

Full Length Research Paper

Investigation of high school students' attitude and anxiety levels towards Mathematics in terms of some variables

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Received 03 April, 2015; Accepted 1 July, 2015

The purpose of this study was to investigate Turkish high school students' attitude and anxiety levels towards mathematics. For this purpose, the methodology employed in this study was a descriptive study. The participants of the study consisted of 361 high school students from three different high school types from a province in Turkey during 2014-2015 fall term. The Mathematics Attitude Scale developed by Aşkar and the Mathematics Anxiety Assessment Scale adapted to Turkish by Akın et al. were used as the measuring instruments. The data was quantitatively analysed by using independent samples t-tests and one-way ANOVA. Findings showed that gender and class levels had no significant effect on the students' attitude and anxiety levels towards mathematics, whereas school type had significant effect on the attitude and anxiety.

Key words: Mathematics, anxiety, attitude, gender, school type, class level.

INTRODUCTION

Anxiety

Anxiety is defined as a feeling which sometimes encourages people to carry out creative and positive behaviors by motivating them in everyday life and sometimes hinders such positive attitudes and generally creates uneasiness. According to theories with learning approach, anxiety is a feeling acquired via conditioned behavior and conveys the properties of stimulus. Not the source of anxiety but the volume and duration and also the importance of outside challenge determine that anxiety is either a normal or pathological case (Başarı, 1990). Spielberg also categorizes the anxiety into two

groups as state anxiety and trait anxiety. State anxiety reveals itself in a specific situation or time when it appears, it can point out a dangerous situation potentially. Trait anxiety reveals an anxiety that doesn't appear with regard to a specific situation and individuals who have this anxiety can be anxious in any situation (Croft, 2000, cited in Dede, 2008).

Mathematics anxiety

Although mathematics studies depend on logic and reasoning, it notices in many people as a profound

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emotionality. In this sense, mathematical thinking and emotional and affective perspective towards mathematics are incorporated (Hannula, 2005). In this context, anxiety is one of the most pervasive issues which are related to mathematics in affective domain (Baloğlu and Koçak, 2006). Ashcraft and Faust (1994) define mathematics anxiety as mental disorder, fear of mathematics and a feeling of intense anger and frustration when one is required to solve and understand mathematical procedures and problems. It reveals that mathematics anxiety includes both cognitive and affective components, so this approach toward mathematics anxiety is crucial. Adamu (2014) mentioned in his article that “Richardson and Suinn (1972) defined mathematics anxiety in terms of its (debilitating) effects on mathematics performance. They observed that the feeling of tension and anxiety interferes with manipulation and solving of mathematical problems in a wide variety of ordinary life and academic situations”. Freedman (2013) also defines mathematics anxiety as “an emotional reaction to mathematics based on a past unpleasant experience which harms future learning”. One of the most effective factors of learning is anxiety developed against lesson. It is not possible for students to be successful without eliminating anxiety which may stem from lesson content or negative experiences. Rotella and Learner (1993) reached the result that fear and anxiety about mathematics prevented even children to think clearly and hindered the establishment of relations in providing organization between information in the study carried out on mathematics. It is put forward that mathematics anxiety stems from various reasons such as students’ not caring for school or their lessons, weak personality concept, and teacher and parental attitude to Mathematics (Norwood, 1994).

On the other hand, Cemen (1987) defines anxiety about mathematics as a reactional case activated against mathematical content situations perceived as a threat to self-respect, and presented an anxiety model including environmental, personal, and situational reasons as a process. According to this model, anxiety is the interaction of these reasons producing anxiety reaction with its psychological signs. According to this, decisions are made by struggling to control anxiety during cognitive activities. If there is powerful and obvious issue/task related confidence, basically self-respect, then the individual can cope with anxiety, and can direct it to issue/task. However, if the individuals do not have the competence to control the anxiety, in that case, this may weaken their performance.

Tobias (1993) defines mathematics anxiety as a case which shows itself in the form of sensational tension or worry when an individual comes across such cases in which he has to solve mathematical problems and to carry out processes related with numbers. This case anxiety may cause forgetfulness and lack of confidence in the individual.

