

# The Effect of Math Anxiety on Students' Performance in the Intermediate and Secondary Classes

Mohammad Faysal Anouti<sup>1</sup>, Sanaa Shehayeb<sup>2</sup>, Mahmoud Mchiek<sup>3</sup>

<sup>1</sup>Lebanese International University, Lebanon

<sup>2,3</sup>Lebanese International University, Lebanon

**Abstract:** *This research study aims at examining the relationship between math anxiety and students' performance, through their overall grade averages in mathematics, in the intermediate and secondary classes excluding grade twelve. For this research study, the researchers were not interested in determining the cause and effect between students' math anxiety, the independent variable, and their performance, the dependent variable, so they have remained observers during the process. The sample of the study has consisted of 124 participants out of 1620 students, 84 in classes of the intermediate level and 40 in the first and second year secondary, from two different private schools. First, the researchers have determined students' overall mathematical grade averages based on grade cards delivered by the administrations of both private schools at the end of the academic year. After that, the researchers have employed a standardized five point likert scale survey questionnaire for math anxiety self-test as the research instrument. Through the quantitative approach, the researchers have adopted the correlation design to explore the possible relationship between students' math anxiety and their performance, through their overall mathematical grade averages. For statistics, the researchers have used the bar diagram and the scatter plot to represent the data collected, the correlation coefficient and the one way ANOVA test for analysis. Results of the study have revealed that anxiety has a strong negative correlation and a significant effect on the overall mathematical grade averages of the sample of students in the intermediate and secondary levels excluding grade twelve. The researchers recommend teachers to detect if math anxiety is negatively affecting students' performance and adopt the students-centered approach to support the learning and performance of the highly anxious students. In addition, future researches should be dedicated to examining the impact of math exams anxiety in grade 12 and primary classes, and determining math chapters that trigger students' math anxiety the most.*

**Keywords:** Math anxiety, performance, overall grade average, mathematics.

## 1. Introduction

### 1.1 Background of the Study

During the past decades anxiety has been a critical and a significant topic to examine in humans studies. The relationship between anxiety and students' academic performance "short term achievements", through their test grades, is widely recognized in literature as many studies have approached and concluded its existence (Kumar & Karimi, 2010; Lyons & Beilock, 2012). The negative effect of anxiety on student's performance, through their grades is increasing year after year (Nuffield Foundation, 2017). Concerning mathematics, anxiety originates from the nature of the material itself since it is a multi-systematic process (Young, Wu, & Menon, 2012). Sometimes the social vision of mathematics, as a highly complicated material, may create high negative effect during the classroom sessions and mainly during the timed exams (Young, Wu, & Menon, 2012). Some researchers indicated that poor math skills negatively affect students' anxiety during timed exams, and others clarified that higher math anxiety is mostly associated to lower achievers. More importantly, high level of anxiety can create anxious memory, which in turn, directly affects students' long and short term accomplishments in mathematics and other subject materials (Buckley, 2013).

### 1.2 Theoretical Framework

After years of researches, it is still not clear if math anxiety is the result of students' poor mathematical performance or vice versa. Many students in higher classes could be dealing with math anxiety because of a bad mathematical experience or a poor mathematical performance at early ages, or because they lack of a decent mathematical knowledge that serves them when they need it. According to the Debilitating Anxiety Theory, developed in 1990 by Ray Hembree, math anxiety can negatively affect students' engagement and attitude towards mathematical tasks, acquirement of mathematical information, processes of problem solving, understanding of definitions and concepts and construction of knowledge. In addition, unlike those who deal with lower rates of math anxiety, people who suffer from higher rates perform poorly in their exams because they tend to answer quickly and finish their exam as fast as possible without checking the accuracy of their answers. Such reality suggests that those who suffer from high rates of math anxiety are unable of processing the mathematical task on hand and understanding the math concepts and definitions properly (Sharma, 2017).

The Higher Math Anxiety → The Lower Students' Math Performance

Figure 1: Relationship Between Students' Math Anxiety and Their Mathematical Performance (The Debilitating Anxiety Model)

**Research Questions**

- 1) Is there a negative correlation between students' anxiety and their performance, through their overall mathematical grade averages, in the intermediate and secondary classes, excluding grade twelve?
- 2) What is the effect of anxiety on students' performance, through their overall mathematical grade averages, in the intermediate and secondary classes, excluding grade twelve?

