Mathematics Anxiety of Ninth Grade Students

Güneş Yavuz

Correspondence: Güneş Yavuz, Hasan Ali Yücel Education Faculty, Istanbul University, Istanbul, Turkey.

Abstract

Human beings have been using mathematics since they got familiar with the environment they lived in. Because of this reason, the emphasis of necessity of mathematics education for schools with various levels in different countries has undoubtedly been agreed upon. Mathematics anxiety is a problem for many people. Mathematics anxiety is one of the subjects that have attracted interest of training psychologists and mathematics teachers. It can have detrimental effects for high school students including feelings of nervous tension, fear of rejection, and stress. Mathematics anxiety is intense emotional feelings of anxiety that people have about their ability to understand and perform mathematics. While mathematics anxiety may be perceived as an excuse for poor mathematics performance, it can be a valid, justifiable excuse as well. This study examined the mathematics anxiety levels and changes in mathematics anxiety levels with respect to gender, whether students had prior special tutoring, mathematics achievement level and parental education level of high school ninth grade students in İzmir. The sample included 250 ninth grade students. The data were collected using the "Mathematics anxiety scale" developed by Erol (1989). The scale aimed at measuring students' anxiety towards mathematics. In addition, an individual information form was developed by the researcher to collect demographic data. The data obtained from this study were evaluated using SPSS version 11.0 statistical programme and t-test and ANOVA statistics were calculated. The results show that; mathematics achievement level and parental education level is statistically significant. Mathematics anxiety scores do not exhibit statistically significant difference according to gender and students prior special tutoring.

Keywords: teaching mathematics, mathematics anxiety

1. Introduction

In Turkey, the efforts to eliminate the sources of students' anxiety towards mathematics learning and the negative attitudes resulting from this anxiety have been discussed for many years. However, as per date there has not been a conclusive result toward solution. When we examine this issue as educators one should assert that to reveal such adverse situations we need more research to gain insight into the problem. Researchers emphasize the necessity of starting mathematics education in kindergarten and the influence of teaching Realistic Mathematics on the development of mathematical competence (Papadakis, Kalogiannakis & Zaranis, 2016). Demir (2017) stated the effect of the Realistic Mathematics Education (RME) on student achievement and mathematical anxiety of 10th grade students.

Research about mathematics anxiety has started in the 1960s and as it gained importance many more studies have been conducted since then. Researchers suggested various definitions for mathematics anxiety. Mathematics anxiety was first defined by Dreger and Aiken (1957) as emotional reactions syndrome displayed towards mathematics and arithmetic (Baloglu, 2001). Buxton (1981) on the other hand, defined mathematics anxiety as a panic state which keeps one's thoughts under control. In another study, Morris (1981) defined mathematics anxiety as a phenomenon which is one's illogical fear that when one thinks of mathematics this fear causes one to freeze up, prevents one's learning and performance, and causes distress. Mathematics anxiety is one of the critical factors that can have impact on an individual's education life and job selection.

Considering these definitions it seems that there is need to investigate the causes of mathematics anxiety. The reasons for mathematics anxiety are considered in three dimensions as environmental, mental, and personal factors by the researchers. Among the environmental factors are negative experiences encountered in class, parental pressure on students, insensitive and pedagogically inadequate teachers, preconceptions about mathematics formed in time (e.g., introducing mathematics as a collection of strict rules starting from early years of educational process), and a teacher centred classroom climate where students are passive.

Emotional factors can be listed as teaching strategies not suitable for students' learning styles, student attitudes, easily giving in, lack of motivation, incorrect thoughts and prejudice students develop against their own mathematical ability,

one's low perception of self value, lack of self confidence, and the way of thinking which asserts that mathematics is not necessary. Timidity in asking questions in class, shyness, self-distrust, and prejudiced ideas such as thinking that only males can be successful in mathematics are some of the personal causes.

Most of the time anxiety is observed to be a behaviour which appears in particular stimulating conditions instead of being a general feature measurable by tests. However, after accepting that anxiety was a characteristic of human and that personality was a different dimension, a requirement has appeared to evaluate this feature. In situations especially when one could not cope with anxiety, psychotherapy is applied to determine the conflicting sources that cause anxiety.