Attitude

Attitude is a tendency attributed to the individual and regularly constitutes his/her thoughts, feelings and behaviours related to the psychological incident. The power of the attitude is equal to the total cognitive, sensational and behavioural aspects, which is high in fixed attitudes. The more powerful an attitude is, the more difficult it is to change it (Erkuş, 1994). Attitude is determined as a psychological variable seen as an important predictor of behaviour with its cognitive, perceptive and behavioural dimensions. Attitude includes the tendency to the attitude object, the objection to an attitude subject or being on that side (Çakır et al., 2006). Attitude is a mental, sensational and behavioural objection to pre-tendency of the individual organized depending on himself and any object around him, social issue, object, or experience against an incident, information, feeling and motivation (İnceoğlu, 2004, 19).

Mathematics attitude

Attitudes towards mathematics have been described in different ways (Zan et al., 2007, cited in Dede, 2012):

- i) negative or positive level of affect combining mathematics. This approach omits the cognitive component of attitude,
- ii) a bi-dimensional definition: attitude toward mathematics is seen as the pattern of emotions and beliefs associated with mathematics and behaviours do not appear explicitly in here, and
- iii) attitudes are shaped with three elements such as a behaviour related to mathematics, beliefs related to mathematics, and emotional reaction. This approach reveals complex constitution of attitudes.

On the other hand, most of the students set themselves far from mathematical procedures for fear that they may make mistakes.

Researches carried out about mathematics fear and anxiety pointed out that there is the existence of a low but remarkable correlation among the attitudes towards mathematics lesson as the students’ experiences in mathematics increase (Altun, 2005). Many students in Turkey develop a negative attitude to mathematics lessons with the thought that mathematics is very challenging and that it is impossible for them to learn it starting from the primary school years; therefore, they also come to a position to lose their self confidence in mathematics learning.

This negative attitude develops against mathematics, without doubt, stems from the anxiety of not being able to learn mathematics well. At this point, it is necessary to conduct studies to determine the students’ mathematics anxiety level in order to reduce it to the lowest level (Yenilmez et al., 2004).

Table 1. Distribution of students taking part in the study according to schools.

Type of school	Female	Male	Total
Vocational High School	38	82	120
Anatolian High School	69	49	118
Science High School	63	60	123
Total	170	191	361

Table 2. Distribution of students taking part in the study according to grades.

Grade	Female	Male	Total
9 th Grade	60	49	109
10 th Grade	50	49	99
11 th Grade	32	43	75
12 th Grade	28	50	78
Total	170	191	361

The purpose and importance of the study

This study aimed to investigate the high school students' attitude and anxiety levels towards mathematics in terms of their gender, school type and class level. The literature have revealed that few studies investigating students' attitude and anxiety levels towards mathematics according to gender, school type and class level have been conducted. Therefore, the answers to the following research questions are sought;

- 1) Do students' attitude and anxiety levels towards mathematics show significant differences according to gender?
- 2) Do students' attitude and anxiety levels towards mathematics show significant differences according to school type?
- 3) Do students' attitude and anxiety levels towards mathematics show significant differences according to class level?

METHOD

Research design

The methodology employed is a descriptive study in order to determine the anxieties and attitudes of students attending grades 9, 10, 11 and 12 of various high school mathematics lessons in terms of different variables. A descriptive model aims to describe a past or present case in its original form (Karasar, 1994).

Sample

The sample for the study consisted of 361 students attending an Anatolian High School, a Vocational High School and a Science High School in a province of Turkey during 2014-2015 fall term. Some of the demographic properties of the participants are shown in Tables 1 and 2.

When Tables 1 and 2 are examined, it can be seen that 47. 1% (n=170) students are female, and 52. 9% (n=191) are male. Regarding school types, 33.2% (n=120) students attend a Vocational High School, 32. 7% (n=118) attend an Anatolian High School and 34. 1% (n=123) attend a Science High School. Also, it is also seen that 30. 2% (n=109) of the students are 9th graders, 27. 4% (n=99) are 10th graders, 20. 8% (n=75) are 11th graders, and 21. 6% (n=78) are 12th graders.