**Research Hypotheses**

H<sub>0</sub>1: There is no negative correlation between students' anxiety and their performance, through their overall mathematical grade averages, in the intermediate and secondary classes, excluding grade twelve.

H<sub>0</sub>1: There is a negative correlation between students' anxiety and their performance, through their overall mathematical grade averages, in the intermediate and secondary classes, excluding grade twelve.

H<sub>0</sub>2: There is no significant relation between anxiety and students' performance, through their overall mathematical grade averages, in the intermediate and secondary classes, excluding grade twelve.

H<sub>1</sub>2: There is a significant relation between anxiety and students' performance, through their overall mathematical grade averages, in the intermediate and secondary classes, excluding grade twelve.

**Limitations of the Study:** There were two limitations concerning this study. First, the limited number of private schools provided and the second is the exclusion of public schools. Because of that, the researchers were obliged to reduce scoping and consequently the number of the studied cases.

**Delimitations of the Study:** School principals of both private schools have collaborated with the researchers and fulfilled their demands. They have facilitated distributing the questionnaires among their students and delivered their overall grade averages at the end of the academic year, which in turn had a strong impact on the accuracy of the study results.

**2. Literature Review**

Kumar and Karimi (2010) examined the relationship between math anxiety, and students' mathematical performance. A group of 424 school students responded to a mathematics anxiety questionnaire. They even investigated the differences between boys and girls in math anxiety. Results of the study revealed that math anxiety is negatively correlated to students' mathematical performance and that it affects males and females in the same way (Kumar & Karimi, 2010).

Lyons and Beilock (2012) revealed that anxiety is tied to low math grades and standardized test scores, yet not all math-anxious individuals perform equally poor in the material. They indicated that, even though basic math abilities are important for every-day life, many people feel

anxious when they have to do math during their daily routine. More importantly, Lyons and Beilock (2012) found out that highly math-anxious individuals' showed significantly poorer math performance relatively to a non-math material (Lyons & Beilock, 2012).

Moreover, Mbugua, Kibet, Muthaa and Nkonke (2012) assured that examining factors, like anxiety, that affect the learners' mathematical grades and dealing with them adequately give our students more opportunities to join higher learning institutions to learn and pursue their sciences related future careers (Mbugua, Kbet, Muthaa, & Nkonke, 2012).

Furthermore, Buckley (2013) pointed out that many believe that only students who are blessed with high intelligence are capable of developing higher mathematical skills. The researcher divulged about the fact that a series of experiments, completed by a US research, has shown that anxiety can lead to a drop in math performance during an exam by hindering the amount of resources an individual depends on to complete a mathematical test. Buckley (2013) also revealed that, because of anxiety, students can develop a negative attitude towards mathematics as many anxious individuals usually try avoiding subjects, courses and careers that involve math, which in turn may limit their opportunities and career path-ways (Buckley, 2013).

Finally, Beilock and Willingham (2014) revealed that if math anxiety is provoked during the problem solving then it can rob most people of their working memory, which in turn can lead to lower performance. In addition, Beilock and Willingham (2014) indicated that teachers can play a role in reducing students' math anxiety (Beilock & Willingham, 2014).

**3. Methodology**

**Subject Selection:** The researchers targeted the overall mathematical grade averages of students aged from 12 till 16 in all classes of the intermediate level, the first and second year secondary level in two private schools for two reasons. First, because mathematics is a basic subject material in the educational system of any school. Second, because mathematics becomes more abstract as students advance in classes so their anxiety may keep on affecting their grades.

**Rational of the Study**

There is a need to examine students' anxiety in timed exams in mathematics at all levels in order to reduce it as much as possible and even deal with it at early classes.

**Significance of the Study**

This study contributes to the literature by examining the impact of math anxiety on students' performance, through their overall grade averages, in two Lebanese schools. Lebanon is known as a country that lacks of findings. Thus, the results of this research definitely add to the literature.

**Research Design:** This quantitative research study, through its correlation design, explores the possible relationship that exists between students' anxiety in all classes of the intermediate level, the first and second year secondary, and

their overall mathematical grade averages based on the analysis of the data collected from the survey questionnaires

standardized items (Freedman, Ellen, 2006). The survey consisted of 10 items and each one was ranked from one to five in the following way: 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree and 5 = strongly agree.

