LEBANESE AMERICAN UNIVERSITY

GENDER DIFFERENCES IN MATH ACHIEVEMENT, STUDENTS' ATTITUDES,
AND TEACHERS' BELIEFS

By
MADONA KAMAL CHARTOUNY

A thesis
Submitted in partial fulfillment of the requirements
for the degree of Master of Arts in Education

School of Arts and Sciences
May 2011

LEBANESE AMERICAN UNIVERSITY

School of Arts and Sciences - Beirut Campus

Thesis approval Form

Student Name: Madona Chartouny I.D. #: 200300548

Thesis Title : Gender Differences in Math Achievement, Students' Attitudes, and Teachers' Beliefs

Program : Master of Arts in Education. Emphasis: Math Education

Department : Education Department

School : **School of Arts and Sciences**

Approved by:

Thesis Advisor: Dr. Ketty Sarouphim Signature:

Member : Dr. Iman Osta Signature:

Member : Dr. Samar Zebian Signature:

Date : 23.5.2011

THESIS COPYRIGHT RELEASE FORM

LEBANESE AMERICAN UNIVERSITY

By signing and submitting this license, I (the author(s) or copyright owner) grant the Lebanese American University (LAU) the non-exclusive right to reproduce, translate (as defined below), and/or distribute my submission (including the abstract) worldwide in print and electronic format and in any medium, including but not limited to audio or video. I agree that LAU may, without changing the content, translate the submission to any medium or format for the purpose of preservation. I also agree that LAU may keep more than one copy of this submission for purposes of security, backup and preservation. I represent that the submission is my original work, and that I have the right to grant the rights contained in this license. I also represent that my submission does not, to the best of my knowledge, infringe upon anyone's copyright. If the submission contains material for which I do not hold copyright, I represent that I have obtained the unrestricted permission of the copyright owner to grant LAU the rights required by this license, and that such third-party owned material is clearly identified and acknowledged within the text or content of the submission. IF THE SUBMISSION IS BASED UPON WORK THAT HAS BEEN SPONSORED OR SUPPORTED BY AN AGENCY OR ORGANIZATION OTHER THAN LAU, I REPRESENT THAT I HAVE FULFILLED ANY RIGHT OF REVIEW OR OTHER OBLIGATIONS REQUIRED BY SUCH CONTRACT OR AGREEMENT. LAU will clearly identify my name(s) as the author(s) or owner(s) of the submission, and will not make any alteration, other than as allowed by this license, to my submission.

Name:

Nadema Charouny

Signature:

Date:

30/5/2011

PLAGIARISM POLICY COMPLIANCE STATEMENT

I certify that I have read and understood LAU's Plagiarism Policy. I understand that failure to comply with this Policy can lead to academic and disciplinary actions against me.

This work is substantially my own, and to the extent that any part of this work is not my own I have indicated that by acknowledging its sources.

Name: *Maabma Charouny*

Signature:

Date: *30/5/2011*

ACKNOWLEDGMENTS

This dissertation holds far more than just the culmination of years of study. It also reflects the relationships I have with many supportive and inspiring people who each contributed to my development as a scholar and teacher.

First to my advisor Dr. Ketty Sarouphim, in the classroom, I learned from you how to use psychology to become a better teacher, and outside the classroom I learned how to be a career woman who is strong and successful yet kind and compassionate. Thank you for the time and care you have put in my work, I couldn't have completed it without your guidance.

To Dr. Iman Osta, your enthusiasm and dedication in teaching and your commitment to always improving math education, taught me that in order to be a good math teacher I need to keep on being an inquisitive learner.

To Dr. Samar Zebian, you are my model in being a serene and a caring teacher. Thank you for believing in me.

To my father Kamal Chartouny, you are my role model in teaching and parenting. You always had a wise advice and a gentle push to keep me going. Thank you for your moral and financial support.

To my mother Maguy Chartouny, you took great care of me when I was very busy and you loved me relentlessly, for that I am deeply thankful.

To my siblings Marie-Anne and Rizkallah Chartouny, you were patient with me during my long and stressful hours of work and you stood by me in times of weakness.

To my friends, you supported me when I needed it the most and you knew how to cheer me up when I was discouraged. Thank you.

And last but surely not least to my husband Ghassan Akkary, you loved me just the way I am, you supported my studies and inspired my future ambitions, you were my stronghold and my patient guide. I love you.

To my loving father

GENDER DIFFERENCES IN MATH ACHIEVEMENT, STUDENTS' ATTITUDES, AND TEACHERS' BELIEFS

Madona Kamal Chartouny

Abstract

The purpose of this study was to reinforce research on gender differences in math education in Lebanon by studying the topic as it pertains to students' attitudes and achievement, teachers' beliefs, as well as teachers' differential behavior with boys and girls. The sample consisted of 171 students in grades 7, 8 and 9 and their three corresponding math teachers. The researcher administered questionnaires to students concerning their attitudes toward math, interviewed teachers and conducted classroom observations. The results of the study showed that girls and boys in grades 7, 8 and 9 held similar moderately positive attitudes toward mathematics. With respect to achievement, no significant differences were found in math averages between boys and girls. Results also showed that teachers were not gender biased in their choice of the most successful students. They attributed girls' success to ability and effort whereas boys' success was attributed to ability and intrinsic motivation. Finally, the classroom observations showed that the number of boys who participated in class exceeded that of girls. In addition, a higher number of boys were called to the board or asked to answer a question.

Keywords: Gender Differences, Math Education, Intermediate cycle, Students' Attitudes, Students' Achievement, Teachers' Beliefs.

TABLE OF CONTENTS

Chapter	Page
I. Introduction	1-9
1.1 - Context of the problem	1
1.2 - Purpose of the study	2
1.3 - Research Questions	2
1.4 - Rationale and Significance	2
1.5 - Literature Review	4
1.5.1 - Mathematical achievement	4
1.5.2 - Attitudes toward mathematics	5
1.5.3 - Teachers' perceptions	6
1.6 - Operational Definition of Variables	7
1.6.1 - Students' achievement	7
1.6.2 - Students' attitudes	7
1.6.3 - Teachers' beliefs and behaviors	7
1.6.4 - Gender differences	8
1.7 – Limitations	8
II. Literature Review	10-23
2.1 – Introduction	10
2.2 - Gender Differences in Mathematical Achievement	10
2.3 - Gender Differences in Attitudes toward Mathematics	15
2.4 - Teachers' Beliefs	19
2.5 - Conclusion	22

III. Methodology	24-31
3.1 – Introduction	24
3.2 – Participants	24
3.3 – Instruments	24
3.3.1 - Students’ achievement	25
3.3.2 - Attitudes towards mathematics scale	25
3.3.3 - Attribution interview	27
3.3.4 – Observation	26
3.4 – Procedures	26
3.5 - Validity and Reliability	28
3.6 - Procedures for Reviewing the Literature	28
3.7 - Data Analysis	29
3.7.1 - ATM scale	29
3.7.2 - Gender differences	30
3.7.3 - Teachers’ attributions interview	30
3.7.4 - Classroom observation	30
IV. Findings	32-43
4.1 – Introduction	32
4.2 - Attitudes towards Math	32
4.2.1 - Students’ attitudes towards math	33
4.2.2 - Enjoyment of mathematics	34
4.2.3 - Value of mathematics	36
4.2.4 - Classroom observations	37

4.3 - Students' Achievement in Mathematics	39
4.4 - Teachers' Beliefs and Behaviors	39
4.5 – Conclusion	42
V. Conclusion and Recommendations	44-51
5.1 – Introduction	44
5.2 - Gender Differences in Mathematical Achievement	45
5.3 - Gender Differences in Attitudes Towards Mathematics	46
5.4 - Teachers' Beliefs and Behaviors	50
5.5 – Recommendations	51
VI. References	52-54
VII. Appendices	55-63
Appendix A : Attitudes Toward Mathematics Scale (ATM)	55
Appendix B : Attributions Interview	58
Appendix C: Classroom Observation	61

List of Tables

Table	Table Title	Page
Table 1	Distribution of Boys and Girls per Grade Level	63
Table 2	Students' Mean Attitudes Toward Mathematics	64
Table 3	Students' Attitudes Towards Mathematics by Gender and Grade Level	65
Table 4	Enjoyment of Mathematics by Gender and Grade Level	66
Table 5	Enjoyment of Mathematics	67
Table 6	Value of Mathematics by Gender and Grade Level	68
Table 7	Value of Mathematics	69
Table 8	Students' Achievement in Mathematics	70
Table 9	Students' Achievement in Mathematics by Gender and Grade Level	71
Table 10	Accuracy of Teachers' Choice of Most Successful (MS) Student	72
Table 11	Accuracy of Teachers' Choice of Least Successful (LS) Student	73

CHAPTER ONE

Introduction

“You don’t really imagine a female mathematician. If you imagine a mathematician at least I think of a man”

(Brandell & Staberg, 2008).

