WCES 2012

Eighth grade students’ attitude, anxiety, and achievement pertaining to mathematics lessons

Hüseyin YARATAN ** and Leman KASAPOĞLU ***

ABSTRACT: The aim of this study is to investigate differences in attitudes, anxiety, and mathematical achievement due to gender, and school location; and to depict how well anxiety and attitudes towards mathematics determine students’ mathematical achievement controlling for gender and school location. Attitude and anxiety scales were administered to 188 eighth grade students and the data collected were analyzed using t-test and multiple regression analyses. Results revealed significant differences in attitude, and in mathematics scores, but no significant differences in the anxiety scores with respect to gender, and location of schools. $R^2=.448$ implied that 44.8% of the variability in the mathematical achievement of students can be explained by students’ anxiety ($\text{Beta}=-.432$), attitudes ($\text{Beta}=.216$), gender ($\text{Beta}=-.113$), and school location ($\text{Beta}=-.291$). $R^2$ change=.377, depicts that students from similar school locations and with the same gender are likely to have higher achievement scores in mathematics if they have higher positive attitudes and lower anxiety.

Keywords: mathematics anxiety, attitude towards mathematics, achievement in mathematics, gender, school location

1. INTRODUCTION

Starting from the very beginning levels of mathematics education, many students are faced with failure due to various reasons. Steen (1999) found out that most U.S. students leave high school with far below the minimum expectations for mathematical understanding. As Smith (2004) states, a student’s failure in performing well in mathematics may be because of psychological variables such as fear of failure, anxiety and low self-esteem in mathematics. Like Smith, Probst (2002) stated the most frequent reason for students to be unsuccessful in mathematics is math anxiety. He explains math anxiety as the state of being uneasy, apprehensive, or worried when taking a mathematics class. As he believes math anxiety makes the student powerless and unable to cope with a mathematics class. According to Townsend, Lai, Lavery, Sutherland and Wilton (1999), because of the relationship between mathematics anxiety and mathematics achievement, mathematics anxiety should be examined in students at all levels. Webb (2004) claims that mathematics anxiety can occur in all levels of education and once it is established, it can persist for life. He emphasizes the importance of early identification of math anxiety for future math learning.

Attitude is another psychological construct that affects students’ performance in mathematics. Akkoyunlu (2003) defines attitude towards mathematics as a matter of like or dislike of mathematics. He says that students’ attitudes towards mathematics play an important role in mathematical achievement. According to Bloom (as cited in Akin, 2002), developing positive attitudes towards mathematics courses increases students’ achievement. Conversely, a math student with negative attitudes and low motivation shows lower performance rates.

** Asst. Prof. Dr., Eastern Mediterranean University, huseyin.yaratan@emu.edu.tr
*** Secondary School Mathematics Teacher, Ministry of National Education and Culture, lemansoyer@yahoo.com.tr

1877-0428 © 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of Prof. Dr. Hüseyin Uzunboylu
doi:10.1016/j.sbspro.2012.05.087
1.1 Attitudes towards mathematics

There is no doubt that a comprehensive mathematics education is needed for all types of schools in all countries (Baser and Yavuz, 2003). “In the field of mathematics education, research on attitude has been motivated by the belief that something called ‘attitude’ plays a crucial role in learning mathematics.” (Neale, 1969, p. 631). As Schoenfeld (1989) states, the conceptions, attitudes, and expectations of students regarding mathematics and mathematics education have been considered to be very significant factors underlying school experience and achievement. The way people engage in mathematical activities is shaped by their conception of mathematics. Schoenfeld found that the strongest correlation was between mathematical performance and perceived mathematical ability. On the other hand, Aiken (1970) admits that there is a causal ordering relationship between attitudes towards mathematics and mathematical achievement. Attitudes affect the level of performance; then, in turn the level of performance affects attitudes. Hence, it can be concluded that there is a reciprocal (non-recursive) relationship between attitude towards and achievement in mathematics.

