difficult and time-bound examinations of concrete materials mathematics, normative books and the difficulty of some subjects [9]. Affective factors are related to personality types, mathematics avoidance, negative attitudes towards mathematics, lack of trust, level of mathematics achievement, negative school experiences, gender bias, family and teacher behaviors [10].

Mathematics-related researches have also shown that people are associated with negative experiences and training experienced in educational life. Teachers' negative attitudes and unrealistic lesson practices, time-limited mathematics testing, fear of doing something wrong in the classroom, asking teachers something, inadequate group work and the chance to work, material and manipulation can be important reasons for increasing math anxiety.

The methods used in mathematics education and the structure of mathematical concepts can be defined as situational reasons. Important reasons for creating mathematics anxiety are the teaching strategies used by mathematics teachers and teachers [11]. The behaviors of an

authoritarian mathematics teacher may have negative effects such as failure, inadequacy and inadequate feeling on the students [12]. Mathematical concepts that have no connection in real life and therefore abstract content can increase anxiety [11]. The negative effects of math anxiety on mathematics learning may cause the individual to fail to escape mathematics naturally [13], [14]. While the negative effects of math anxiety on mathematics learning are so important, it is possible to cope with math anxiety by knowing and eliminating the causes. In this study, the differences and relation between Mathematical Anxiety Levels and Mathematics Achievements will be evaluated according to the grade levels of high school students from two different school types.

1.1 Scope and importance of the research

This research aims to determine the anxiety and mathematics achievement levels of high school students who have an important place in the education system of our country. In order to achieve this basic goal, the following questions are sought:

- What are the math anxiety levels and mathematics achievements of the students in private and public high schools in Turkey?
- Are there any differences between math anxiety levels and mathematics achievement of the students in terms the type of high schools they are enrolled in Turkey?

This research is important in terms of the effect of factors such as the type of school, gender, which affect the formation of anxiety in mathematics anxiety and mathematics achievement levels of high school students and thus guidance on reducing or completely eliminating the anxiety which may negatively affect mathematics achievement.

1.2 Counting and limitations of research

It was accepted that the students studying in the state and private schools participating in the research reflect their true feelings and thoughts while answering the questions in the measurement tools. This research is limited to data on the 2017-2018 academic year.

2 Method

In this part of the research; research model, sample and data collection tool, and analysis are emphasized.

2.1 Research model

In this study; State Anatolian High School and Private High School1, High SchooL2 and High School3. "Mathematics Anxiety" emotions and thoughts of the class students have been tried to be measured. In this context, research is a survey model research.

2.2 Data collection tool

In order to determine the anxiety levels of mathematics students of 75th Year Anatolian high school (State Anatolian High School) and Ayseabla College(Private), who are the sample of the research, Mathematics Anxiety Scale which was developed by Richardson and Suinn (1972) (Scale named as Math Anxiety Rating Scale-MARS-A) and adapted to Turkish culture by Erol [1], was used. Math anxiety scale which is a 4-item Likert-type scale of 45 items and the validity and reliability study was conducted, the Cronbach Alpha coefficient was determined as 0.91 for this study and it was accepted that the scale was reliable [15].

The highest score is 180 and the lowest score is 45. 45-68 Low, 69-108 Normal, 109-128 anxiety, 129-180 High anxiety was determined according to the scores obtained from this scale [3]. Student success grades; at the end of the semester the teacher was taken. No measurements have been made.

2.3 Sampling, data collection

A sample of 121 students, of which 58 students in the Ayseabla College and a total of 63 students in the 75th Year Anatolian High School, were selected. Mathematical Anxiety Scale was applied to the general mathematics course before applying; In the analysis of the data, it was examined whether the levels of math anxiety and success differed by using frequency distribution and variance analysis. Then the t-test was used to evaluate the relationship between gender and the difference between anxiety and success.

2.4 Analysis process

The data were entered into the SPSS program and the frequency and percentiles of the question items of the scale were used according to the school type variable levels, and the variance analysis (ANOVA) was used for the difference between the school type grade level anxiety scores and the spring year math achievement scores, and the correlation between the math anxiety scores and the math achievement scores were examined. Then the t-test was used to evaluate the relationship between gender and the difference between anxiety and success.

3 Results and Findings

In this section, the findings and comments are determined in accordance with the purpose of the research. The distribution of the school type, the grade level and the characteristics of the students are shown in Table 1.