1.1 - Context of the Problem

Gender differences in math education is a topic that has been much debated in the literature (Hanna, 2003; Villalobos, 2009). In order to grasp the essence of the problem researchers hypothesized, experimented, and evaluated through various lines of inquiry. Some studies focused on gender differences in math achievement, others investigated students’ attitudes toward the subject matter, and yet others examined the teachers’ beliefs regarding boys’ and girls’ performance abilities in math.

Most results on mathematical achievement showed no significant differences between boys’ and girls’ at the intermediate level. These differences emerged at the secondary level (Georgiou, Stavriniades, Kalavana, 2007; Hanna, 2003; Preckel, Goetz, Pekrun, & Kleine, 2008; Tapia & Marsh, 2004; Tsui, 2007).

With regard to attitudes toward math, research on this topics showed that although students perceive mathematics to be a male domain (Brandell & Staberg, 2008), general attitudes toward the subject did not show any significant difference pertaining to gender (Tapia & Marsh, 2004). On the other hand, boys did demonstrate a higher confidence in their abilities and a lower level of anxiety in comparison to girls (Hanna, 2003; Herbert & Stipek, 2005; Villalobos, 2009).

The literature on teachers' beliefs regarding boys' and girls' performance abilities in math showed mixed results. Li (2009) conducted a study on teachers' beliefs concerning the mathematical ability of boys and girls. The results showed that teachers had higher performance expectations for boys than they did for girls. In another similar study, teachers were also found to attribute boys' success mostly to ability whereas girls' success was attributed to effort (Fennema, Peterson, Carpenter, and Lubinski, 1990).

1.2 - Purpose of the Study

The current study extended the existing research to a new context and a wider combination of variables. Its purpose was to reinforce research on gender differences in math education in Lebanon. The aim was to study the topic as it pertains to students' attitudes and achievement, teachers' beliefs, as well as teachers' differential behavior with boys and girls if it existed.

1.3 - Research Questions

The study addressed the following questions:

1. Do significant differences exist between boys' and girls' attitudes toward math?
2. Do gender differences in math achievement exist?
3. What are the beliefs of math teachers regarding differences in boys' and girls' mathematical abilities and characteristics?
4. Do teachers interact differently with their male and female students?

1.4 - Rationale and Significance

A widespread belief is that math is a male domain (Brandell & Staberg, 2008; Georgiou et al., 2007; Hanna, 2003). To change this stereotype, research is needed to

debunk this myth. Therefore, it was necessary to re-examine gender differences in math achievement, especially in a traditional country such as Lebanon.

Many researchers supported the idea that attitudes toward math are formed by social influences. For example, parents' and teachers' attitudes toward math, and in particular their attitudes toward children as learners of math, impinge on students' perceptions of their own interest and ability in math (Georgiou, et al., 2007). The existing disparity in the beliefs of parents, teachers, and students concerning mathematical abilities of boys and girls has led to a male dominance in the math classes at the secondary level and later on in the math-related careers such as scientists, engineers and mathematicians (Brandell & Staberg, 2008). Research has shown that these differences emerge at the late elementary or early intermediate phase and accentuate at the secondary level (Tapia & Marsh, 2004). Hence, the focus of this study was on the intermediate cycle where gender differences in math were found to be at their early beginning.

The Lebanese context of this study was found to be significant for two reasons. First, there is a lack of literature on gender differences in math achievement and attitudes towards the subject in Lebanon. Second, the Lebanese culture remains a fairly traditional culture. Lebanon still suffers from gender discrimination in many areas, particularly in schooling and choice of careers. Given that mathematics was a masculine labeled domain, young Lebanese girls tended to avoid this subject, so as not to risk having a masculine label (Sarouphim, 2009). Thus, the significance of this study was that it shed light on how the school's environment affected the achievement of boys and girls in math as well as their attitudes towards this subject-matter.

In Lebanon, at the time of the study, math was a mandatory subject at all grade levels up to grade 10. Students at the end of grade 10 were faced with two choices: they can either choose the scientific track or the humanities track. Students who chose the scientific track in grade 11 were faced with three choices in grade 12. They were able to opt for one of the following tracks: general sciences, life sciences, or sociology and economy. Thus, students in grade 10 were faced with a choice that will affect their math studies in higher grades and, consequently, in their future careers. This choice was much affected by the students' attitudes toward math (Brandell & Staberg, 2008). Therefore, the significance of this study was that it examined the attitudes of Lebanese boys and girls towards math, their perceptions of the usefulness of the subject and the extent to which they enjoyed studying it, factors that were found to be important predictors of the students' future choices (Brandell & Staberg, 2008).

Moreover this study shed light on the Lebanese teachers' beliefs which is also a factor that was shown to affect their behavior and involvement with their students (Li, 1999; Muller, 1998).

1.5 - Literature Review

I summarized this section by deleting some studies completely and by deleting few ideas from others.

1.5.1 - Mathematical achievement

The Trends in International Mathematics and Science Study (TIMSS) was conducted in 2007. Of the 36 countries participating in the testing of grade 4, 21 countries showed significant differences in the achievement of boys and girls, 13 in favor of boys and 8 in favor of girls. Scores for 8th graders were obtained from 47 countries of them, 24

countries showed a significant difference between the achievement of boys and girls in math, 8 in favor of boys and 16 in favor of girls. Lebanon participated in the TIMSS of 2007 only for 8th graders. The results showed a statistically significant difference in favor of boys who outperformed girls by 13 out of 80 score points (US Department of Education, 2008).

In another study, Tsui (2007) did not find any significant difference in achievement among Chinese and American boys and girls in eighth grade. However, in both countries boys outnumbered girls among the high math performers. Differences in achievement emerged in the US at the secondary level and were exhibited in significant differences in college entrance examinations scores, a result which was not found for Chinese high school students.

Georgiou and colleagues (2007) conducted a study to examine the mathematical attitudes and achievement of 255 eighth graders in Cyprus. A questionnaire was designed to measure students' attributions of their own success and their attitudes towards math. Students also took a math achievement test. The results did not show significant difference between boys' and girls' math achievement. However, boys tended to believe more than girls did, that their success was due to their intellectual abilities.

1.5.2 - Attitudes toward mathematics

An attitude towards math is two fold: first, the objective perception of math as either a gendered or a gender neutral domain, and secondly, the subjective personal attitude toward math defined in terms of enjoyment and interest (Brandell & Staberg, 2008; Tapia & Marsh, 2004).

In a study conducted by Brandell and Staberg (2008) the question: “Mathematics: a female, male or gender-neutral domain?” was answered by 1300 Swedish students who were between 15 and 17 years old. The results showed that math was viewed as a male domain. This view was stronger among boys than it was among girls, and it was strongest among boys in the science program. Success, interest, and importance of math for the future were viewed as male traits. Girls’ success was perceived to be the result of diligent hard work.

1.5.3 - Teachers’ perceptions

Teachers’ beliefs and perceptions do affect their behavior and impact their classroom instruction. Li (1999) conducted a literature review of approximately 50 articles studying gender differences in mathematics in relation to teachers’ beliefs. The review revealed that teachers perceived mathematics as a male domain. They tended to overrate boys’ mathematical capacity. The review also showed that teachers had higher expectations for boys and a more positive attitude towards them. These biased beliefs are in turn perceived by the students themselves which lead to a gender-biased view towards their own capacities and those of the opposite sex.

Teachers’ perceptions were also investigated in a study conducted by Fennema and colleagues (1990). Thirty eight, first grade female teachers were interviewed to assess their attributions of success and failure for boys and girls. The teachers were also asked how they characterized the most successful boy and girl in their classroom. The results showed that teachers attributed boys’ success to ability and intrinsic motivation and girls’ success to effort in the first place and then to ability. The boys’ failure was attributed to lack of teacher help and lack of effort and girls’ failure to lack of effort and difficulty of task.

Teachers described the most successful boys as competitive, enjoy math and very independent. Girls were given almost the same characteristics but in lower ratings.

The opposite results were found in a study conducted by Helwig and colleagues (2001). In this study, 15 third grade teachers and 14 fifth grade teachers rated the skill level and classroom behavior of their students. Regression and correlation analyses were computed to measure the relationship between teacher perceptions of mathematical skills and student gender. The results showed that teachers disregarded gender when rating the mathematical skill of their students. They relied on test scores and student's effort.

1.6 - Operational Definition of the Variables

1.6.1 - Students' achievement

Students' achievement is operationally defined as the student's overall average in math. In other words, the students' grades in math for the school year 2009-2010 will be used to determine their achievement in math.