Zan and Di Martino (2007) tried to distinguish between positive and negative attitudes by simply defining a positive attitude as a positive emotional disposition toward the subject, and a negative attitude as a negative emotional disposition toward the subject. They go on by stating that this dichotomy between positive/negative attitudes pervades mathematics education research both implicitly and explicitly. For example, classic studies regarding the relationship between attitude and achievement investigate the correlation between positive attitude and success. In the same way, studies aiming to change attitude set the objective of changing negative attitude into a positive one. Furthermore, Knight (2005) divides attitude into three components as belief, emotional response, and behavior and admits that attitudes are one of the key determinants of performance.

Several researchers worked on the factors for determining the nature of attitudes towards mathematics. These factors can be listed as parents (Tsao, 2004; Tapia & Marsh II, 2004; Akin, 2002; Akkoyunlu, 2003), teachers (Tsao, 2004; Tapia & Marsh II, 2004; Akin, 2002; Akkoyunlu, 2003; Gökbulut, Yangın, Sidekli, 2008; Koç, 2003; De Waal, n.d.), teaching methods (Akin, 2002; Akkoyunlu, 2003; Gökbulut, Yangın, Sidekli, 2008; Koç, 2003; De Waal, n.d.; Colbeck, Cabrera & Terenzini, 2001; Morrell & Lederman, 1998), peer groups (Tapia and Marsh II, 2004; Akin, 2002), Society (Tsao, 2004), students’ self-confidence (Tsao, 2004; Akin, 2002), students’ motivation (Tsao, 2004), students’ previous experiences (Akin, 2002), and teacher’s evaluations (Koç, 2003; De Waal, n.d.).

1.2 Mathematics anxiety

Students with math anxiety experience extreme levels of discomfort when doing or even thinking about mathematics (Webb, 2004; Zaslavsky, 1994). Ma and Xu (2003) states that this discomfort state includes dislike, worry and fear, tension, frustration, distress, helplessness, and mental disorganization. On the other hand, Ferguson (1986) lists three dimensions of mathematics anxiety: Mathematics test anxiety (anticipating, taking and receiving mathematics tests), numerical anxiety (number manipulation) and abstraction anxiety (abstract mathematical content). Mathematics anxious people are always nervous in mathematical situations. Therefore, they always try to avoid such environments (Civelek, Meder, Tüzen, and Aycan, 2003).

Cemen (1987) models mathematics anxiety as a process which includes environmental antecedents such as negative mathematics experiences or lack of parental encouragement; dispositional antecedents such as negative attitudes or lack of confidence; and situational antecedents such as classroom factors or instructional design. Cemen says that this process results in some physiological reactions like perspiring, difficulty in breathing, nervous stomach or increased heart beat. Grosse (2002) also mentions the physiological stage of mathematics anxiety. As he says, when the body senses the anxiety, it releases adrenaline. Then the brain’s higher order thinking is temporarily overridden and reduced to a much primal level. This higher-order thinking is the key for doing mathematics. He concludes that when the higher-order thinking procedures stop, your mind goes blank and you will not be able to handle mathematical situations. Furthermore, Freedman (2003) claims that mathematics anxiety is an emotional reaction to mathematics based on a past unpleasant experience which harms future learning. However, a good experience can overcome these past feelings and then contribute to future achievement in mathematics classes.

Ashcraft and Kirk (2001) studied the relationships among working memory, mathematics anxiety and mathematical performance. As they state, people with high mathematics anxiety demonstrated smaller working memory spans when assessed with a computation-based task. This reduced working memory capacity causes an increase in reaction time and errors when performing the computation task. High-anxiety students are less competent in mathematics, unable to perform the necessary calculations at the same level of accuracy as low-anxiety students.