Table 1 Sampling Characteristics

School	9th grade	10th grade	11th grade
75th Year Anatolian High School	12 Females	10 Females	8 Females
	9 Males	12 Males	12 Males
Ayse Abla College	9 Females	12 Females	10 Females
	13 Females	5 Females	9 Females

3.1 Differences between school types

75th Year Anatolian High School has been investigated by analyzing the ANOVA test in which the grade level math anxiety scores of high school students have been differentiated and the results are presented in Table 2. (9A;N=21,Mean=103,1905),(10B;N=22,Mean=95,8182) ((11A;N=20,Mean=90.6500)

Table 2 75th Year Anatolian High School, Class Level Mathematics Anxiety Score ANOVA Analysis Results

ANOVA					
Anxiety Score	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	446,685	2	223,343	,499	,610
Between Groups	26869,061	60	447,818		
Total	27315,746	62			

75th Year Anatolian High School 9-C, 10-F, 11-A students' Anxiety Points in the analysis of the difference between the average; Firstly, the homogeneity of the variance of the groups was analyzed and the result; Test of Homogeneity of Variances was found to be $p > \alpha 0,875 > 0,05$ and variance, homogeneity was observed. The above findings were obtained. According to the findings; $0,610 > 0.05, p > \alpha$, Red hypothesis (Ho), hypothesis (Ho). In the evaluation, there was no difference between the 75th year Anatolian High School Grade Anxiety Grade scores. High school students' private high school Ayseabla College Science High School grade level math anxiety scores were analyzed by ANOVA test and the results are shown in Table 3. (FL9A;N=21,Mean=81.5714),(FL10A;N=19,Mean=78.1579)
(FL11A;N=18,Mean=65.1111)

Table 3 Ayseabla College Grade Level Math Anxiety Score ANOVA Analysis Results

ANOVA					
Anxiety Score	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	1153,947	2	576,974	0,868	,426
Between Groups	22376,122	56	406,839		
Total	23530,069	58			

Ayseabla college class levels (Science High School 9-A, Science High School 10-B, Science High School 11-A class) and the Mathematics Anxiety Score Scale that were obtained according to the results of Mathematics Anxiety Score Scale were used. First of all, the homogeneity of the variance of the groups was analyzed and the results of the Test of Homogeneity of Variances were found to be $p > \alpha\, 0,129 > 0,05$, and when the homogeneity of variance was observed, ANOVA was applied. $0,426 > 0.05, p > \alpha$, Reject Alternate Hypothesis (Ha), Accept Null hypothesis (Ho). Assessment: There is no statistical difference among Ayseabla College Class Levels Anxiety Points.

3.2 Differences between genders

The t-test results of the 75th year Anatolian High School students' mathematics anxiety levels were investigated in Table 4.

Table 4 t-Test Results of the Differences between the Gender Groups of the 75th Year Anatolian High School

	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**t**	**Sig(p)**
Math Anxiety	Females	26	93,2692	15,69855	3,07874	-1,532	0,196
	Males	37	100,6216	20,61870	3,38969		

According to Table 4, there is no difference between the gender groups in the 75th year Anatolian high school in terms of math anxiety $(0,196 > 0,05; p > \alpha)$.

3.3 t-Test Results of Math Anxiety Differences between Gender Groups

The t-test results of Ayseabla College Science High School students' mathematics anxiety levels were investigated in Table 5.

Table 5 Ayseabla College t-Test Results Related to Differences between Gender Groups

	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**t**
Math Anxiety	Females	29	82,8276	19,72864	3,66352	-2,469
	Males	29	96,0000	20,88232	3,87775	

Table 8 Ayseabla College Science High School Mathematics Achievement Turkey (LSD) multiple comparison tests

Multiple Comparisons						
Tukey HSD						
(I)Grade Level	(J)Grade Level	Mean Difference(I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
FL9A	FL10A	3,41353	6,69124	,867	-12,7040	19,5311
	FL11A	16,46032*	6,78812	,048	,1094	32,8112
FL10B	FL9A	-3,41353	6,69124	,867	-19,5311	12,7040
	FL11A	13,04678	6,95106	,155	-3,6966	29,7902
FL11A	FL9C	-16,46032*	6,78812	,048	-32,8112	-,1094
	FL10F	-13,04678	6,95106	,155	-29,7902	3,6966
*The mean difference is significant at the 0.05 level						

According to Table 5, there is no difference in terms of math anxiety among the gender groups of the 75th year Anatolian high schools $(0, 198 > 0, 05; p > \alpha)$.