1.6.2 - Students' attitudes

In this study, attitudes toward mathematics are measured through a self-report instrument that assesses two variables: math enjoyment and value of learning math. Value lies in recognizing the importance and significance of mathematics to the individual and society. Enjoyment is about liking mathematics and being interested in the problems, terms and computations (Aiken, 1974). The Attitudes Toward Mathematics (ATM) scale was used to measure Enjoyment and Value of Mathematics.

1.6.3 - Teachers' beliefs and behaviors

Teachers' beliefs are gender bias free if teachers hold accurate perceptions of students' abilities which are not influenced by gender (Helwig et al., 2001). These beliefs influenced

teachers' behaviors in the classroom, their instructional decisions, questioning strategies, and the difficulty level of the material they presented in class (Fennema et al., 1990). In this study, an interview was conducted to assess teachers' beliefs. As a result of this interview, teachers' beliefs were operationally defined by the teachers' accuracy in choosing the two least successful and the two most successful math students in their class, their attributions of causation of success and failure for these students and the characteristics teachers gave to the most successful male and female students in their class.

Teachers' classroom behavior was assessed through observations. This variable was operationally defined as the teacher's questioning methods, their teaching style and their communication with the students. In this study, a coding sheet about teachers' behaviors was used to determine the occurrence or nonoccurrence of teachers' behaviors as they pertained to their students' gender, as well as the frequency of occurrence of these behaviors.

1.6.4 - Gender differences

In this study, gender differences were assessed through all the variables examined. As such, gender differences in students' achievement were operationally defined as any statistically significant difference found between boys' and girls' overall math averages. Also, gender differences in students' attitudes were operationally defined as any statistically significant difference found in the ATM scores between boys and girls. Gender differences in teachers' beliefs and attributions were defined as a teacher's biased perception of the most and least successful student, a significant difference in teachers' attributions of causation of success and failure for boys and girls, and a difference in the characteristics given to the most successful boys and girls.

1.7 - Limitations

The limitations of this study were the following:

1. The study was conducted in one school only, with a sample of students limited to the intermediate grade levels. Thus, the results cannot be generalized to other schools in Lebanon or other grade levels.
2. The beliefs and perceptions of only three math teachers were investigated, thus limiting generalization of the results.
3. Only three female math teachers participated in the study. Thus, the perspective of male teachers was excluded.
4. Observations were limited to two 50 minutes sessions per section. Thus, a range of students and teachers behaviors might have been missed.
5. The number of girls was double that of boys in all the sections that participated in this study. Thus, the unequal gender distribution could have affected the findings obtained in this study.

CHAPTER TWO

Literature Review

2.1 - Introduction

This chapter presents a review of the literature on gender differences in mathematical achievement, and students' attitudes towards mathematics. Also reviewed in the literature are teachers' beliefs concerning their male and female students' mathematical abilities and characteristics.

2.2 - Gender Differences in Mathematical Achievement

Studies on gender differences in mathematical achievement showed that at the intermediate level, male and female students' performance were not significantly different. However, differences in favor of boys emerged at the secondary level (Georgiou, Stavrinides, Kalavana, 2007; Hanna, 2003; Preckel, Goetz, Pekrun, & Kleine, 2008; Tapia & Marsh, 2004; Tsui, 2007).

In Lebanon, studies on gender differences in mathematics achievement are scarce. One study was conducted by Hassan (2001) to investigate gender differences in achievement among 3rd and 7th graders in five subject areas: Arabic, foreign language (English or French), mathematics, science, and life skills. The sample of this study consisted of the participants in the Monitoring Learning Achievement project (MLA). The sample consisted of 7,059 3rd graders and 3,788 7th graders who represented almost 10% of the Lebanese population for each age group. This stratified sample represented various geographic distributions, types of school, and location. Students were tested in each of the 5 subject areas. Tests were 40 to 50 minutes long and consisted of generally objective items. The math test for grade 3 assessed five content areas: numbers, operations, measurement,

geometry, and problem solving. The results did not show any significant difference pertaining to the overall achievement of boys and girls in math. However, boys outperformed girls in measurement and in problem solving. The math test administered in grade 7 assessed three content areas: operations, geometry, and algebra. The results showed non-significant differences; however, boys slightly outperformed girls in geometry and operations on the analysis and synthesis levels. These results challenge the results of the MLA studies in other countries which yielded significant gender differences in math. The lack of significant difference in achievement could be explained as a determination from Lebanese girls to show that they are capable of achieving similar results to boys in math and science.

In another study, Tsui (2007) examined gender differences in the achievement of high schoolers in China. Data were obtained from college entrance examination scores. SAT scores of American students were used for comparison purposes. The researcher also re-examined the math scores of 1,040 eighth graders collected in a different study to explore gender differences among high achievers. The results did not show any significant differences in achievement among Chinese boys and girls in eighth grade. Also both genders were equally represented among high achievers. As for high-school seniors, the results in China did not show significant gender differences in the overall average scores. In the US, boys consistently out-performed girls on the math portion of the SAT. However, in both countries, boys outnumbered girls among the high math performers. In an attempt to explain this lack of difference in the college entrance examination scores of Chinese boys and girls versus the significant difference in the SAT scores, the researcher presented four arguments. First, in China the presence of a rigorous and demanding math curriculum, high

school city-wide entrance examinations, and highly competitive college entrance examination challenged the schools to maintain a high level of education. Secondly, the selection and training of teachers in China differed from that in the US. Chinese teachers were required to have a diploma in the subject they taught. Thus, Chinese math teachers possessed deep understanding of math and were competent enough to guide their students in the systematic investigation of mathematics. Thirdly, the lack of difference in the results between boys and girls may be the result of the Chinese cultural belief that academic achievement is a function of hard work rather than innate ability. This belief, widely uncommon in the US, gives equal chances for boys and girls to achieve good results in math. Finally, the Chinese “one child per family” policy allowed parents to have high expectations for and spend more money on their child’s education than American parents did.

Alkhateeb (2001) conducted a study in the United Arab Emirates (UAE) to investigate gender differences in math education among students in third grade up to grade 12. The math achievement results of 200 students, 100 males and 100 females, were obtained from the records of the Ministry of Education over a period of ten years. The results showed no overall significant differences, but girls slightly outperformed boys in the last six school years. The researcher explained the results as follows: first, in the UAE the living standards are high, and families of high SES believe in the equality between boys and girls. Secondly, females spend more time on school work since their outdoor activity is limited. Thirdly, the UAE schools were not co-educational; that is, female teachers taught girls and male teachers teach boys. This system seemed to have a positive influence on

girls, allowing them the freedom to express themselves in the classroom; also, teaching was being tailored to their specific learning styles.

Georgiou, Stavrinides, and Kalavana (2007) conducted a study to examine the mathematical attitudes and achievement of 255 eighth grade students in Cyprus. A questionnaire was designed to measure students' attributions of their own success and their attitudes towards math. Students also took a math achievement test. The results did not show a significant difference between boys' and girls' math achievement. However, boys tended to believe more than girls did, that their success was due to their intellectual abilities.

Differences in achievement between boys and girls can be related to different problem solving strategies acquired in early education (Fennema & Carpenter, 1998). Girls used concrete solution strategies whereas boys were more abstract in their solutions. These differences favored boys' performance in later grades where math becomes a more abstract topic.

The Trends in International Mathematics and Science Study (TIMSS) was conducted in 2007. Of the 36 countries participating in the testing of grade 4, 21 countries showed significant differences in the achievement of boys and girls, 13 in favor of boys and 8 in favor of girls. Scores for 8th graders were obtained from 47 countries of them, 24 countries showed a significant difference between the achievement of boys and girls in math, 8 in favor of boys and 16 in favor of girls. Lebanon participated in the TIMSS of 2007 only for 8th graders. The results showed a statistically significant difference in favor of boys who outperformed girls by 13 out of 80 score points (US Department of Education, 2008).

Penner (2003) investigated the interaction between gender and item difficulty in mathematics and science achievement tests. The results of the TIMSS conducted in 1995 were used as source of data. In order to represent a variety of geographical locations and levels of development, the researcher selected the following 10 countries: United States, Canada, Australia, New Zealand, Lithuania, the Czech Republic, Sweden, Austria, South Africa, and Cyprus. A two stage stratified sample was used in selecting schools and math classes in each of the selected countries. Item difficulty was defined according to the percentage of students who answered an item incorrectly. Gender differences in mathematics test scores favoring boys were found in all of the countries included in this study. The results showed that in Cyprus, Lithuania, South Africa, and the United States, less difficult items were slightly more difficult for girls than for boys. As items became more difficult, more boys answered the items correctly. For the other countries, no significant difference was found on easy items but differences increased as problems became more difficult. Also, girls had higher odds of solving a problem incorrectly. These results indicate that the male-female gap in math achievement could be manipulated by changing the difficulty level of tests. This might also explain why different tests yield different results in terms of the performance of boys and girls.