Trujillo and Hadfield (1999) divide the causes of mathematics anxiety into three areas: “environmental”, “intellectual”, and “personality” factors. Environmental factors include negative experiences in the classroom, parental pressure, insensitive teachers, teaching mathematics as a rigid set of rules, and a class with no participation. Intellectual factors include being taught with methods that don’t match the individual learning styles, student attitudes, lack of confidence in mathematical ability, and lack of perceived usefulness of mathematics. Personality factors include poor participation in class due to shyness, low self-esteem, and viewing mathematics as a male
domain. Furthermore, as Furner and Duffy (2002) state, mathematics anxiety can be caused by poor mathematical performance. Ma and Xu (2003) also, stress the idea that there is a causal ordering relationship between mathematics anxiety and mathematics achievement.

This study will assume that there is a reciprocal causal relationship between mathematics anxiety and mathematics achievement. Furthermore, research suggests that students with negative attitudes towards mathematics have performance problems simply because of anxiety (Tapia & Marsh II, 2004; Webb, 2004). Hence, a reciprocal relationship between mathematics anxiety and attitude towards mathematics will also be assumed. As it was concluded earlier, a reciprocal (non-recursive) relationship between attitude towards and achievement in mathematics will also be an assumption in this study.

1.3 The Cyprus Turkish Education System

The Department of Educational Planning and Program Development in the Ministry of National Education and Culture organizes the structure of the educational system in the Turkish Republic of Northern Cyprus (TRNC). The department prepares all the educational programs to be implemented by the schools. At the beginning of the academic year, programs are sent to the schools by the department.

<table>
<thead>
<tr>
<th>Higher Education</th>
<th>Age</th>
<th>Doctoral Degree</th>
<th>Master’s Degree</th>
<th>Bachelor’s Degree</th>
<th>Multi-program Modern High Schools</th>
<th>Modern Vocational Technical High Schools</th>
<th>Apprenticeship Education</th>
<th>Special Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Education</td>
<td>18-19</td>
<td>Fine Arts High School</td>
<td>Colleges</td>
<td>Anatolia High School</td>
<td>Basic Education</td>
<td>Middle School Phase</td>
<td>Apprenticeship Education</td>
<td>Special Education</td>
</tr>
<tr>
<td></td>
<td>17-18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16-17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15-16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compulsory Basic Education</td>
<td>14-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Basic Education</td>
<td>Middle School Phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13-14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11-12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Basic Education</td>
<td>Primary School Phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8-9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7-8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6-7</td>
<td>Pre-School class</td>
<td></td>
<td></td>
<td>Basic Education</td>
<td>Pre-School Phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4-5</td>
<td>Play Class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

_Figure 1_. The General Structure of the Cyprus Turkish Education System
(Department of Educational Planning and Program Development, 2005)

The educational system in the TRNC is divided into three main periods as can be seen in Figure 1: “Basic Education”, “Secondary Education” and “Higher Education”. Basic education consists of three periods: “Preschool”, “primary school” and “middle school”. During the pre-school period, students attend nursery at the age of 4; then they attend pre-school classes within the elementary schools at the age of 5. They continue with elementary school between the ages 6-11. Elementary school education comprises 5 grades. After the elementary school, students go to the middle school which has 4 grades – grades 6 to 9. It begins from the age of 11-12 up to 14-15. Compulsory education starts from the pre-school class and ends at the end of the secondary school. Secondary education is composed of 3 or 4 grades (10-12 or 10-13) depending on the programs. Higher education is the period after secondary education.
1.4 Mathematics education in the middle schools of North Cyprus

Middle school mathematics education is designed to educate learners who would be able to transfer mathematical knowledge into real life situations, solve problems, share their thinking and problem solving strategies; and enjoy learning mathematics (Department of Educational Planning and Program Development, 2008). The mathematics education programs applied in middle schools are constructed based on the following idea: “Mathematics is a philosophy of life”. The main skills in middle school mathematics that the students are aimed to attain are the following: Mathematical communication, problem solving, logical reasoning, seeking for information, decision making, active learning, predicting, exploring relationships, creative thinking, and critical thinking. All these skills are attained through all the grades of the middle school (Department of Educational Planning and Program Development, 2008).