In this respect, there are various difficulties encountered in the measurement of mathematics anxiety. When the scales aimed at assessing mathematics anxiety investigated; the most frequently used and translated into various languages and adopted to be used is the Mathematics Anxiety Rating Scale (MARS) among the many scales.

1.1 Statement of the Problem

Mathematics anxiety is regarded as a problem. It may influence students' everyday life, academic careers, and even contribute to stress, which is well known to cause many other problems. Depending on this the purpose of this study was to identify the extent of mathematics anxiety among high school students in Izmir by administering a survey.

1.2 Objective Questions

The research questions that were addressed in this study are given below.

1- What is the level of ninth grade students' mathematics anxiety scores?

2- Do the mathematics anxiety scores of ninth grade students show meaningful differences according to

a- gender?, b- whether students had prior special tutoring?, c- mathematics achievement level?, d- parental education level?, d-1 Mothers educational level, d-2 Fathers educational level

2. Method

The process carried out to achieve the purpose of this study is described below.

2.1 Research Method

The purpose of this study was to assess the degrees mathematics anxiety of high school students. This is a descriptive study. The study investigated whether the existing and pre-existing mathematics anxiety level change with respect to gender, school type, whether students had prior special tutoring, mathematics achievement level, and parental education.

2.2 Population and Sample

The population of this study consisted of all 9th grade students in the city of İzmir. The sample of the study included 250 ninth-grade (15 aged) students.

2.3 Data Collection Instruments

The instruments used to collect data in this study were the 'Mathematics Anxiety Scale', and a 'Personal Information Form' developed by the researcher to obtain demographic information about the students. As the data collection instrument, 'Mathematics Anxiety Scale', developed by Erol (1989), was used to assess students' anxiety towards mathematics. The Mathematics Anxiety Rating Scale (MARS-A) developed by Richardson and Suinn (1972) was also used extensively to measure mathematics anxiety. This scale is a 98-item Likert-type scale. The items are related to daily life statements and are solutions to mathematical problems involving academic conditions that contain the complexity of numbers or mathematical problems that may cause anxiety. The responses are coded from 1 to 4. The total anxiety score was the sum of all the ratings. Possible scores range from 98 to 392. This is a component of mathematics anxiety score and indicates the degree of mathematics anxiety (Richardson and Woolfolk, 1980). The scale was administered to 397 university students and the reliability coefficient was found to be 0.93.

The Mathematics Anxiety Rating Scale (MARS-A) was translated into Turkish, revised, and adapted as an 84-item scale. Using split-half and test-retest methods reliability coefficient were found as 0.93 and 0.86 respectively (Bayraktar, 1985).

The Mathematics Anxiety Rating Scale (MARS-A) was administered to 150 students and among the students having highest item means in the MARS-A, top 10% were selected in the development of the new Mathematics Anxiety Scale (MANX). Items having the highest means were determined. Interviews were conducted with students who had high scores in the MARS-A. However, these students did not accept to respond to all of the questions. Based upon the interview results and information obtained from items having the highest means in the MARS-A, a new scale consisting of 45 items was developed. The New scale was named as Mathematics Anxiety Scale (MANX). Erol (1989) reported Cronbach Alpha reliability coefficient of the new instrument as 0.91.

In this study, the new instrument was administered to 250 ninth grade students, the data obtained were analysed using SPSS 11.0 statistical program, and Cronbach Alpha reliability coefficient was determined as 0.91. The new Mathematics Anxiety Scale was a 45-item Likert-type scale, with coding ranging from one to four. The positive items were constructed using a Likert-scale format with the following anchors: 1 always, 2 often, 3 sometimes, and 4 never. For the negative items coding was reversed. Possible scores ranged from 45 to 180.

2.4 Data Analyses

The data obtained from this study were evaluated using SPSS version 11.0 statistical programme and t-test and ANOVA statistics were calculated. In the analyses, arithmetic means and standard deviations of mathematics anxiety scores were calculated. Means were compared using t-test, ANOVA, and Scheffe test to determine if the differences between them were meaningful or not.

3. Results

The results are provided with respect to objective questions. In the first objective, I have tried to find answer to the question what is the level of ninth grade students' mathematics anxiety scores? Mathematics anxieties mean scores of ninth grade students are shown in Table 1.