Data collection tools

In order to evaluate the students' attitudes towards mathematics, a Likert type mathematics attitude scale developed by Aşkar (1986) and a personal information form developed by the researcher in order to collect the necessary information about the students were performed. In the information form, questions about gender, class level and school type of the participant students were gathered. In the present study, one dimensional definition of attitude has been adopted because the attitude scale includes negative or positive level of affect combining mathematics. The attitude scale consisted of 20 items. The Cronbach alpha reliability of the scale was found as 0.93. In this scale, there were 10 positive and 10 negative statements. Negative statements were reversed according to the scores mentioned above. The attitude test was graded on a scale of one to five. Each of the students participating in the study was asked to select one of the following choices for each statement; "strongly agree", "agree", "neutral", "not agree" and "strongly disagree". In a Likert type scale, since the scale point consisted of the total response points given to the items, each attitude item in the scale is pointed. For positive items, they are graded as 1,2,3,4,5 from the category "strongly disagree" to "strongly agree"; and conversely for the negative items they are graded as 5,4,3,2,1 from the category "strongly disagree" to "strongly agree". Therefore the highest possible points to be obtained from the 20 statement survey are 100 points, while the lowest is 20 points. If the points' level is high, this would show that the attitude towards the Mathematics lesson is high.

On the other hand, in order to evaluate the students' anxiety levels about mathematics lesson, a Mathematics Anxiety Rating Scale containing 24 items that was developed by Plake and Parker (1982) and translated into Turkish by Akın et al. (2009). It consisted of two factors such as mathematics learning anxiety and mathematics evaluation anxiety. Mathematics Anxiety Rating Scale containing 24 items is in the form of Likert scale. The reliability coefficient of the scale (Cronbach alpha coefficient) was found as 0.94. The students are required to choose one of the following; "never worry", "seldom worry", "often worry", "usually worry" or "always worry" for each of the 24 items given in the anxiety scale. The items in the scale are graded as 1,2,3,4 and 5 from the category "never worry" to "always worry". Therefore, the lowest level of points achievable from the 24 question scale is 24, while the highest is 120 points. If the points are low, this would show that the anxiety level is low, whereas a high points level indicates their anxiety level is high.

Data analysis

All analyses were performed by using the Statistical Package for Social Sciences (SPSS) software. Two dependent variables were measured in the study: (1) attitude toward mathematics, and (2) anxiety toward mathematics. The independent variables measured

Table 3. Independent samples t-test results according to gender.

Variable	Gender	n	\bar{x}	s	sd	t	p
Attitude	Female	183	66.70	18.90	359	1.88	.06
	Male	178	62.82	20.21			
Anxiety	Female	170	55.18	21.87	359	.531	.06
	Male	191	56.43	22.78			

Table 4. Mean and standard deviation results of students' attitude and anxiety levels according to school type.

Variable	Type of high school	n	\bar{x}	sd
Attitude	Vocational High School	120	56.31	19.68
	Anatolian High School	118	66.23	18.89
	Science High School	123	71.67	17.20
Anxiety	Vocational High School	120	68.32	24.07
	Anatolian High School	118	54.10	19.58
	Science High School	123	45.32	16.48

the following variables: (1) gender of students, (2) class level of students, and (3) school type of students. The data was analysed by using independent samples t-tests and one-way ANOVAs and testing for main effect at the .05 level. According to the choice the students marked, arithmetic mean (\bar{x}), standard deviation (s) and percentage calculations were worked out and interpreted.

FINDINGS

The findings of the study are given according to the research questions.

Research question 1: Do students' attitude and anxiety levels towards mathematics show significant differences according to gender?

As seen in Table 3, there was no significant difference between gender concerning the students' attitude and anxiety levels towards mathematics [$t_{(359)} = 1.88$, $p > .05$; $t_{(359)} = -.531$, $p > .05$]. The findings also revealed that female students had higher scores on their attitude levels towards mathematics ($\bar{x} = 66.70$) and were more positive than male students ($\bar{x} = 62.82$).