Students at the eighth grade take five mathematics classes per week to complete the topics which can be listed as follows: Whole numbers, rational numbers, irrational numbers, indices, equations, system of equations, line equations, and line graphs, slope, inequalities, permutations, combination, probability, triangles, trigonometric relations, surface areas, and volume. In the textbook learning activities are organized in such a way that students are able to discover the principles and procedures by themselves. The examples were chosen from the daily life situations, and from the students’ own environments. For students to enjoy mathematics, several mathematical games were placed in the learning activities. When looking through the book, it is observed that the rules and important ideas are emphasized with the use of different colors like yellow, green, or red. In this way, the book attracts the student’s attention. Problem solving strategies were explained carefully and were shown step by step. Also, visual components like graphical presentations were added. Moreover, in order to prevent students from getting bored when they study the book, some cartoon characters were placed on the pages. All these additions to the new book were done to develop positive attitudes and decrease anxiety levels of the students.

1.5 Problem statement and research questions

Mathematics anxiety and negative attitudes towards mathematics can be considered as two serious problems in mathematics education. Because of high anxiety and negative attitudes associated with mathematics, students avoid taking or attending mathematics classes, get into trouble in mathematical situations, and moreover they refuse to get engaged in meaningful learning and learn through memorization just to get through the course, and eventually fail to learn enough mathematics. This study was conducted to figure out the nature of the relationship between these two psychological constructs and mathematics achievement of eighth-grade students in North Cyprus with the hope that the study will have important implications for students, teachers, parents and administrators.

To investigate this problem following research questions were set: (i) How do the students’ attitudes towards mathematics, their levels of mathematics anxiety, and their mathematical achievements differ with respect to a) location of schools, b) gender of students from both schools, c) gender of students from urban schools, and d) gender of students from rural schools? (ii) How well do the attitudes towards mathematics and mathematics anxiety of students determine mathematical achievement controlling for gender and school location?

2. METHODOLOGY

Quantitative research methods have been used in this study. Primarily, correlational and comparative research methods have been implemented. The study concentrated on collecting and analyzing data to find answers to the research questions specified above.

Participants selected for this study were eighth grade middle school students who were at the last stage of the middle school and were supposed to have attained the goals set for the mathematics education in the middle schools. Thus, their attitudes towards mathematics and mathematics anxiety have taken their final form and are based on their experiences during the three years they have spent in the middle school. The population for this study comprises all of the twenty five middle schools in North Cyprus. The study was conducted in both urban and rural schools. Hence, one urban and one rural school were randomly selected. In the urban school, there were eight classes with a total of 198 eighth grade students. There were four classes of eighth grade students in the rural middle school with a total of 83 eighth grade students. Since the total number of eighth grade students in the rural school was appropriate for the sample size, all of the eighth grade students were selected. In order to have close sample sizes from the two schools, four classes were randomly selected from the eight classes of eighth grade students in the urban school. Hence, 105 eighth graders from the urban participated in the study. Total number of participants was 188. There were 49 female and 56 male participants from urban middle school, and 41 female and 42 male participants from the rural middle school.

Two instruments were administered in this study. The first instrument was the Mathematics Attitude Scale, developed by Aşkar (1986) which included twenty items. There were 10 items reflecting positive attitudes and 10 items reflecting negative attitudes towards mathematics. The second instrument was the Mathematics Anxiety Scale, developed by Aşkar (1986) which included twenty items.
developed by Bindak (2005) which included sixteen items. Twelve items were considered as positive and four items considered as negative for mathematics anxiety. Students responded to the items of both scales by choosing one of the five alternatives presented on a five point Likert scale set as “Strongly Agree”, “Agree”, “Neutral”, “Disagree” and “Strongly Disagree”.

The two scales were assumed to have high content validity and therefore, they were applied without making any changes in their contents. However, in order to figure out the reliability of the scales, a pilot study had been conducted and a middle school apart from the two middle schools that were chosen for the study was selected as the pilot school. Through group administration procedure, 63 eighth grade students responded to the scales. According to piloting data analysis, the reliability coefficients (Cronbach’s Alpha) were found as .937 for the attitude scale and .920 for the anxiety scale and both were considered to have excellent reliability.