3.3 Differences between school type mathematics achievement grade levels

The variance analysis and the levels of the differences in the mathematics achievement level of the students who make up the school type sample according to the grade level they have studied are also investigated by Turkey (LSD) multiple comparison tests and the results are given. The Mathematics Achievement Score of 75th Year Anatolian High School students sample was analyzed by ANOVA test, and the results are presented in Table 6. Student success grades; At the end of the semester the math teacher evaluated. Evaluation was used. No measurements.

Table 6 Results of Analysis of Variance Related to Differences between Mathematics Achievement Points

ANOVA	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	2642,141	2	1321,071	2,965	,069
Within Groups	28072,359	3	445,593		
Total	30714,500	5			

9C, 10F, 11A CLASSES

In the sample, the homogeneity of the variance of the groups was analyzed and the result; Test of Homogeneity of Variances was found to be $p > \alpha\ 0, 254 > 0, 05$ and variance, homogeneity was observed.

The above findings were obtained. According to Table 6, there is no difference in terms of the 75th year Anatolian High School Grade Math Levels. ($0.069 > 0.05$ i.e. $p > \alpha$, Reject H_a, Accept H_0.

The mathematics achievement scores of the students in Ayseabla College of Science High School which the grade level achievement scores were taken from the course lecturer were analyzed through ANOVA test whether the scores were differentiated or not and the results were presented in Table 7.

Table 7 Results of analysis of variance related to differences between mathematics achievement points.

ANOVA			
	Sum of Squares	**df**	**Mean Square**
Between Groups	2849,656	2	1424,828
Within Groups	24563,447	55	446,608
Total	27413,103	57	

FL 9A, FL 10B, FL 11A CLASSES

In the sample, the homogeneity of the variance of the groups was analyzed and the result; Test of Homogeneity of Variances was found to be $p > \alpha\ 0, 473 > 0, 05$ and variance, homogeneity was observed. The above findings were obtained. According to Table 6, there is a difference in Ayseabla College Mathematics Achievement Points. ($0.049 < 0.05$, $p < \alpha$, H_a Accept, H_0 Reject). The levels of the differences were investigated with the help of Turkey (LSD) multiple comparison test and the results are given in Table **??**.

According to Table **??**; FL9A-FL11A ($p < \alpha$, $0, 048 < 0, 05$) and FL11A-FL9C ($p < \alpha$, $0, 048 < 0, 05$) There is a difference in success.

3.4 The relationship between math anxiety scores and mathematics achievement at the school level

A relationship between the grade level mathematics anxiety scores and mathematics achievement in both School types is analyzed by Correlation Analysis and explained in Table 9.

According to Table 8, there was no correlation between 75th year Anatolian High School and Ayseabla College Class Levels Mathematics Anxiety Scores and Mathematics Achievement Score ($0, 379 > 0, 05$, $0, 375 > 0, 05$, $0.86 > 0, 05$, $0, 902 > 0, 05$, $0, 847 > 0, 05$, $0, 243 > 0.05$)

Table 9 School type Math anxiety and mathematics achievement Correlation scores table

	75thYear Anatolian High School			Ayseabla College		
	AL9C	**AL10F**	**AL11A**	**FL9A**	**FL10B**	**FL11B**
Per Cor (Rxy)	0,208	-0,210	0,034	-0,028	0,046	0,0281
Sig.(2 Tailed) (p)	0,379	0,375	0,886	0,902	0,847	0,243
	$0,379 > 0,05$	$0,375 > 0,05$	$0,886 > 0,05$	$0,902 > 0,05$	$0,847 > 0,05$	$0,243 > 0,05$

3.5 Type of school mathematics anxiety status evaluation table

In the evaluation of the Mathematical Anxiety Scale m, the highest score is 180 and the lowest score is 45. 45-68 Low, 69-108 Normal, 109-128 anxiety, 129-180 High anxiety was determined according to the scores obtained from this scale (Erktin, Donmez, Ozel, 2006). The evaluation of the school type sample is explained in Table 10.

Table 10 School type *Math Anxiety Scale* evaluation table

	75thYear Anatolian High School			Ayseabla College		
ANXIETY SITUATION	**AL9C**	**AL10F**	**AL11A**	**FL9A**	**FL10B**	**FL11B**
45-68 Low	1	-	3	2	6	-
69-108 Normal	12	16	14	13	8	18
109-128 With Anxiety	6	6	2	3	3	2
129-180 High Concerned Anxiety	2	-	1	4	-	1
Total	21	22	20	22	17	19

In the descriptive evaluation of the Mathematics Anxiety Scale scores; It is seen that the next grade level in which the anxiety exists in the first grade level of both school types is decreasing.