Likewise, the anxiety level of female students about mathematics ($\bar{x} = 55.18$) was less than male students ($\bar{x} = 56.43$). Hence, it can be said that the attitude of female students to mathematics is more positive when compared to the male students, and their anxiety level is therefore lower.

Research question 2: Do students' attitude and anxiety levels towards mathematics show significant differences according to school type?

As shown in Table 4, the mean scores of students are ($\bar{x} = 71.67$) in Science High School, ($\bar{x} = 66.23$) in Anatolian High School and ($\bar{x} = 56.31$) in Vocational High School for attitude variable. In addition, the mean scores for anxiety are ($\bar{x} = 45.32$) in Science High School, ($\bar{x} = 54.10$) in Anatolian High School and ($\bar{x} = 68.32$) in Vocational High School.

According to these results, it can be seen that the attitude score of the students attending the Science High School is higher, while their anxiety levels about Mathematics Lesson is lower than other school types. Based on these findings, it can be stated that the students whose attitudes towards Mathematics is high have lower anxiety about Mathematics. On the other hand, the students whose attitude level is low have higher anxiety. Findings of students' attitude and anxiety levels according to school types are also given in Table 5.

According to Table 5, there was a statistically significant difference between attitude and anxiety scores of students on Mathematics among schools. [$F_{(2-358)} = 21.236$; $F_{(2-358)} = 39.773$, $p < 0.05$]. Students' attitudes and anxieties on Mathematics change significantly in connection with the school types. According to the results of the Scheffe test, which was carried out in order to figure out any significant difference occurring between school types, the

Table 5. One-way ANOVA results of students' attitude and anxiety levels according to school types.

Variable	Variance Source	Square Total	sd	Square Mean	F	p	Significance Difference
Attitude	Between Groups	14703.779	2	7351.890	21.236	.000	B-A, C-A
	Within Groups	123939.722	358	346.200			
	Total	138643.501	360				
Anxiety	Between Groups	32660.585	2	16330.292	39.773	.000	B-A, C-A
	Within Groups	146990.097	358	410.587			
	Total	179650.681	360				

A: Vocational High School, B: Anatolian High School, C: Science High School.

Table 6. Mean and standard deviation results of students' attitude and anxiety levels according to the class levels.

Variable	Class Level	n	\bar{x}	sd
Attitude	9 th Grade	111	62.901	17.773
	10 th Grade	91	63.335	20.199
	11 th Grade	83	65.518	20.170
	12 th Grade	76	68.368	20.130
Anxiety	9 th Grade	109	58.633	20.784
	10 th Grade	99	55.353	17.360
	11 th Grade	75	54.306	28.233
	12 th Grade	78	54.025	23.675

attitude of the students attending the Vocational High School is lower than other school types, while their anxiety on Mathematics is higher than other school types. One of the reasons for this may be due to the Mathematics success of students attending vocational school being lower than the students attending other high school types.

Research question 3: Do students' attitude and anxiety levels towards mathematics show significant differences according to class levels?

As seen in Table 6, the students' attitude to Mathematics according to class level is (\bar{x} = 62.901) for 9th grade (\bar{x} =63.335) for 10th grade (\bar{x} = 65.518) for 11th grade and (\bar{x} = 68.368) for 12th grade respectively. According to these findings, 12th grade students' attitudes are the highest. That is, the students' attitude has increased in accordance with their class levels. On the other hand, the table 6 also shows the anxiety scores of the students as follows; (\bar{x} = 58.633) for 9th grade, (\bar{x} = 55.353) for 10th grade, (\bar{x} = 54.306) for 11th grade and (\bar{x} = 54.025) for

12th grade. It is seen that the students' anxiety level decreases, while the class level increases. According to these results, the attitude scores of the students attending 12th grade are higher, whereas their anxiety levels towards mathematics is lower. Results of students' attitude and anxiety levels according to students' class levels are also given in Table 7.