In summary, results on gender differences in achievement in mathematics are mixed. As the country, school, test, and grade level vary, the performance of students varies as well. The conclusion that could be drawn is that “boys and girls are different. One is not better than the other; they are just different” (Geist & King, 2008, p.43). Research has shown that girls tend to be less confident about their performance in comparison to boys. Also girls’ and boys’ experiences in learning mathematics differ significantly from one

another. These differences are perpetuated by the practiced teaching methods, the current curriculum, parental expectations and teachers' behaviors in the classroom. Thus, scholars need to re-examine the current educational system to meet the needs and learning styles of both boys and girls (Geist & King, 2008).

2.3 - Gender Differences in Attitudes toward Mathematics

An attitude towards mathematics is twofold: first the objective perception of math as either a gendered or a gender neutral domain, and secondly, the subjective personal attitude toward math defined in terms of enjoyment and interest (Brandell & Staberg, 2008; Tapia & Marsh, 2004). In this study, the second type of attitude towards mathematics is examined.

Hamzeh (2009) conducted a study to examine Lebanese students' attitudes towards math as a subject and towards math teachers. Another purpose was to examine teachers' perceptions of the attitudes of their students towards math as a subject and towards math teachers. The sample consisted of 132 7th, 8th, and 9th graders from two different schools. Data was collected through questionnaires administered to students, interviews conducted with the teachers and classroom observations. The results showed that students generally have a positive attitude towards math as a subject and no significant gender differences existed in these attitudes. Attitudes towards math and attitudes towards math teachers exhibited a strong positive correlation. Also, teachers perceived their students to have positive attitudes towards math as a subject and towards math teachers.

In a study conducted by Brandell and Staberg (2008) the question: "Mathematics: a female, male or gender-neutral domain?" was answered by 1300 Swedish students between 15 and 17 years old. The questionnaire "Who and Mathematics" was used to examine

students' perceptions of mathematics as a female, male or gender-neutral domain and to assess age and gender differences in attitudes. The results showed that math was viewed as a male domain. This view was stronger among boys than it was among girls, and it was strongest among boys in the science program. Students also believed that boys, more than girls, enjoyed challenging problems, found math easy, and needed mathematics for their future careers. The latter was an important observation because it reflected students' awareness of a "structurally gendered labor market". Female students considered that it was typical for girls to worry about not doing well, wish to do better, and find mathematics boring. They also believed that it was important for them to understand math and they should work harder than boys to do well in math. The older students in this study believed that boys considered math as their favorite subject more than girls did. The younger students tended to perceive mathematics as a gender-neutral domain. Success, interest and importance of math for the future, which are positive aspects of mathematics, were viewed as male-related traits. Negative aspects were identified as more female-related traits; in particular, girls' success was perceived to be the result of diligent hard work rather than high ability or motivation.

Ibrahim (2009) conducted a study to examine the frequency and nature of participation of female and male students in elementary mathematics classrooms in Lebanon and the teachers' reaction to their participation. The study was a descriptive study, based on classroom observations. The observations were in the form of videotapes of math classes recorded as part of the Mathematics Reform for All in Lebanon (MARAL) Project. In order to study reasoning, critical thinking and communication in Lebanese elementary mathematics classrooms, the MARAL project which was both a research and development

project was officially launched in October 2002. A total of 249 math lessons were videotaped, a stratified random sample of 77 lessons were chosen to become the subject of analysis in this study. Three instruments were used for data collection. The first instrument was used to study the frequency and nature of girls' and boys' participation in the classroom. The second instrument aimed at examining students' participation and teacher-student interaction during participation. The third instrument was used to study the nature and frequency of teachers' responses to the mistakes of students. In order to determine inter-rater reliability, both the researcher and a second rater coded the lessons using the three instruments. Frequency tabulations and a series of Chi-square tests were used to analyze data collected from the study. Results revealed significant differences favoring boys in "answering teachers' questions" and "students' initiation of a question or comment". Teachers were also found to give more attention to boys than girls, chose more boys than girls to solve an exercise on the board and to answer a question from their seat. However, once a teacher chose a student to answer a question or pass to the board, no significant differences were found in the way the teacher interacted with boys and girls. Also no significant differences were found in the way teachers addressed mistakes committed by male and female students.

Preckel, Goetz, Pekrun, and Kleine (2008) examined the achievement, non-verbal reasoning ability, self-concept, interest and motivation in mathematics of students in gifted and average-ability groups. The sample consisted of 181 six graders randomly stratified with respect to school type, SES, rural/urban population, and gender. The results showed that gifted and non-gifted girls had lower levels of interest and motivation in mathematics in comparison to the boys. On measures of self-concept, boys in the gifted group had

significantly higher scores than those in the average-ability group, but the girls' scores were similar in both ability groups. This finding shows that girls tended to underestimate their abilities whereas boys have higher self-confidence. Regarding achievement, boys performed significantly better than girls in both ability groups.

In another similar study, Tapia & Marsh (2004) investigated students' attitudes towards math using the Attitudes Towards Mathematics Instrument (ATMI). The instrument measured six constructs: confidence, anxiety, value, enjoyment, motivation, and parent/teacher expectations. The sample consisted of 134 students enrolled in a math course at a university. The results showed that attitudes towards math were not affected by gender; rather the level of math anxiety had the same effect on girls' and boys' attitudes, and the level of math anxiety had an effect on measures of enjoyment, motivation, and self-confidence.

Along the same lines, Georgiou and colleagues (2007) conducted a study to examine the mathematical attitudes and achievement of 255 eighth grade students in Cyprus. The Attitudes Towards Mathematics (ATM) Scale was used to measure two dimensions of attitudes: attraction and usefulness of mathematics. To determine boys' and girls' attributions of success, the Math Achievement Attributions Scale was used. Students could attribute their success to effort, talent, ability, level of intelligence, or parents' expectations. Also the Affective Reactions Scale assessed students' affective reaction to math examinations. Items of the questionnaire were worded around feeling upset, motivation, discomfort, anger, enjoyment, and other related concepts. For analysis purposes, the sample was divided to four groups: high achieving boys, low achieving boys, high achieving girls, and low achieving girls. The results showed that the score of

attribution of success to ability for high achieving boys was significantly higher than all other groups. Scores in attribution to effort were not significantly different between boys and girls. Also, high achieving boys had a significantly more positive attitude towards math in comparison to low achieving boys but not in comparison to high achieving girls.

Although attitudes towards math and achievement had a high correlation, a positive attitude towards math was not a predictor of high achievement. The researchers concluded that three factors could best predict math achievement: attribution to ability, finding math as threatening and finding it challenging.

2.4 - Teachers' Beliefs

Teachers' beliefs are gender bias free if teachers hold accurate perceptions of students' abilities which are not influenced by gender (Helwig et al., 2001). These beliefs influence teachers' behaviors in the classroom, their instructional decisions, questioning strategies, and the difficulty level of the material they present in class (Fennema et al., 1990).

Tiedemann (2000) conducted a study to investigate the beliefs of mathematics teachers concerning their male and female students' achievement in mathematics, the respective reasons for the successes and failures and their learning characteristic. The sample consisted of 52 teachers who taught 312 students in grades 3 and 4. Most of the teachers participating in this study were women. Each teacher was asked to identify six students, three girls and three boys, from their class. The teachers were told to choose one boy and one girl from each performance level; high, average, and low. Then teachers were asked to fill a questionnaire for each of the chosen students. The questionnaire consisted of 21 items covering six categories: attribution of current performance in mathematics (4

items), estimation of the child's competence (4 items), attribution of improvement (4 items), attribution of deterioration (4 items), presumed self-concept of the child (3 items), and prognosis of performance (2 items). The results showed that teachers believed that the average achieving boys were more logical than equally achieving girls. Mathematics was perceived to be more difficult for average achieving girls than for average achieving boys. Girls were thought to benefit less than boys from additional effort and needed to invest more effort than boys to achieve the same level of performance. Teachers attributed unexpected failure of girls to low ability and unexpected failure of boys to lack of effort. Also, teachers were found to be aware of the girls' lower self-confidence in their own ability in comparison to boys. These results showed that the average and low performing girls were at a disadvantage because teachers' ratings of this group's competence and performance were the lowest.