The participants’ mid-term mathematics exam scores were obtained from the school administrators. The exam scores were assigned out of 10. It was assumed that the evaluation of the mid-term exam results was based on the same criteria in both middle schools.

3. RESULTS

The analysis of data has been performed to find the answers of the research questions stated earlier. Ten items in the Mathematics Attitude Scale which reflected positive attitudes towards mathematics were coded as Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1. The remaining ten items which reflected negative attitudes towards mathematics were reverse coded as Strongly Agree=1, Agree=2, Neutral=3, Disagree=4, Strongly Disagree=5. Scores obtained from twenty items were added to get a total score from the attitude scale. The maximum total score for attitude scale was 100, and the minimum total score for the attitude scale was 20. A score which was above the average (60) was interpreted as a positive attitude. A score which was below the average was interpreted as a negative attitude.

Twelve items which reflected the existence of mathematics anxiety in the Mathematics Anxiety Scale were coded as Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1. The remaining four items which reflected non-existence of mathematics anxiety were coded as Strongly Agree=1, Agree=2, Neutral=3, Disagree=4, Strongly Disagree=5. Scores obtained from sixteen items were added to get a total score from the anxiety scale. The maximum total score for anxiety scale was 80, and the minimum total score for the attitude scale was 16. The average total anxiety score was 48. An anxiety score which was above 48 indicated a high anxiety; and below 48 indicated a low anxiety.

Independent samples t-tests to search for significant differences between urban and rural school students in their attitude, anxiety, and mathematics scores were performed and the results were recorded in Table 1. It was assumed that the sample had a normal distribution since the sample size was large enough. Levene’s test results revealed that

<table>
<thead>
<tr>
<th>Table 1: Independent Samples t-test for Differences in Mathematics, Attitude, and Anxiety Scores of Students with respect to Location of Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
</tr>
<tr>
<td>Attitude</td>
</tr>
<tr>
<td>Anxiety</td>
</tr>
</tbody>
</table>

*p < .05 (2-tailed). **p < .01 (2-tailed).

variances for the student groups from the two school locations could be assumed as equal. Significant differences have been specified in the mathematics scores, and attitude scores of students from rural and urban schools, t(186)=3.392, p=.001 and t(186)=-2.176, p=.031, respectively. Thus, it is concluded that the urban school students have higher mathematical achievements (Mean=4.5, SD=2.849) than the rural school students (Mean=3.13, SD=2.584). On the other hand, students from urban schools exhibited lower attitudes towards mathematics (Mean=58.10, SD=20.290) than the rural school students (Mean=64.77, SD=21.614). However, t-test results revealed no significant difference between anxiety scores of students with respect to school location.

As it can be seen from Table 2, the independent samples t-tests for differences in attitude, anxiety, and mathematics scores revealed no significant differences between the
Table 2: Independent Samples t-test Results for the Differences in Mathematics, Attitude, and Anxiety Scores of Students with respect to Gender

<table>
<thead>
<tr>
<th>Score</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban School</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>103</td>
<td>1.785</td>
<td>.077</td>
</tr>
<tr>
<td>Attitude</td>
<td>103</td>
<td>1.867</td>
<td>.065</td>
</tr>
<tr>
<td>Anxiety</td>
<td>103</td>
<td>-1.023</td>
<td>.309</td>
</tr>
<tr>
<td>Rural School</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>81</td>
<td>1.329</td>
<td>.188</td>
</tr>
<tr>
<td>Attitude</td>
<td>81</td>
<td>1.061</td>
<td>.292</td>
</tr>
<tr>
<td>Anxiety</td>
<td>81</td>
<td>.479</td>
<td>.633</td>
</tr>
<tr>
<td>Both Schools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>186</td>
<td>2.073</td>
<td>.040*</td>
</tr>
<tr>
<td>Attitude</td>
<td>186</td>
<td>2.125</td>
<td>.035*</td>
</tr>
<tr>
<td>Anxiety</td>
<td>186</td>
<td>-.389</td>
<td>.698</td>
</tr>
</tbody>
</table>