As can be seen in Table 7, there was no significant difference between students' attitude and anxiety scores according to class level

[$F_{(3-357)}=1.369$, $p> 0.05$; $F_{(3-357)}= .0872$, $p > 0.05$].

DISCUSSION AND CONCLUSION

In the present study, the attitudes and anxieties of students attending different high schools about Mathematics courses were investigated in terms of gender, class level and type of high school.

When the results of students' attitudes and anxieties to Mathematics were examined according to gender, no significant statistical difference was found between attitude and anxiety in terms of gender [Table 3, $t_{(359)} = 1.88$, $p>.05$ and $t_{(359)} = -.531$, $p>.05$]. It can be said that there is no significant effect on students' attitudes and anxieties about Mathematics lesson. However, female students' attitude mean to Mathematics lesson was found to be higher (\bar{x} =66.70) than male students (\bar{x} =62.82). Similarly, female students' anxiety (\bar{x} =55.18) about Mathematics lesson was found to be lower than the male students (\bar{x} =56.43). Hence, it can be said that female students' attitudes to mathematics lesson is more positive than male students. This result is due to the fact that their anxiety level is lower than the male students. Although a number of studies have been carried out to ascertain whether or not students' attitude and anxiety about mathematics has had any difference in terms of gender, obtained results have shown differences. In the studies, Cooper and Robinson (1991) found that the gender

Table 7. One-way ANOVA results of students' attitude and anxiety levels according to students' class levels.

Variable	Variance Source	Square Total	Sd	Square Mean	F	p
Attitude	Between Groups	1576.811	3	525.604	1.369	.252
	Within Groups	137066.690	357	383.940		
	Total	138643.501	360			
Anxiety	Between Groups	1306.839	3	435.613	.872	.456
	Within Groups	178343.843	357	499.563		
	Total	179650.681	360			

variable did not display any significance on Mathematics anxiety. In 1998, Zettle and Houghton stated that there was no significance difference between anxiety levels about mathematics between female and male students. Kurbanoglu and Takunyacı (2012) determined that students' anxiety, attitude and self-sufficiency beliefs regarding mathematics lessons did not display any significant difference according to gender in one of their studies entitled "Investigation of high school students' anxiety, attitude and self-sufficiency beliefs in respect to gender, school type and class level to mathematics lesson". Taşdemir (2013) also stated that statistically speaking, there was no significant difference in anxiety levels of students about Mathematics lessons according to the gender variable. However, Alexander and Martray (1989) found that when compared to each other, females possessed a higher anxiety to Mathematics lessons than males. In their study about the relation between attitude to Mathematics and Mathematics anxiety levels of boarding teachers' training school students, Yenilmez and Özabacı (2003) established that students of boarding teachers' training school did not demonstrate significant differences in their attitude to Mathematics lessons. In their study, where they evaluated the emotional reactions to Mathematics success and Mathematics, Stipek and Granlinski (1991) established some differences between the genders. Accordingly, they identified that females had lower mathematical talent than that of males, and that females developed negative attitudes to learning mathematics. Hence the findings belonging to gender variable of the study coincide with those of some studies, but not some research. The fact that males and females undergo different socialization processes, that they have different experience opportunities, and that the reactions they receive for the activities they carry out change according to their genders causes them to feel themselves to be sufficient in different fields (Kuzgun, 2003).

One of the findings obtained in this study was that the students' attitude to mathematics and their anxiety levels indicated that there was statistically significant difference according to the types of school [Table 5, $F_{(2-358)} = 21.236$ and $F_{(2-358)} = 39.773$, $p < 0.05$]. That is, the students'