In a more recent study, Tiedemann (2002) investigated further the influence of math teachers' gender-related stereotypes on their beliefs about the ability and effort of their students. The sample consisted of 48 teachers, mostly females who taught 288 third and fourth graders. Each teacher was asked to identify six students, three girls and three boys, from each performance level: high, middle and low. Then teachers were asked to fill two questionnaires; the first on their students' mathematical abilities and the second on their effort resources, one for each chosen student. The teachers were also given a questionnaire in order to assess their own gender stereotypes. The results showed that teachers who believed in the gender role stereotypes attributed lower mathematical abilities to their female students in comparison to the male students. No differences were found in the ability attribution among teachers who did not adopt gender role stereotype. The same

results were found for effort resources. Thus teachers' biased perceptions were found to affect their beliefs about their students' abilities and effort resources. The researcher argued that this finding was detrimental to girls' self-concept and achievement. Gender role stereotypes among teachers were found to affect their perceptions of average and low performing students but not their perceptions of high performing students. The researcher concluded that gender differentiated perceptions of teachers in elementary school may be responsible for the differences in boys' and girls' beliefs in their own mathematical competence at the elementary school level.

Teachers' beliefs and perceptions do affect their behavior and impact their classroom instruction. Li (1999) conducted a literature review of approximately 50 articles studying gender differences in mathematics in relation to teachers' beliefs. The review revealed that teachers perceived mathematics as a male domain. They tended to overrate boys' mathematical capacity. The review also showed that teachers had higher expectations for boys and a more positive attitude towards them. These biased beliefs are in turn perceived by the students themselves which lead to a gender-biased view towards their own capacities and those of the opposite sex.

Teachers' perceptions were also investigated in a study conducted by Fennema and colleagues (1990). Thirty eight, first grade female teachers were interviewed to assess their attributions of success and failure of their male and female students. The teachers were also asked to describe the characteristics of the most successful boys and girls in their classrooms. The results showed that teachers attributed boys' success to ability and intrinsic motivation and girls' success to effort and ability. The boys' failure was attributed to lack of teacher help and lack of effort whereas girls' failure was attributed to lack of effort and

difficulty of task. Teachers described the most successful boys as competitive, enjoyed math and were very independent. Girls were given almost the same characteristics but in lower ratings.

Conversely, in a study conducted by Helwig and colleagues (2001), 15 third grade teachers and 14 fifth grade teachers rated the skill level and classroom behavior of their students. The regression analysis showed that teachers disregarded gender when rating the mathematical skill of their students. Rather, they relied on test scores and their students' level of effort.

Finally, in a study investigating the effect of both parents' and teachers' beliefs on children's perceptions of their own academic competence, Herbert and Stipek (2005) examined a sample of 300 children from first to fifth grade. The results showed that teachers' and parents' beliefs were the most significant determining factors of students' perceptions of their own competence and their attitudes towards math. The findings also revealed that teachers rated girls' literacy abilities higher than of boys. Parents rated their sons' math abilities higher than their daughters' abilities. Also, the teachers' ratings were found to reflect the students' actual performance more than the parents' ratings did.

2.5 - Conclusion

Most results on mathematical achievement showed no significant differences between boys' and girls' at the intermediate level. These differences emerged at the secondary level (Georgiou, Stavriniades, Kalavana, 2007; Hanna, 2003; Preckel, Goetz, Pekrun, & Kleine, 2008; Tapia & Marsh, 2004; Tsui, 2007).

With regard to attitudes toward math, research on this topics showed that although students perceive mathematics to be a male domain (Brandell & Staberg, 2008), general

attitudes toward the subject did not show any significant difference pertaining to gender (Tapia & Marsh, 2004). On the other hand, boys did demonstrate a higher confidence in their abilities and a lower level of anxiety in comparison to girls (Hanna, 2003; Herbert & Stipek, 2005; Villalobos, 2009).

The literature review on teachers' beliefs regarding their male and female students' abilities and characteristics yielded the following results: 1) teachers had higher performance expectations for boys than they did for girls. 2) Teachers were also found to attribute boys' success mostly to ability whereas girls' success was attributed to effort. 3) Teachers described the most successful boys as competitive, enjoyed math and were very independent. Girls were given almost the same characteristics but in lower ratings. (Fennema, Peterson, Carpenter, and Lubinski, 1990; Herbert & Stipeck, 2005; Li, 2009; Tiedemann, 2000).

CHAPTER THREE

Methodology

3.1 - Introduction

In order to study and document gender differences in math education in Lebanon, data collection from Lebanese students and teachers was fundamental. The instruments used for data collection were questionnaires given to students, and structured interviews conducted with three school teachers, in addition to classroom observations. This chapter provides an account of the methods and procedures used for collecting and analyzing data.

3.2 - Participants

The sample of students and teachers participating in this study was a non-randomized, purposive sample.

The study was implemented in a private school in Jounieh that catered to students from middle socio-economic status. Students from the two sections in each of the grades 7, 8 and 9 participated in the study. Thus, the sample consisted of 171 students: 112 girls and 59 boys. Pertaining to grade levels, the sample was divided as follows: 62 grade 7, 67 grade 8, and 42 grade 9 (See Table 1). The students' ages range between 12 and 16 years.

In addition, the three math teachers who taught the students participating in this study were also part of the sample. The teachers were all female having more than 15 years of experience in teaching. At the time the study was conducted, the first teacher taught two sections of grade 9, the second teacher taught two sections of grade 8 and one section of grade 7, and the last teacher taught one section of grade 7.

3.3 - Instruments

The following instruments were used for data collection.

3.3.1 - Students' achievement

Students' grades in math for the school year 2009-2010 were used to calculate their averages. Each student received one score in math, which reflected the student's achievement at the time of data collection.

3.3.2 - Attitudes towards mathematics scale

In this study, the Attitude toward Mathematics (ATM) scale was used to measure students' attitudes toward math (Aiken, 1974). The scale was a five-level Likert-type scale designed to measure students' Enjoyment and Value of Mathematics (See Appendix A). It consisted of two subscales, namely Enjoyment (E) and Value (V), consisting of 16 and 8 items respectively. According to Aiken, coefficient alpha for the E scale was .95 and .85 for the V scale. The E scale comprised items like: "Mathematics is enjoyable and interesting to me", "Mathematics makes me feel nervous and uncomfortable". The V scale comprised items like: "Mathematics has contributed greatly to the development of society", "Mathematics helps to develop the mind and teaches a person to think". Some items were constructed in a positive manner such as: "Mathematics has contributed greatly to the development of society", whereas others were constructed in a negative manner, for example: "I am not motivated to work very hard on mathematics lessons".

The interval scoring technique used in this study was developed by the researcher in accordance with the literature on scoring Likert type scales. Burns (2000) explained that after the questionnaire is completed, each item may be analyzed independently or item responses may be summed to generate a score for a group of items. For this reason, Likert scales are called summative scales. Likert type scales are often treated as interval scales because, when properly constructed, there is equal distance between each value. By treating

this type of attitudinal measurement as intervals, researchers can calculate mean scores which can then be compared.

3.3.3 - Attribution interview

The teachers were interviewed to assess their beliefs on their students' math achievement with respect to gender. The interview script was derived from the attribution interview in Fennema et al. (1990). The interview consisted of two parts (See Appendix B). In the first part the teachers were asked to choose the two most successful (MS) students and the two least successful (LS) students in their class. They were then given a list of causes of success and another one for causes of failure. They were asked to attribute the success and failure of each of the previously chosen students to one or more of the listed causes. In the second part of the interview (i.e., question 6) teachers were presented with a list of characteristics from which they chose what best characterized the MS girl student and MS boy student in their class.

3.3.4 - Observation

The goal of the observation was to add another source of data to increase the validity of the results of this study. The coding sheet was developed for this study with items chosen according to the literature. It was used by the researcher who focused on observing the following behaviors as they pertained to gender: (1) teacher's questioning, attention given to students, and expectations from students. (2) Students' participation, enjoyment of the class, and time spent on task (See Appendix C).

3.4 - Procedures

The data collection process began with a meeting with the school's principal. The purpose of the research was discussed in order to obtain her approval for distributing the

questionnaires to the students and conducting the interviews and observations. The principal showed great interest in the work and immediately granted the permission for data collection.

The researcher met separately with each of the three teachers participating in the study. The purpose of the study was explained briefly and vaguely so that the teachers' behaviors in the classroom and their answers would not be biased. All teachers accepted to sit for the interviews and gave their consent for the researcher to attend their classes.

A meeting was then held with the head of the middle school to organize with her the classroom observations and to find the suitable time for distributing the questionnaires to the students. The meeting resulted in a schedule extending over a period of 15 days, from March 20 till April 5, at which date all observations and questionnaires were collected.

The questionnaires were collected in periods other than the math period so that the students had complete freedom to express their opinions. The researcher and the classroom teacher were present during questionnaire collection.