**Research Instruments:** The researchers conducted their study using a 5 point-likert scale survey questionnaire of

Nb	Question	Answers				
		Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	I cringe when I have to go to math class.					
2	I am uneasy about going to the board in a math class.					
3	I am afraid to ask questions in math class.					
4	I am always worried about being called on in math class.					
5	I understand math now, but I worry that it's going to get really difficult soon.					
6	I tend to zone out in math class.					
7	I fear math tests more than any other kind.					
8	I don't know how to study for math tests.					
9	It's clear to me in math class, but when I go home it's like I was never there.					
10	I'm afraid I won't be able to keep up with the rest of the class.					

**Validity and Reliability Test:** Concerning the validity of the survey questionnaire, the researchers used the same standardized items and did not modify any item in order to reserve its validity. Regarding the reliability of the survey questionnaire and in order to examine its consistency, each of the 124 students have filled the survey; then, after two weeks each one of them have completed it for the second time. Later on, for each student, the researchers have compared his answered items in both copies and then calculated the total number of points of each copy. After finding out that each student have answered almost the same way twice, and that his total scores did not differ that much in the first and second copy of the survey, the researchers were able to consider the survey questionnaire as reliable.

Students who receive between 40 and 50 (included) deal with a high degree of anxiety.

**Table of Frequencies and Percentages of Students' Classes**

	Classes of Students		
	Frequency	Percent	Age Average
Grade 7	24	19.35	12
Grade 8	32	25.81	13
Grade 9	28	22.58	14
Grade 10 (first year secondary)	25	20.16	15
Grade 11 (second year secondary)	15	12.1	15

**Data Collection Procedure:**

The researchers sent a copy of the survey questionnaire to the administration of each private school and requested distributing it among their students. Later on, the researchers received the acceptance of the math coordinators and the principals of both private schools, and implemented their study. The researchers distributed copies of survey questionnaire among all students in grades seven eight and nine in the first school, and among all students in the first and second year secondary in the second school. At the end of the implementation, the researchers organized the data for analysis.

**4. Data Analysis**

For their study, the researchers analyzed the data collected using the Excel Software and the Statistical Package for the Social Sciences (SPSS).

According to Freedman (2006):

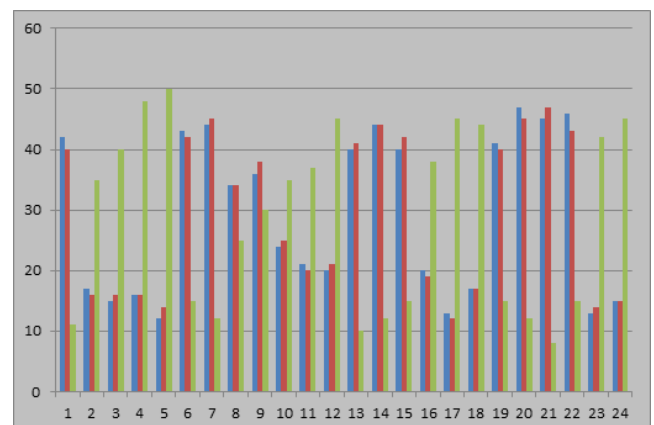
The anxiety self-test is formed of 10 questions. Since each question is rated from 1 to 5, then the lowest score is  $1 \times 10 = 10$  while the highest score is  $5 \times 10 = 50$

Students who receive between 10 and 19 (included) are not anxious;

Students who receive between 20 and 29 (included) deal with a low degree of anxiety;

Students who receive between 30 and 39 (included) deal with an average degree of anxiety;