anxiety about mathematics lessons changes significantly in accordance with types of high school. According to the Scheffe test conducted in order to find out in what type of high school, the results showed that the attitude of students in Vocational High Schools appears to be lower than other school types, and their anxiety about mathematics lessons, however, is higher. On the other hand, the attitude of the students in Science High Schools is higher than the other school types, while their anxiety is lower. As for the reason behind this result, it can be shown that the success level of students in Science High Schools is higher than the other high school types. According to statistics from the Higher Education Council for Turkey (Turkish: YÖK), in the university national entrance examination of secondary education students' in 2005, the results according to the type of high school were as follows: General High School graduates accurately answered 5.72 questions, Anatolian High School graduates accurately answered 27.86 questions, Anatolian Teacher Training School graduates answered 24.77 questions, Technical High School graduates answered 5.41 questions, Science High School graduates answered 38.52 questions, Multi Program High School graduates answered 3.13 questions, Anatolian Trade High School graduates answered 4.15 questions, Theology and Preacher Training High School graduates accurately answered 1.38 questions, while Industry High school graduates answered 0.98 questions out of 45 mathematics questions (YÖK, 2007). The fact that the students' confidence increases for mathematics lessons, and that they experience the feeling to be able to succeed in the lesson affects their attitude in a positive way and as they experience success, their anxiety level also drops (Wine, 1971). Even if this success does not stem from mathematics, but from any other lesson, this affects the anxiety level about Mathematics positively.

One of the other crucial findings obtained from the study is that the students' attitude and anxiety about mathematics according to class level (Grade) did not demonstrate any significant differences [Table 7, $F_{(3-357)} = 1.369$, $p > 0.05$; $F_{(3-357)} = .0872$, $p > 0.05$]. Nevertheless, the students' attitude scores in 12th grade is the highest

(\bar{x} = 68.368). That is to say, the students' attitude increased in alignment with the increase in class level. Hence, it is seen that as the class level increased, the anxiety point means of the students (\bar{x} = 54.025) dropped. According to these results, it is observed that the attitude scores of the students in the 12th grade turned out to be higher than other class levels, while their anxiety level was lower. However, this difference between attitude and anxiety points is not significant. In their study, Yenilmez and Özbey (2006) stated that the higher the class level of primary school students was, the less their anxiety was. Moreover, in another study, Kurbanoglu and Takunyacı (2012) stated that while the class levels of high school students increased, their attitude levels decreased. This result is consistent with the result of the present study. Yenilmez and Özabacı (2003), in their study carried out to find the relation between attitude and anxiety of boarding teachers' training school students about mathematics, specified that as the class level increased, the students' attitude means to mathematics lesson decreased. In their study carried out on 204 students from 6th, 7th and 8th grades, Dede and Dursun (2008) indicated that as the class level increased, the students' anxiety level increased as well. These findings also coincide with the findings of the present study.

Limitation and further study

This study shows three major findings: (1) there was a statistically no significant difference between gender concerning the students' attitude and anxiety levels towards mathematics, (2) there was a statistically significant difference between attitude and anxiety scores of students on Mathematics among school types, and (3) there was a statistically no significant difference between students' attitude and anxiety scores according to grade level. According to these results, this current investigation point out only the differences between attitude and anxiety scores of students on Mathematics among school types. However, it should not be neglected that there are many elements such as students' learning styles, teaching materials and methods, and the depth or superficiality of mathematics curriculums which may affect students' anxiety and attitude levels (Koca and Şen, 2002 cited in Dede 2012). Therefore, what and how is the effect of different high school curriculums in the sample (Anatolian High School, Vocational High School, and Science High School) on these findings? The causes behind this result of the research may be a trend of next research with this reason. What is the effect of high school students' learning styles, learning environments, and individual differences, etc. on these results? These questions also suggest new studies for specialists.

On the other hand, this current research study is limited

with the responses given by high school students to items in the questionnaires in a natural setting. Naturally, it may be hard to determine students' attitudes and anxieties using only a survey therefore next study could involve the conducting of classroom observations and in-depth interviews with high school students in order to capture what principal causes behind students' attitudes and anxieties towards mathematics.

Finally, due to the limited sample size (high schools in a province of Turkey), therefore, it may be hard to generalize the results of the present research to other environments. Therefore next studies could examine whether similar findings can be obtained from studies based on extensive samples from different cities, regions and countries.

Conflict of Interests

The authors have not declared any conflict of interests.

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