The observation sessions were 50 minutes long each. Each section was observed twice, thus 12 observation sessions took place within 15 days. The researcher used a coding sheet to note the meaningful behaviors of both students and teachers, as well as the frequency of their occurrence (See Appendix C).

The three teachers were interviewed to determine their beliefs on the mathematical abilities of boys and girls, the causes of their success and failure, and the characteristics of students who are successful. The interviews were structured following a prepared set of questions (See Appendix B). Each teacher answered the same set of questions for each section they taught, thus resulting in a total of six interviews. The interviews were conducted in

parallel with the classroom observations. Each interview lasted approximately 10 minutes and all the answers were recorded by the researcher as well as any other relevant comment.

The students' grades were obtained from the school's administration at the end of the school year. The grades were given to the researcher in a sealed envelope.

3.5 - Validity and Reliability

Reliability is defined as the extent to which data are constant through different administrations of the instrument (Fraenkel & Wallen, 2006). The reliability of the students' questionnaire is ensured by the coefficient alpha for the Enjoyment scale which is .95 and .85 for the Value scale (Aiken, 1974). As for the interview, given its format, that is, a structured interview, its reliability was high (Fraenkel & Wallen, 2006).

In order to increase validity and reliability, triangulation was used. Triangulation involved the use of three different methods of data collection: structured interviews with the teachers, classroom observations, and a thorough literature review on gender differences in math education pertaining to teachers' beliefs and behaviors.

3.6 - Procedures for Reviewing the Literature

A thorough review of the literature was effected to examine various aspects of gender differences in math education, especially at the intermediate level. The following components were emphasized:

A review of related literature was done to determine whether significant differences existed between boys' and girls' achievement in math at the intermediate level.

The literature was reviewed to investigate boys' and girls' attitudes toward math as a subject matter. The review focused on whether students perceived mathematics to be a male domain. Also, the general attitudes of students toward math were examined in the

literature. In addition, the literature was reviewed to investigate boys' and girls' attitudes towards their math abilities and the level of anxiety experienced when working with mathematics.

The review of the literature also focused on teachers' beliefs regarding boys' and girls' performance abilities in math. Studies on teachers' beliefs were reviewed to determine whether teachers had higher performance expectations for boys than they had for girls, as well as to examine their opinions concerning attribution of causation of boys' and girls' success and failure in math.

In sum, the review of the literature process focused on gathering information about gender differences in math education; students' achievement and attitudes pertaining to gender, and teachers' beliefs concerning boys' and girls' abilities and the reasons behind their success and failure in the subject matter.

3.7 - Data Analysis

3.7.1 - ATM scale

Data gathered using the ATM scale was analyzed using SPSS. The instrument was a Likert type scale consisting of 5 levels. Scores on each item ranged from (-2) to (+2) where (-2) corresponds to negative attitudes and (+2) to positive attitudes. Items constructed in a positive manner were scored in the following way: Strongly disagree (SD) (-2), Disagree (D) (-1), Undecided (U) (0), Agree (A) (+1), Strongly Agree (SA) (+2). Items constructed in a negative manner were scored in a reversed way, that is: Strongly disagree (SD) (+2), Disagree (D) (+1), Undecided (U) (0), Agree (A) (-1), Strongly Agree (SA) (-2). One total score was calculated for each student. Total scores that were positive numbers reflected positive attitudes, whereas negative total scores reflected negative attitudes.

3.7.2 - Gender differences

To assess gender differences in students' achievement and attitudes, a one-way ANOVA was performed with gender as the independent variable and both achievement and attitudes as the dependent variables.

3.7.3 - Teachers Attributions Interview

Data collected from the three interviews with the teachers were gathered and analyzed quantitatively. First, the teachers' choices of the two MS students and the two LS students were compared to these students' averages in math in order to determine the accuracy of the teacher's choice. Second, teachers' attributions of causation of success and failure for the previously chosen students were identified. Third, the characteristics given by the teachers to the most successful boy and the characteristics given to the most successful girl in their class were also determined.

3.7.4 - Classroom observation

The results of the observations were coded by the researcher and analyzed qualitatively. The data was classified under "math teachers' behavior" and "students' classroom behavior." For teachers' behavior the subtopics were: teacher's questioning, attention given to students, and expectations from students. As for the students' behaviors, the subtopics included the following: students' participation, enjoyment of the class, and on-task behavior. The results of the classroom observations were analyzed as they relate to gender differences: Do teachers display differential behavior with boys and girls? Are the behaviors of boys and girls similar to one another in math classes? The results of the

observations were used to support the results obtained in the students' questionnaires and teachers' interview.

CHAPTER FOUR

Findings

4.1 - Introduction

This study aimed at extending the existing research on gender differences in mathematics to a new context and a wider combination of variables. The new context is Lebanon; the purpose is to reinforce research on gender differences in math education in this country. Another purpose was to study gender differences in relation to students' attitudes and achievement in mathematics, teachers' beliefs about the characteristics of the most successful male and female students as well as the respective reasons for their success, and finally teachers' differential behavior with boys and girls.

This chapter presents the results of data collected through questionnaires distributed to students in grades 7, 8 and 9. The results also encompass interviews with three middle school math teachers as well as observations conducted in each of the six sections participating in the study.

4.2 - Attitudes towards Math

In order to answer the first research question: "Do significant differences exist between boys' and girls' attitudes toward math?" the Attitudes Towards Mathematics scale (ATM) was administered to 171 students from grade 7 to grade 9. The questionnaire is divided into two main sections: Enjoyment of Mathematics and Value of Mathematics. The items of the first section were grouped into five domains; these are: enjoyment of mathematics, developing mathematical skills, stress related to mathematics, extending mathematical knowledge and emotions towards mathematics. Items of the Value of

Mathematics section were grouped into three domains; these are: Importance of mathematics as a subject, interest in mathematics and implications of mathematics outside the classroom.

For each student, a general score was computed that represents their attitude towards mathematics. Data gathered using the ATM scale were analyzed using SPSS. Since the instrument is a Likert type scale consisting of 5 levels, scores on each item ranged from -2 to +2 where -2 corresponds to the most negative attitudes and +2 to the most positive attitudes. Items constructed in a positive manner were scored in the following way: Strongly disagree (SD) (-2), Disagree (D) (-1), Undecided (U) (0), Agree (A) (+1), Strongly Agree (SA) (+2). Items constructed in a negative manner were scored in a reversed way; that is: Strongly disagree (SD) (+2), Disagree (D) (+1), Undecided (U) (0), Agree (A) (-1), Strongly Agree (SA) (-2). One general score, ranging between -48 and +48, was calculated for each student. A general score ranging between -48 and -30 reflects a negative attitude, between -29 and -10 a moderately negative attitude, between -9 and +9 a neutral attitude, between +10 and +29 a moderately positive attitude and between +30 and +48 a positive attitude.

4.2.1 - Students' attitudes towards math

As shown in table 2, the results showed that the participants as a group had moderately positive attitudes towards math. In grade 7, girls were found to have moderately positive attitudes towards math ($M = 14.34$) whereas boys had mostly neutral attitudes ($M = 9$). On the other hand, in grade 8, the opposite results were found. That is, boys had moderately positive attitudes ($M = 15.17$) whereas girls had mostly neutral attitudes ($M =$

8.14). Finally, in grade 9, both boys and girls had similar moderately positive attitudes ($M = 18.07$ for boys and 16.71 for girls).

Also, the results of the two-way ANOVA (see Table 3) examining grade by gender type (3×2) on students' attitudes, did not yield a significant main effect for gender, $F([1, 165] = 0.10, p = 0.75)$. The main effect of grade was also not found to be statistically significant, $F([2, 165] = 1.21, p = 0.30)$. The interaction effect was not statistically significant either, $F([2, 165] = 1.45, p = 0.24)$.

4.2.2 - Enjoyment of mathematics

For the Enjoyment of Mathematics section a score ranging between -32 and $+32$, was calculated for each student. A score ranging between -32 and -20 reflects a negative attitude, between -19 and -8 a moderately negative attitude, between -7 and $+7$ a neutral attitude, between $+8$ and $+19$ a moderately positive attitude, and finally between $+20$ and $+32$ a positive attitude.

Also, the two-way ANOVA did not yield a significant main effect for gender, $F([1, 165] = 0.020, p = 0.887)$. The main effect for grade level was also found to be statistically not significant, $F([2, 165] = 0.186, p = 0.308)$. The same applies to the interaction effect, $F([2, 165] = 2.073, p = 0.129)$ (See Table 4).