Table 1. High School Students' Mathematics Anxiety Mean Scores

N	$\overline{X}$	SD
250	83.18	22.09

As reported in Table 1, high school students' mean scores on the mathematics anxiety scale was 83.18 and standard deviation of the scores was 22.09. Accordingly, I can say that high school students' mathematics anxiety is at a moderate level.

The second objective question of the study was designed as; do the mathematics anxiety scores of ninth grade students show meaningful differences according to gender? Mathematics anxiety mean scores of ninth grade students and the results of t-test carried out to determine the differences (if any) according to gender, are shown in Table 2.

Table 2. t-test results of high school students' mathematics anxiety scores according to gender

Gender	N	$\overline{X}$	SD	df	t	p
Female	129	83.86	22.50	248	0.49	0.61
Male	121	82.46	21.72			

As Table 2 shows, mathematics anxiety scores do not exhibit statistically significant difference according to gender (t=0.49, p=0.61>0.05). Mathematics anxiety mean scores of females and males are close to each other. Though the mean scores of females are a little higher than males', both groups' mathematics anxiety levels are moderate.

The third objective question of the study was designed as; do the mathematics anxiety scores of ninth grade students show meaningful differences according to whether students had prior special tutoring? The results of t-test conducted to determine whether mathematics anxiety mean scores of ninth grade students differ according to whether they had prior special tutoring are shown in Table 3.

Table 3/ t-test results of high school students' mathematics anxiety scores according to whether they had prior special tutoring

Prior special tutoring	N	$\overline{X}$	SD	df	t	p
Yes	191	82.90	22.02	248	0.35	0.72
No	59	84.08	22.49			

As seen in Table 3, there was no statistically significant difference between students' mathematics anxiety scores according to whether they had prior special tutoring. The mathematics anxiety mean scores of both groups are close to each other (t=0.35, p=0.72>0.05).

Table 4. The results of ANOVA analysis conducted to determine whether mathematics anxiety scores of ninth grade students differ according to their mathematics achievement level

	Sum of Squares	df	Mean Square	F	p
Between Groups	57028,464	3	19009,488	72,460	0,00
Within Groups	64537,072	246	262,346		
Total	121565,54	249			

p< .05

The fourth objective question of the study was, do the mathematics anxiety scores of ninth grade students show meaningful differences according to their mathematics achievement level? The results of ANOVA conducted to determine whether mathematics anxiety scores of ninth grade students show meaningful differences according to their mathematics achievement level are displayed in Table 4.

The results in Table 4 indicate a statistically significant difference between the students' mathematics anxiety scores and their mathematics achievement level. Scheffe test was conducted to determine which groups differed significantly. The results of Scheffe test are shown in Table 5.

Table 5. Scheffe test related to the differences between high school students' mathematics anxiety scores and their mathematics achievement levels

Groups	Very good (1)	Good (2)	Moderate (3)	Poor (4)	Direction of difference
Very good (1)		Significant diff*	Significant diff*	Significant diff*	1<2, 1<3, 1<4
Good (2)	Significant diff*		Significant diff	Significant diff	2>1, 2<3, 2<4
Moderate (3)	Significant diff*	Significant diff*		Significant diff*	3>1, 3>2,3<4
Poor (4)	Significant diff*	Significant diff*	Significant diff*		4>1, 4>2, 4>3

The results of Scheffe test indicate that although mathematics anxiety mean scores of students who are successful in mathematics is low ($\overline{X}$ = 64.57), as the mathematics achievement level decreases mathematics anxiety mean scores increases. The students who are not successful at mathematics have considerably high mathematics anxiety mean scores ($\overline{X}$ =120.40).

The fifth objective question was, do the mathematics anxiety scores of ninth grade students show meaningful differences according to their mothers' education level? The results of ANOVA conducted to answer this question are shown in Table 6.

Table 6. The results of ANOVA analysis conducted to determine whether mathematics anxiety scores of ninth grade students differ according to their mothers' education level

	Sum of Squares	df	Mean Square	F	p
Between Groups	9533,823	4	2383,486	5,21	0,00
Within Groups	112031,71	245	457,272		
Total	121565,54	249			

p< .05

Table 6 indicates that there is a statistically significant difference between students' mathematics anxiety scores and their mothers' education level (p<0.05). Scheffe test was conducted to determine the groups that differed significantly. The results of Scheffe test are shown in Table 7.