4 Conclusion, Discussion

According to the research results; 75th Year Anatolian High School and Ayseabla colleges Science High School Grade High School students did not differ in terms of math anxiety levels ($F(3) = 0,4999, 0,610 > 0.05, p > \alpha$). There is no statistically significant difference between the scores of mathematics grades of high school students according to their grade level. So, students' concerns about mathematics do not change significantly according to the level of the class they study; normal, 109-128 anxious, 129-180 high concerned; Anxious and High Anxiety Rate: It is seen in Table 11 that students' prejudices towards mathematics are broken as the grade level increases, and this result is seen in Table 11.

Table 11 Anxious and High Anxious

75thYear Anatolian High School			Ayseabla College		
AL9C	**AL10F**	**AL11A**	**FL9A**	**FL10B**	**FL11B**
%38	%27	%15	%31	%18	%5

Another result obtained from the study; the mathematics achievement level of the sample which applied both types of mathematics Mathematical Anxiety Scale was not significant in the 75th Year Anatolian High School while there was a significant difference between the grade levels of Ayseabla Science High School.

The difference from the FL11A subgroup was verified in the Tukey result. This can be interpreted as the increase in the level of mathematics achievement as the class level increases In both types of schools, Scale could not be applied because senior students were reported in the preparation of university exam. It may be thought that the inclusion of this sample will change the outcome of the data. Another finding found in the study was that there was no statistically significant difference between the levels of anxiety related to mathematics according to the gender variable ($t - 2,469, 0,198 > 0,05$, so $p > \alpha$).

This finding showed that the gender variable had a significant effect on students' math anxiety. However, the mean score of the female students about mathematics ($= 82.8$) was higher than that of male students ($= 96$). From here, it can be said that male students are slightly more anxious than female students.

Another finding reached in the study is; Correlation analysis between school type grade level anxiety score and mathematics achievement was not found to be significant. Correlation analysis rates are; 75thYear Anatolian High School ($9C$; $0,379 > 0,05$ $-10F$; $0,375 > 0,05$ $-11A$; $0.86 > 0,05$), Ayseabla College Science High School ($FL9A$;, $0,902 > 0,05$ $-FL10B$, $0,847 > 0,05$ $-FL11A$ $0,243 > 0,05$) The relationship of anxiety and success is not the case in two school types. This is an important finding for the purpose of the study. In the frequency analysis of the sample; with a high frequency (Question19; 55%). The most important cause of the students to worry about the mathematics exams were determined as unannounced. In this case, it is emphasized that the anxiety against the course increases in making an unannounced examination.

Another question item with high frequency is question 15, its frequency is 80%. In simple mathematical operations, he was asked if he doesn't sound like he couldn't calculate money, for example. This situation can be defined as a lack of self-confidence in the use and implementation of mathematics in daily life. Another question is; Question12 is the percentage and the frequency percentage is 65%. I'm afraid to

explain even the problems I can solve. This situation can be defined as lack of self-confidence against mathematics.

4.1 Suggestions

The student fails when he/she is worried, and when he/she fails, the student is afraid of the lesson and the failure is realized. The students studying in the small class are found to be more anxious than the students in the higher level.

This situation was determined in the research findings that these students may cause a new school, new friends and different teachers to have a new system in their transition from primary to secondary education and this may cause anxiety.

The best constructive recommendation for this situation; It can be suggested to plan and implement adaptation programs, especially the 9th-grade students, general contents of the courses, the introduction of teachers, the school environment and the school life, the examination system and reducing anxiety. Orientation programs can be prepared. In addition, as the grade level increases, the increase in mathematics achievement can be interpreted as the focus on the lessons as a channel to the preparation of the university exam. In item frequency evaluation of the scale; the most common cause of the students to worry about the mathematics exams were determined unquestionably (Question19; 55%). For this situation that causes the student to be taken into consideration, before the examination of the students' readiness to take into account, if necessary, determining the dates of the exam with the students, will be shown to have a positive effect on the reduction of anxiety. The problem of simple mathematical operations, for example, not to deduct from the money to calculate the top of the sound (Question15; 80%), the suggestion of the student is not kept away from simple mathematical calculations in daily life and the practical calculation of the acquisition of the family to be sent to shopping, for example.

The percentage frequency of Question 12 in scale is 65%. It is stated that I am afraid to explain even the problems I can solve. For this situation, the lack of self-esteem for mathematics operations is the fact that it was proposed to be introduced in the previous years in the family and that it should be started from the pre-school.

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