As shown in table 5, the distribution of scores in the Enjoyment of Mathematics section resembled the distribution of the scores on the general attitudes towards math. The attitudes of boys in grade 7 were neutral ($M = 2.9$) in terms of enjoyment of mathematics, whereas girls had moderately positive attitudes ($M = 7.76$). The situation was reversed in grade 8 ($M = 7.91$ for boys and 2.14 for girls). As for grade 9, both boys and girls had moderately positive attitudes ($M = 9.28$ for boys and 9.21 for girls). The overall enjoyment

scores reflected neutral attitudes for both boys ($M = 6.45$) and girls ($M = 5.96$); that is, no gender differences were found.

In the “Liking of mathematics” domain which contains the items: “I usually enjoy studying mathematics in school,” and “Mathematics is enjoyable and interesting to me” the scores revealed that both boys and girls had mostly neutral attitudes ($M = 0.49$ for boys and 0.63 for girls).

On the “Developing mathematical skills” domain the results showed that boys and girls had similar scores ($M = 1.86$ for boys and 1.68 for girls). In other words, boys and girls were equally interested in working hard on mathematical problems, solving new problems and developing their mathematical skills by studying this subject more.

Students’ scores on the “Stress related to mathematics” domain showed similar results for boys and girls, revealing that mathematics was a subject-matter that did not cause stress ($M = 1.06$ for boys, $M = 1.57$ for girls). In this domain students were asked about getting upset while trying to work on mathematics lessons, remaining calm when studying mathematics, or feeling nervous, confused, and uncomfortable towards mathematics in general.

The results on the “Extending mathematical knowledge” domain showed moderate scores for both boys ($M = 2.3$) and girls ($M = 1.58$). That is, both boys and girls were moderately interested in learning more information in mathematics.

The last domain in the Enjoyment of Mathematics section is “Emotions towards mathematics”. The results showed that neither boys ($M = 0.73$) nor girls ($M = 0.59$) had particularly strong emotions in liking or disliking mathematics.

4.2.3 - *Value of mathematics*

For the Value of Mathematics section, a score ranging between -16 and +16, was calculated for each student. A score ranging between -16 and -10 reflects a negative attitude, between -9 and -4 a moderately negative attitude, between -3 and +3 a neutral attitude, between +4 and +9 a moderately positive attitude, and finally between +10 and +16 a positive attitude.

The two-way ANOVA did not yield a significant main effect for gender, $F([1,165] = 0.394, p = 0.531)$. The main effect for grade level was also found to be statistically not significant, $F([2, 165] = 0.916, p = 0.402)$. The same applies to the interaction effect, $F([2, 165] = 0.314, p = 0.731)$ (See Table 6).

As shown in table 7, the results of the Value of Mathematics section revealed that both boys and girls had similar moderately positive attitudes ($M = 7.2$ for boys, $M = 6.59$ for girls) towards math as a subject-matter..

When asked about the “Importance of mathematics as a subject” by itself and in comparison to other subjects, both boys and girls showed moderately positive attitudes ($M = 2.3$ for boys, $M = 2.01$ for girls). In other words, students believed that mathematics was an “important and necessary subject”, and “one of the most important subjects for people to study”.

The results of the domain entitled “Implications of mathematics outside the classroom” showed that boys and girls had moderately positive to positive attitudes ($M = 3.23$ for boys, $M = 3.67$ for girls). That is, students believed that mathematics has “contributed greatly to the development of society”, that it helps develop the mind and teaches a person to think, and is very important in everyday life.

Finally, the “Interest in mathematics” domain contained items measuring general interest in mathematics such as “Mathematics is an interesting subject” as opposed to personal interest in mathematics like “Mathematics is an interesting subject to me”. Scores showed an overall moderately positive attitude for both boys and girls ($M = 1.66$ for boys, $M = 1.23$ for girls).

In conclusion, the results of the Attitudes Towards Mathematics scale showed that the participants as a group had moderately positive attitudes towards math. In grade 7, girls were found to have moderately positive attitudes towards math whereas boys had mostly neutral attitudes. On the other hand, in grade 8, the opposite results were true. Finally, in grade 9, both boys and girls had similar moderately positive attitudes.

4.2.4 - Classroom observations

In order to increase validity and reliability of the study, two classroom observations were conducted in each of the six sections participating in the study. Each session was 50 minutes long. The researcher used a coding sheet developed for this study with items chosen according to the literature (See Appendix C). It was used by the researcher to observe the following behaviors as they pertain to gender: (1) teacher’s questioning, attention given to students, and expectations from students. (2) Students’ participation, enjoyment of the class, and time spent on task.

The results of the observations as related to students’ attitudes towards math revealed slight, but not significant gender differences.

In grade 7, the following results were observed: 1) In both sections, the percentage of boys who raised their hand to either ask or answer a question was double that of girls. 2) In one section, 4 boys and 1 girl exhibited off-task behavior, in the other section 2 boys and

2 girls exhibited off-task behavior. 3) Although the number of boys and girls who did not seem to enjoy the class was less than 2 students per section, while observing the class there was constant low-volume side chatter unrelated to studying mathematics.

The observations conducted in grade 8 yielded the following results: 1) A higher number of boys raised their hands to answer the teacher's questions and participate in class. 2) Frequent off-task behavior was observed among boys (more than 3 per session), and only one incident per session was observed among girls. 3) The number of questions asked by male students was double that asked by female students. 4) The observer noted the same number of boys and girls (always under 4 students) who did not seem to enjoy the class. It should also be mentioned that in one session 2 boys were kicked out of the classroom for disrupting the class work.

The observations conducted in grade 9 yielded the following results: 1) The percentage of girls raising their hands to answer a question was lower than that of boys. 2) More boys exhibited off-task behavior. 3) Boys and girls equally raised their hand to ask a question or comment on an idea. 4) In two of the four sessions, the teacher allocated 20 minutes for individual work before common correction. All students were interested and on-task except for 2 boys and 2 girls who were not interested and even one boy was sleeping.

In conclusion, in all grades and sections the frequency of classroom participation was higher among boys than it was among girls. In general, both boys and girls seemed to enjoy the class equally well; however boys showed a higher frequency of disruptive behavior than girls.

4.3- Students' Achievement in Mathematics

In order to answer the second research question: “Do gender differences in math achievement exist?” the means and standard deviations of math grades for the school year 2009-2010 were computed for boys and girls in grades 7, 8, and 9. Also a two-way ANOVA (2x3 gender by grade level) was performed to test for significant differences in achievement.

As shown in table 8, the differences in the math averages of boys and girls in all grades were negligible (less than 0.7 out of 20 points). Also, the two-way ANOVA did not yield a significant main effect for gender, $F([1,165] = 0.00, p = 0.999)$. The main effect for grade level was also found to be statistically not significant, $F([2, 165] = 0.387, p = 0.68)$. The same applies to the interaction effect, $F([2, 165] = 0.295, p = 0.745)$. In other words, the results of this study did not reveal gender differences in math achievement among students in all grade levels (see Table 9).

4.4 - Teachers' Beliefs and Behavior

In order to address the third research question: “What are the beliefs of math teachers regarding differences in boys' and girls' mathematical abilities and characteristics?” interviews were conducted with the three math teachers of grades 7, 8 and 9.

The teachers were asked to nominate their most and least successful male and female students and to justify their answers. The interviews also addressed the characteristics of these students as perceived by the teachers.

As shown in table 10, for the choice of the most successful student, the teachers nominated 2 boys and 4 girls. Based on the students' math achievement the teachers were accurate 5 out of 6 times. For the selection of the second most successful student, the teachers also nominated 2 boys and 4 girls and were accurate 4 out of 6 times. The 2 inaccurate nominations were one boy and one girl.

As for the choice of the least successful student (see table 11), teachers nominated 4 girls and 2 boys and were accurate 5 out of 6 times. The choice of the second least successful student yielded different results. Teachers nominated 2 girls and 4 boys and were accurate only 2 out of 6 times. The 4 inaccurate nominations were 3 boys and one girl.

With respect to justifying their nominations, the teachers answered as follows: girls' success was attributed to high ability (6 times), effort (6 times), teacher's help (3 times) and others' help (once). Whereas the success of boys was attributed to high ability (4 times), and intrinsic motivation (twice).

On the other hand, the causes of failure for girls were attributed unanimously to student's low ability, whereas the reasons for boys' failure were assigned as follows: lack of effort (5 times), lack of intrinsic motivation (twice), and low ability (once).

In sum, the teachers accurately nominated the most successful boys and girls in their classes, but they were inaccurate, mostly about boys, in their nomination of the least successful students. Also, the teachers attributed the boys' success mostly to ability and girls' success to effort, whereas the boys' failure were attributed to low effort and the girls' failure to low ability.