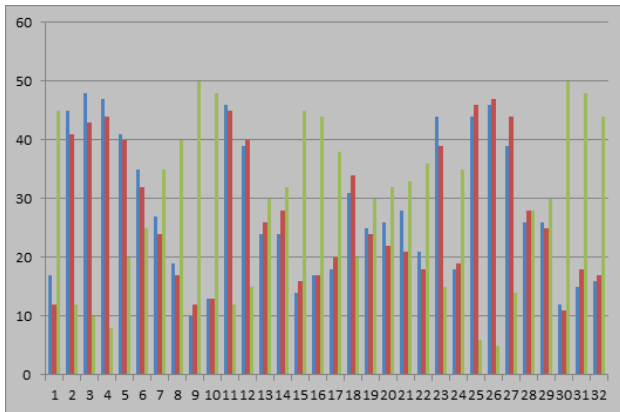
**Bar Diagrams**



**Chart 1:** Students' Math Anxiety Self-Test Scores and their Overall Grade Averages in Grade Seven

The blue bars represent scores of the first anxiety self-test, the red bars represent scores of the second anxiety self-test while the green bars represent the overall mathematical grade averages, over 50, of students in grade seven.

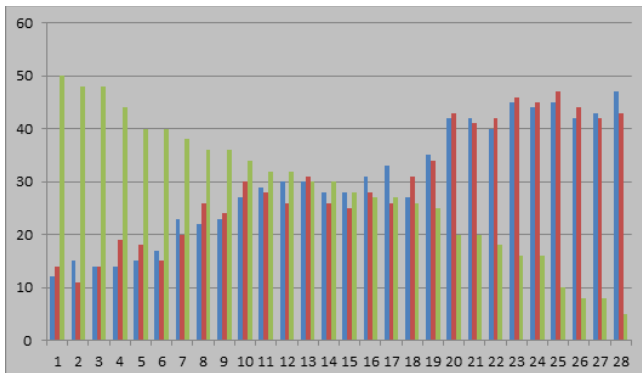
The chart above clearly shows that the math anxiety self-test scores of each student were close to each other and that students in grade seven with high level of anxiety score less than others.



**Chart 2:** Students' Math Anxiety Self-Test Scores and their Overall Grade Averages in Grade Eight

The blue bars represent scores of the first anxiety self-test, the red bars represent scores of the second anxiety self-test while the green bars represent the overall mathematical grade averages, over 50, of students in grade eight.

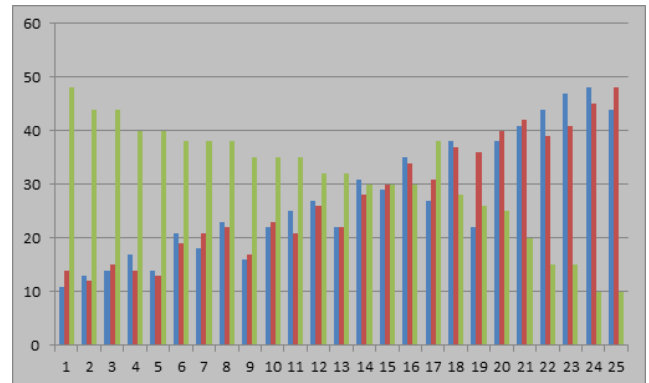
The chart above clearly shows that the math anxiety self-test scores of each student were close to each other and that students in grade eight with high level of anxiety score less than others.



**Chart 3:** Students' Math Anxiety Self-Test Scores and their Overall Grade Averages in Grade Nine

The blue bars represent scores of the first anxiety self-test, the red bars represent scores of the second anxiety self-test while the green bars represent the overall mathematical grade averages, over 50, of students in grade nine.

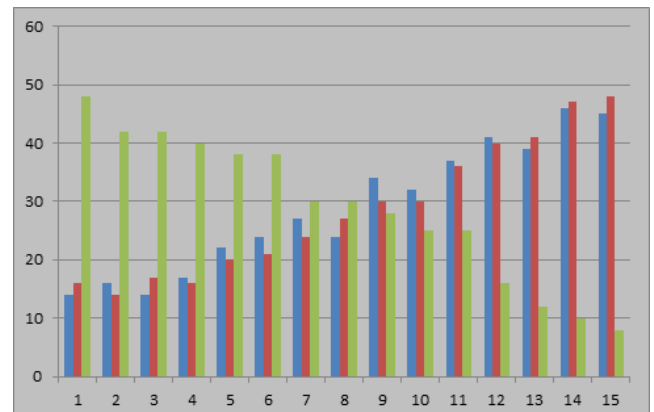
The chart above clearly shows that the math anxiety self-test scores of each student were close to each other and that students in grade nine with high level of anxiety score less than others.