Table 7. Scheffe test related to high school students' mathematics anxiety scores and their mothers' education level

Groups	Illiterate (1)	Primary School (2)	Middle School (3)	High School (4)	BS (5)	Direction of difference
Illiterate (1)		Insignificant Diff.	Insignificant Diff.	Insignificant Diff.		
Primary School (2)	Insignificant Diff.		Insignificant Diff.	Insignificant Diff.	Significant Diff.*	2>5
Middle School (3)	Insignificant Diff.	Insignificant Diff.		Insignificant Diff.	Insignificant Diff.	
High School (4)	Insignificant Diff.	Insignificant Diff.	Insignificant Diff.		Insignificant Diff.	
BS (5)	Insignificant Diff.	Significant Diff.*	Insignificant Diff.	Insignificant Diff.		5<2

According to Scheffe test results, mathematics anxiety mean scores of the students whose mothers were primary school graduates, were found to be high ($\overline{X}$ = 94.88). The mathematics anxiety mean scores of students whose mothers had BS degrees, were lowest ($\overline{X}$ =76.62). The students whose mothers were primary school graduates and the students whose mothers had BS degrees have created this difference. The results suggest that students, whose mothers' education level is low, have higher mathematics anxiety mean scores.

Table 8. The results of ANOVA analysis conducted to determine whether mathematics anxiety scores of ninth grade students differ according to their fathers' education level

	Sum of Squares	df	Mean Square	F	p
Between Groups	6072,754	4	1518,188	3,22	0,01
Within Groups	115492,78	245	471,399		
Total	121565,54	249			

p< .05

The final objective question was, do the mathematics anxiety scores of ninth grade students show meaningful differences according to their fathers' education level? The results of ANOVA conducted to answer this question are shown in Table 8.

As seen in Table 8 that there is statistically significant difference between students' mathematics anxiety scores and their fathers' education level ($p < 0.05$). Scheffe test was conducted to determine the groups that differed significantly. The results are shown in Table 9.

Table 9. Scheffe test related to high school students' mathematics anxiety scores and their fathers' education level

Groups	Illiterate (1)	Primary School (2)	Middle School (3)	High School (4)	BS (5)	Direction of difference
Illiterate (1)		Insignificant Diff.	Insignificant Diff.	Insignificant Diff.		
Primary School (2)	Insignificant Diff.		Insignificant Diff.	Insignificant Diff.	Significant Diff.*	2>5
Middle School (3)	Insignificant Diff.	Insignificant Diff.		Insignificant Diff.	Significant Diff.*	3>5
High School (4)	Insignificant Diff.	Insignificant Diff.	Insignificant Diff.		Insignificant Diff.	
BS (5)	Insignificant Diff.	Significant Diff.*	Significant Diff.*	Insignificant Diff.		5<2, 5<3

According to Scheffe test results, mathematics anxiety mean scores of the students whose fathers were primary school graduates, were found to be high ($\overline{X} = 92.27$). The mathematics anxiety mean scores of students whose fathers had BS degrees, were the lowest ($\overline{X} = 78.92$). The students whose fathers were primary school graduates and those whose fathers had BS degrees have created this difference. In addition, mathematics anxiety mean scores of the students whose fathers were middle school graduates, were found to be high ($\overline{X} = 90.48$). This score is also significantly different from the mean scores of students whose fathers had BS degrees. The results suggest that students, whose fathers' education level is low, have higher mathematics anxiety mean scores.

4. Discussion

In this study, ninth grade students' mathematics anxiety was found to be at moderate levels. This is an expected level in these students. Mathematics anxiety does not have negative influences always. Low level of anxiety can be encouraging, middle level anxiety leads one to success, and high level of anxiety may have negative affects.

Formation of mathematics anxiety is thought to depend on many causes. Research suggested that mathematics anxiety was a type of content-oriented anxiety. Content-oriented anxieties are experienced in particular situations (e.g., mathematics classes) and are only specific to those situations. Most researchers have reported that content-oriented anxiety (also called state anxiety) was different from trait anxiety (stable anxiety) structurally (Benson and Bandalos, 1989; Benson, 1989; Zeidner, 1991, cited in Baloğlu 2001).