* p < .05 (2-tailed)

As can be seen from Table 3 there are significant correlations among study variables except between gender and school location, gender and anxiety, school location and anxiety. Hence, in the regression model (Figure 2) paths between these variables were left out.
A multiple regression analysis for two ordered sets of predictors was conducted to predict the mathematical achievement from attitudes and anxiety of students controlling for the effects of gender and the location of schools on attitude and anxiety of students. The results of the regression analysis were recorded in Table 4. The dependent variable was the mathematical achievement of students. The first set of predictors included gender and the location of schools, and the second set included attitudes and anxiety towards mathematics. Gender and the school location were coded as dummy variables. Regarding the multicollinearity problem, it can be observed from Table 4 that the VIF values for all independent variables are less than 5. Hence, multicollinearity was not considered as a problem for the performed regression analysis.

The results of the regression analysis indicated that gender, school location, attitudes and anxiety accounted for a significant proportion of variability of mathematical achievement, \( R^2 = .448, F(4, 183) = 38.925, p=.00<.01 \). Thus, the regression model was considered as significant, and all of the predictor variables, the location of schools, \( t(187)=-5.223, p<.01 \); gender, \( t(187)=-2.022, p<.05 \); anxiety score, \( t(187)=-4.775, p<.01 \); and attitude score, \( t(187)=2.336, p<.05 \) had significant contributions to the regression equation for mathematical achievement which can be stated as follows:

Mathematics score = 7.627 + (-.291)(Location of School) + (-.113)(Gender) + (-.432)(Anxiety Score) + (.216)(Attitude Score)

Gender and school location, as the first set of predictors, accounted for a significant amount of mathematical achievement variability, \( R^2 = .083, F(2, 185)=8.358, p=.00<.01 \). Attitude and anxiety, as the second set of predictors, accounted for a significant proportion of mathematical achievement variance after controlling for gender and school location, \( R^2 \) change= .377, \( F(2, 183)=63.817, p=.000<.01 \). These results suggest that attitude and anxiety are strong predictors of mathematical achievement over and above gender and school location.

4. DISCUSSION

Starting from the very beginning levels of mathematics education, students are faced with failure due to various reasons. Students’ attitudes towards mathematics and their level of anxiety associated with mathematics are two psychological constructs affecting the students’ mathematical experiences. Researchers found significant relationships between these two constructs and mathematical achievement. Without eliminating the negative attitudes and high anxiety, it is almost impossible to have success in mathematics.

Students shape their attitudes towards mathematics under the effects of several factors such as parents, teachers, teaching methods that their teachers use, peer groups, society, level of self-confidence, motivation, previous experiences and teacher evaluation results. On the other hand, students develop anxiety towards mathematics due to various reasons like negative classroom experiences, poor mathematics performance, negative teacher behaviors, environmental pressure, and parental factors.

The study findings depicted that while there are significant differences in students’ attitudes towards mathematics, there are no significant differences in students’ anxiety levels with respect to gender and location of schools. Furthermore, significant differences were noted in mathematical achievement both with respect to gender and location of schools. If samples from urban and rural schools are investigated individually no significant differences can be recorded in all three constructs with respect to gender. But if the two samples are combined and analyzed, although no significant difference in the anxiety levels are noted, differences were observed in attitudes and mathematics achievements of male and female students.
The results stated above showed that the students have significantly lower attitude scores and higher mathematical achievements in urban schools than in rural schools. Thus, although the urban school students have lower attitudes, they exhibit better performances. The possible reasons for these results can be rooted in the teacher factor, parental factor or in the provided educational opportunities. In urban areas, teachers’ or parents’ expectations might be higher than the expectations in rural areas. Therefore, students are forced to study more. Additionally, private lessons are more frequent in urban areas so students get extra help with their mathematics courses. However, further research should be done on the factors affecting the achievement such as teacher effectiveness, parental expectations and the amount of private lessons students take.