**Chart 4:** Students' Math Anxiety Self-Test Scores and their Overall Grade Averages in the First Year Secondary

The blue bars represent scores of the first anxiety self-test, the red bars represent scores of the second anxiety self-test while the green bars represent the overall mathematical grade averages, over 50, of students in the first year secondary.

The chart above clearly shows that the math anxiety self-test scores of each student were close to each other and that students in the first year secondary with high level of anxiety score less than others.



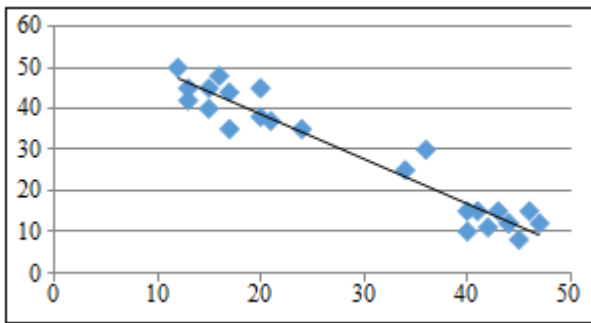
**Chart 5:** Students' Math Anxiety Self-Test Scores and their Overall Average Grades in the Second Year Secondary

The blue bars represent scores of the first anxiety self-test, the red bars represent scores of the second anxiety self-test while the green bars represent the overall mathematical grade averages, over 50, of students in the second year secondary. The chart above clearly shows that the math anxiety self-test scores of each student were close to each other and that students in the second year secondary with high level of anxiety score less than others.

**Regression Analysis**

A regression analysis was conducted to determine the nature of the correlation, if any, between anxiety and students' overall mathematical grade averages in grades seven, eight and nine in the intermediation level, and in grades ten and eleven in the secondary level by comparing student's anxiety degree to that of his mathematics' average.

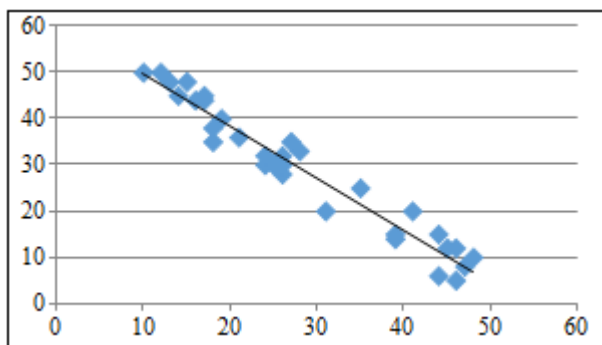




**Scatter Plot 1:** Students' Math Anxiety Self-Test Score Averages and their Overall Grade Averages in Grade Seven

The scatter plot above clearly shows that there exists a linear correlation between students' anxiety score averages and their overall mathematical grade averages in grade seven.

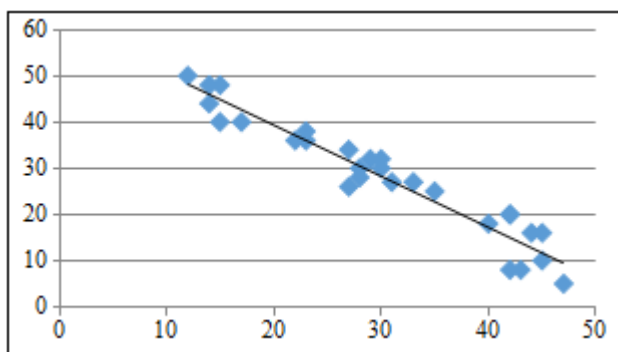
The correlation coefficient  $r = -0.95$  signifies that there exists a strong linear negative correlation between students' anxiety score averages and their overall mathematical grade averages in grade seven.



**Scatter Plot 2:** Students' Math Anxiety Self-Test Score Averages and their Overall Grade Averages in Grade Eight

The scatter plot above clearly shows that there exists a linear correlation between students' anxiety score averages and their overall mathematical grade averages in grade eight.