Researches have reported various factors related to the causes of the development of mathematics anxiety. Lazarus (1974) suggested that mathematics anxiety was a concept that has resulted from the interaction of various factors. Some of these factors can be listed as factors related to the field of mathematics, educational and parental attitude factors, personal values, and expectations from mathematics. Harris and Harris (1987) suggested three main causes as 'student-related', 'teacher-related', and 'teaching-related'. In the most widely used model the main causes for mathematics anxiety were reported as 'situational (state), subjective, and personal' reasons.

The results of this study indicate no difference among ninth grade students' mathematics anxiety scores. Although female students' mathematics anxiety mean scores were higher than male students' scores, the difference was not statistically significant. There are studies that support this result as well as studies reported conflicting results. Chouinard, Vezeau, and Bouffard (1999) reported that mathematics anxiety levels of girls were higher than boys. They found that some differences were greater between 12 and 14 years-old and these differences were said to disappear and become invisible in time. A similar result was reported in various studies in which mathematics anxiety levels of girls were higher than boys' (Varol, 1990; Girgin, 1990; Dong, 1994). Research also emphasized that in society mathematics anxiety was experienced more often by females than by males (Betz, 1978; Dutton, 1956; Pedro, Wolleat, Fennema, & Becker, 1981; Tobias & Weissbrod, 1980).

Another result of this study showed that whether students had prior special tutoring did not create a difference in their mathematics anxiety scores. In addition, it was found that high achievers in mathematics had low mathematics anxiety scores and low achievers in mathematics had high mathematics anxiety scores. This result is also an indication of the relationship among students' mathematics attitude, achievement, and mathematics anxiety. Researchers reported similar results suggesting that students whose achievement levels were low at school had high mathematics anxiety levels (Bozak, 1982; Sargın, 1990; Varol, 1990; Aral, 1997). In addition, Hembree (1990), Sciutto (1996), and Zeidner (1991) found that prior mathematical experience was helpful in estimating the degree of students' mathematics anxiety.

The data analysis also revealed that there was a significant difference between parental education and the students' mathematics anxiety scores. This result indicates the effects of parental attitude on students' mathematics anxiety. Education level may have impact on parents' attitude towards their children. Researches indicate that attitudes of parents who have primary education may be different than attitudes of parents who are university graduates.

Varol (1990) found no significant difference between parental education level and children' anxiety level. Gumus (1997) reported significant differences between parental education level and children' social anxiety level and determined that students whose parents had university degrees had low anxiety levels (Varol, 1990).

This section presents suggestions based on the results of this study.

Parents at home and teachers at school should know the developmental characteristics and the basic features of children' anxiety level and they should be good observers. Children whose anxiety levels are high should be determined and these children as well as their parents should get counselling help. Future attitudes and achievement levels of children should be examined.

Since student' self-confidence abates anxiety, activities that improve this feeling should be emphasized, prior activities at which the students were good at should be remembered and they should be convinced that they could still be good at those activities.

Negative attitudes, behaviours, and beliefs towards mathematical sciences enhance mathematics anxiety. School counsellors, teachers, and parents should help students to become conscious about mathematics and guide them in correcting their misbeliefs.

Researches have shown that some mathematics teachers showed mathematics anxiety and their anxiety was transmitted to their students whether consciously or unconsciously. Therefore, mathematics teachers should find ways of coping with their anxiety. School administration should support teachers in doing this.

Mathematics anxiety is a multifacet construct and involves concepts such as tension, fear, and uneasiness. Thus, the possibility of revealing mathematics anxiety using shallow strategies is considerably low. There is need for help from psychological consultants who are well educated about the concept.

In the long term, students who exhibit excessive anxiety should be directed to the counselling services and treated using improved techniques such as cognitive restructuring.

Since the main causes of mathematics anxiety could be 'student-related', 'teacher-related', and 'teaching strategy-related', in the studies that would be conducted to cope with anxiety, students, teachers, and school administrations should be responsible. They should assume separate roles.

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