Regarding the gender issue, it is found that female students have significantly higher attitude scores and higher mathematical achievements than males. The possible reasons for this result can be simply because of the positive attitudes of female students towards mathematics. On the other hand, girls might spend more time at home than boys, so they spend more time studying.

For finding answers for the second research question, it was investigated how attitudes and anxiety levels of students towards mathematics predict students’ achievement controlling for gender and school location. The multiple regression results indicated that gender, school location, attitudes and anxiety accounted for about half of the variance in mathematical achievement. The students’ anxiety levels made the most significant contribution, while gender made the least. Yet, the other half of the variability in mathematical achievement is accounted for by other independent variables. In order to figure out these variables, further research should be conducted. Furthermore, the results of regression analysis with two ordered sets of predictors depicted that students from similar school locations and with the same gender are likely to have higher achievement scores in mathematics if they have higher positive attitudes and lower anxiety.

5. IMPLICATIONS OF THE STUDY AND SOME SUGGESTIONS

5.1 Implications and suggestions

The study has important implications for students, teachers, parents and administrators. In order to eliminate the students’ negative attitudes towards mathematics and mathematics anxiety, students, parents, teachers, school administrators and education planners should work together, cooperatively.

To build positive attitudes and lower the level of anxiety in mathematics, students should concentrate on understanding the concepts rather than memorizing them, attend classes and do homework regularly, pay extra attention to the problem solving strategies, become aware of the role and applications of mathematics in daily life situations. On the other hand, parents play an important role in shaping their children’s attitudes and anxiety. Parents should start to help their children to gain basic mathematical skills from the early years of childhood by using math games, numerical activities, and engaging their children in daily mathematical situations, for example, calculating the amount of shopping bill. Parents should not forget that their children imitate their attitudes and behaviors. Hence, talking about mathematics in a positive manner would be helpful in creating positive attitudes towards mathematics. Parents should not make their children believe that mathematics is a difficult subject and force them to study mathematics against their will. Also, they should help their children’s assignments even if they themselves don’t understand the assignment completely and encourage their children to ask extra help from their teachers. Another important factor in shaping students’ attitudes towards mathematics and mathematics anxiety is the teacher. In their teaching, teachers should always concentrate on the comprehension of the main concepts, use of mathematical terminology correctly, communicating mathematically, developing problem solving skills, transferring mathematical knowledge to real life situations, but above all, teachers should design learning activities which would be appropriate to the ability of each individual student in their classes. Student-centered teaching methods, creative activities such as group work, mathematics projects and mathematical games should be employed by teachers to make their students enjoy mathematics. All these efforts will help students to overcome their negative attitudes and high anxiety. However, the physical structure of the classroom, educational opportunities, teaching materials, textbooks and technological tools are also important elements of the teaching learning process. School administrators should adjust classes to reasonable sizes and organize the physical structure of the classrooms to make it possible for implementing student-centered methods. Teachers should be provided with necessary instructional materials and technological opportunities in the classrooms. School administrators should report the needs of their schools, regularly to the Ministry of Education and Culture and based on these reports, the Ministry should supply these demands of the school administrators.

In conclusion, the process of education is like a chain. Each segment of the chain has important responsibilities. In order to get desired outcomes, each segment should be aware of what has to be done and complete its task properly.
5.2 Suggestions for further research

The study can be extended further to cover all elementary school, middle school, and high school students. Longitudinal research could be conducted based on observations of the attitudes towards mathematics and mathematics anxiety. Moreover, the possible resources of attitudes and anxiety of students towards mathematics such as parents, teachers, and teaching methods can be investigated through more extended research. Additionally, for exploring the other possible predictors of mathematical achievement, further research should be conducted on factors such as teacher effectiveness, teaching methods or the students’ study habits.

REFERENCES