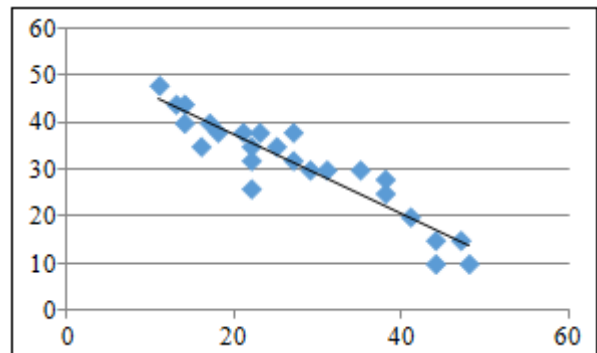
The correlation coefficient  $r = -0.9655$  signifies that there exists a strong linear negative correlation between students' anxiety score averages and their overall mathematical grade averages in grade eight.



**Scatter Plot 3:** Students' Math Anxiety Self-Test Score Averages and their Overall Grade Averages in Grade Nine

The scatter plot above clearly shows that there exists a linear correlation between students' anxiety score averages and their overall mathematical grade averages in grade nine.

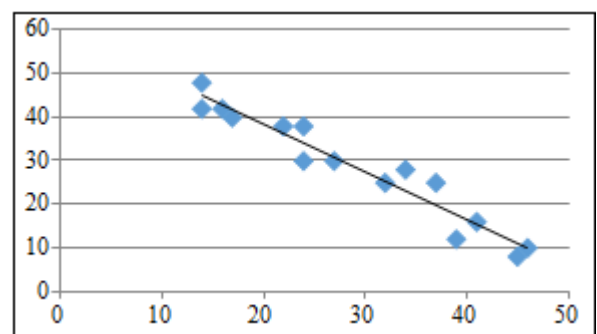
The correlation coefficient  $r = -0.9367$  signifies that there exists a strong linear negative correlation between students' anxiety score averages and their overall mathematical grade averages in grade nine.



**Scatter Plot 4:** Students' Math Anxiety Self-Test Score Averages and their Overall Grade Averages in the First Year Secondary

The scatter plot above clearly shows that there exists a linear correlation between students' anxiety score averages and their overall mathematical grade averages in the first year secondary.

The correlation coefficient  $r = -0.9428$  signifies that there exists a strong linear negative correlation between students' anxiety score averages and their overall mathematical grade averages in the first year secondary.



**Scatter Plot 5:** Students' Math Anxiety Self-Test Score Averages and their Overall Grade Averages in the Second Year Secondary

The scatter plot above clearly shows that there exists a linear correlation between students' anxiety score averages and their overall mathematical grade averages in the second year secondary.

The correlation coefficient  $r = -0.9525$  signifies that there exists a strong linear negative correlation between students' anxiety score averages and their overall mathematical grade averages in the second year secondary.

Based on these results, the researchers concluded that there exists a strong linear negative correlation between students' anxiety and their overall mathematical grade averages in all classes of the intermediate level, the first and the second year secondary. Thus, the researchers rejected their null hypothesis and accepted the alternative one for the first research question.

**One Way ANOVA Test****Results of the One Way ANOVA Test between Students' Anxiety Score Averages and their Overall Mathematical Grade Averages in Grade Seven**

A one-way between subjects ANOVA was conducted to compare the effect of students' anxiety score averages on their overall mathematical grade averages in grade seven. There was a significant effect of students' anxiety score averages on their overall mathematical grade averages in grade seven at the  $p$ -value  $< 0.05$  level for the three conditions  $F(20, 3) = 13.245$ ,  $p = 0.028$ .

**Results of the One Way ANOVA Test between Students' Anxiety Score Averages and their Overall Mathematical Grade Averages in Grade Eight**

A one-way between subjects ANOVA was conducted to compare the effect of students' anxiety score averages on their overall mathematical grade averages in grade eight. There was a significant effect of students' anxiety score averages on their overall mathematical grade averages in grade eight at the  $p$ -value  $< 0.05$  level for the three conditions  $F(25, 6) = 13.614$ ,  $p = 0.002$ .

**Results of the One Way ANOVA Test between Students' Anxiety Score Averages and their Overall Mathematical Grade Averages in Grade Nine**

A one-way between subjects ANOVA was conducted to compare the effect of students' anxiety score averages on their overall mathematical grade averages in grade nine. There was a significant effect of students' anxiety score averages on their overall mathematical grade averages in grade nine at the  $p$ -value  $< 0.05$  level for the three conditions  $F(20, 7) = 24.401$ ,  $p = 0.000123$ .

**Results of the One Way ANOVA Test between Students' Anxiety Score Averages and their Overall Mathematical Grade Averages in the First Year Secondary**

A one-way between subjects ANOVA was conducted to compare the effect of students' anxiety score averages on their overall mathematical grade averages in the first year secondary. There was a significant effect of students' anxiety score averages on their overall mathematical grade averages in the first year secondary at the  $p$ -value  $< 0.05$  level for the three conditions  $F(21, 3) = 25.699$ ,  $p = 0.011$ .

**Results of the One Way ANOVA Test between Students' Anxiety Score Averages and their Overall Mathematical Grade Averages in the Second Year Secondary**

A one-way between subjects ANOVA was conducted to compare the effect of students' anxiety score averages on their overall mathematical grade averages in the second year secondary. There was a significant effect of students' anxiety score averages on their overall mathematical grade averages in the second year secondary at the  $p$ -value  $< 0.05$  level for the three conditions  $F(12, 2) = 47.258$ ,  $p = 0.021$ .

Based on the results above, the researchers found out that there exists a statistically significant relationship between students' anxiety and their overall mathematical grade averages. Thus, the researchers rejected the null hypothesis of the second question and accepted the alternative one.

**5. Summary and Recommendations****5.1 Summary**

The aim of this study was to explore the relationship between anxiety and performance for intermediate and secondary students in Lebanon. Descriptive statistics as well as regression analysis were implemented to examine the extent of this association. Results of this study conformed to other studies in many terms. Math anxiety as a factor affecting students' conduct was also a consequence of Mbugua, Kibet, Muthaa and Nkonke (2012). The strong negative correlation between anxiety and performance was also a result of Kumar and Karimi (2010). The strong relationship between anxiety and performance was also tackled and proved in other studies like Lyons and Beilock (2012) who focused on the effect of highly math-anxious individuals' overall performance and indicated that many students perform poorly in mathematics because of their high level of anxiety. Moreover, Lyons and Beilock (2012) stated that even-though some highly anxious students do well in math tests because of their high skills, they might reach a point in the future where math anxiety overcomes their skills, negatively influences their performance in tasks, and even forbids them from acquiring new skills in upcoming lessons. Further, Buckley (2013) pointed out that anxiety can lead to a series of set-backs and a drop in mathematical tests. Finally, Beilock and Willingham (2014) indicated that math anxiety robs people of their working memory and forbids them from solving problems (Kumar & Karimi, 2010; Mbugua, Kbet, Muthaa, & Nkonke, 2012; Lyons & Beilock, 2012; Buckley, 2013; Beilock & Willingham, 2014).

Researchers of this study have recently targeted anxiety and its effect on students' overall mathematical grade averages because others, through their recommendations in the literature, emphasized on the need of exposing the effect of math anxiety on students in all classes and at all levels, and because there is a need to explore students' anxiety about mathematical tasks even more (Dowker, Sarkar, & Looi, 2016).

Results showed that there exists a strong negative correlation between anxiety and students' overall mathematical grade averages. In addition, they also showed that there is a statistically significant relationship between these two variables. These results add to the literature and enlighten on the effect of math anxiety in a two private schools in Lebanon.

**5.2 Recommendations****For Teachers**

- Math anxiety plays an important factor in determining students' performance in tasks and should be detected on regular basis. According to the above results, math anxiety does affect students' mathematical performance, through their overall grade averages. Thus, mathematics teachers have to detect if math anxiety is negatively affecting students' performance.
- Based on the results of this study, highly anxious students perform worse than their peers. For

that, teachers should abandon their teacher-centered approach and focus on the students as being the center of teaching and learning process.

#### For Future Researchers

- Researchers should determine the mathematics chapters that trigger students' math anxiety the most in the intermediate and secondary levels.
- Since grade 12 has been excluded due to the limitations of study, researchers should also examine the impact of math anxiety on students' performance, through their overall grade averages.
- Since the results of this research study showed that the overall mathematical grade averages of many students in all classes of the intermediate level are negatively affected by their anxiety, further research should be carried out to examine students' math anxiety at primary classes in order to deal with adequately at this early age so that students won't suffer from math anxiety in future classes.

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