The results also showed that the teachers used the following character traits to describe the most successful male students: not at all aggressive, extremely independent,

objective, not easily influenced, not at all dominant, active, competitive, extremely logical, direct, somehow adventurous, loud, makes decisions easily, rarely acts as a leader, rarely has a strong need for security, self-confident, volunteers to answer questions, enjoys math, not at all dependent in math, and extremely persistent on hard tasks.

The teachers used the same characters traits to describe the most successful female students as well.

In sum, the characteristics chosen for the most successful male and female students did not reflect any gender bias on the teachers' part and were based on the students' behavior and attitudes towards math regardless of their gender. However, it should be noted that in one interview when asked about whether being adventurous was a characteristic of the most successful girl, the teacher answered: "Adventurous!? No, that's only for boys!"

To answer the last research question: "Do teachers interact differently with their male and female students?" classroom observations were conducted in the three grades participating in this study. The results related to teachers' behavior showed mostly that teachers paid more attention to boys than girls and gave them more opportunities to participate in the classroom.

The observations conducted in grade 7 yielded the following results: 1) In all sessions, teachers called to the board and asked questions to 18 boys and 21 girls given that in this grade the number of girls is double that of boys. 2) Teachers also chose approximately the same number of boys and girls (between 10 and 15) to answer a certain question. 3) In one section of grade 7, one boy was getting more attention than the other students, through the teacher's frequent remarks and comments.

The observations conducted in grade 8 led to the following conclusions: 1) The teacher called to the board and asked questions to an average of 5 boys and 7 girls per session, given that also in this grade the number of girls is double the number of boys. 2) The teacher gave no particular attention to any student. She was always physically and relationally distant from the students.

In grade 9 the four observations conducted in the two sections yielded the following results: 1) The number of girls called to the board or chosen to answer questions was 4 times greater than the number of boys. However, the number of girls in that class was double that of boys. 2) More attention was given to boys; that is the teacher addressed the boys more frequently and asked about their understanding of the material.

In sum, the observations in all grades showed that teachers' beliefs about boys' and girls' mathematical abilities affected their behavior in the classroom. Thus teachers gave boys more than girls opportunities to participate and answer questions. Also boys were more frequently called to the board and given more attention in general.

4.5 - Conclusion

In conclusion, the results of the ATM scale showed that girls and boys in grades 7, 8 and 9 held similar moderately positive attitudes towards mathematics. In addition, no significant gender differences were found in mathematics achievement.

Moreover, the teachers were accurate in their choices of the two most successful and the two least successful students. Girls' success was mainly attributed to ability and effort whereas boys' success was attributed to ability and intrinsic motivation. On the other hand, boys' failure was attributed to lack of effort whereas girls' failure was attributed to

low ability. The teachers described the most successful boys and girls using similar character traits.

Finally, the classroom observations showed that boys were given twice as much attention as girls by the teachers in all grade levels and sections even though the number of girls in most classes was twice the number of boys.

CHAPTER FIVE

Conclusion and Recommendations

5.1 - Introduction

The purpose of this study was to extend the existing research on gender differences in mathematics to a new context and a wider combination of variables. The new context is Lebanon; the purpose is to reinforce research on gender differences in math education in this country. Another purpose was to study the topic as it pertains to students' attitudes and achievement in mathematics, teachers' beliefs about the characteristics of the most successful male and female students as well as the respective reasons for their success, and finally teachers' differential behavior with boys and girls, if it exists.

The results of the study showed that girls and boys in grades 7, 8 and 9 held a similar moderately positive attitude toward mathematics. In terms of achievement, no significant differences were found in math averages between boys and girls.

Results also showed that teachers were not gender biased in their choice of the most successful students. They attributed girls' success to ability and effort whereas boys' success was attributed to ability and intrinsic motivation. On the other hand, the boys' failure was attributed to lack of effort whereas girls' failure was attributed to low ability. Also, the teachers' descriptions were similar of the most successful boys and girls. Finally, the classroom observations showed that in all grades the frequency of classroom participation was higher among boys than it was among girls. In addition, a higher number of boys were called to the board or asked to answer a question.

This chapter presents a discussion, analysis and interpretation of the results, as they relate to the literature on the one hand, and the Lebanese culture on the other.

5.2 - Gender Differences in Mathematical Achievement

The results revealed no significant gender differences in the math achievement of participants. Given the mixed results in the literature on gender differences in math achievement, these findings are congruent with the majority of the studies reviewed (AlKhateeb, 2001, Georgiou, et al., 2007, Hassan, 2001, & Tsui, 2007) but they also contradict the results found by others (Fennema & Carpenter, 1998 & Penner, 2003).

One explanation might be related to the difficulty level of the tests administered to participants. In his study, Penner (2003) has found that the performance of girls and boys in math is similar on easy items but boys outperform girls on more difficult items. These results indicate that the male-female gap in math achievement could be manipulated by changing the difficulty level of tests. This might also explain why different tests yield different results in terms of the performance of boys and girls.

This result could also be explained in relation to the educational status of women in Lebanon. According to the report published in 2002 by the United Nations' Economic and Social Commission for Western Asia, the percentage of Lebanese women with university degrees has increased to 8%; this percentage remains the highest in the Arab region. However, the gender gap in educational attainment at higher levels remains high in Lebanon with a ratio of 1 woman to every 2 men. Also, only 34% of women at the university level have chosen a scientific major, whereas 64% specialize in literature, humanities, teaching, and other similar majors. Thus, as explained in Hassan (2001), the lack of gender differences in math achievement in this study could be explained as a determination from Lebanese girls to show that they are capable of achieving similar results as boys and consequently specializing in scientific majors.

Another explanation might be related to Tsui's (2007) study that examined gender differences in the achievement of Chinese students. The results did not show any significant differences in achievement among boys and girls in eighth grade. Also both genders were equally represented among high achievers. Tsui suggested that this lack of gender difference in math achievement could be the result of many factors, two of which could apply to the Lebanese context. First, in China as in Lebanon the presence of a rigorous and demanding math curriculum and competitive college entrance examination challenge the schools to maintain a high level of education, and motivate the girls who want to pursue higher education to be better achievers in math. Secondly, Chinese and also Lebanese teachers are required to have a diploma in the subject they are teaching. Thus, math teachers possess deep understanding of math and are competent enough to guide their students in the systematic investigation of mathematics.

The last interpretation of the lack of gender differences in math achievement could be related to the fact that the teachers who taught the participants were all females. Thus they were role models who might have encouraged and inspired young girls to believe in themselves and work hard in math classes.

5.3 - Gender Differences in Attitudes Towards Mathematics

The results of this study showed no significant gender differences in the students' attitudes towards mathematics. As such, both boys and girls were found to have moderately positive attitudes towards math.

These results are consistent with the studies conducted by Hamzeh (2009) and Georgiou and colleagues (2007). In the study conducted by Hamzeh (2009), the attitudes of Lebanese 7th, 8th, and 9th graders towards math and towards math teachers were examined.

The results showed that students had a positive attitude towards math as a subject and no significant gender differences existed in these attitudes. The students' attitudes towards their math teachers were positive as well.

Similarly, Georgiou and colleagues (2007) used the Attitudes Towards Mathematics (ATM) Scale to measure two dimensions of attitudes towards mathematics: attraction to and usefulness of mathematics. The results showed that high achieving boys had a significantly more positive attitude towards math in comparison to low achieving boys but not in comparison to high achieving girls. That is, high achieving girls and boys did not differ significantly in their attitudes towards mathematics.

One interpretation for girls having similar attitudes to boys towards math in this study is that the classroom's atmosphere was not competitive, as found in the classroom observations. Given that girls seem to learn more when classrooms promote cooperative activities and boys seem to learn more when classrooms promote competitive activities (Ambrose & Fennema, 2004), girls in this study were at an advantage with respect to achievement.

Another explanation might be related to the gender distribution of students who participated in this study. Feminist scholars have suggested that math instruction is typically organized around a male perspective and should be reorganized to account for female perspectives. As Ambrose and Fennema (2004) put it: "one such reorganization has been to have single-sex classrooms where females will not be competing with males, and in which instructional activities which capitalize on 'women's ways of knowing' will be used" (p. 5974). In the classrooms participating in this study the number of girls per class was consistently double that of boys and all teachers were female. Thus, the reorganization

suggested in the literature was partially in place in the classrooms studied and giving girls the chance to have positive attitudes towards mathematics.

One interesting result was the difference found in the students' scores on the Enjoyment of Mathematics and Value of Mathematics, the two subscales of ATM measured in this study. Although the difference was not statistically significant, scores on the Value of Mathematics were higher than those on the Enjoyment of Mathematics subscale. This result suggests that although students might not enjoy studying mathematics, they still perceive mathematics as a valuable subject and understand its contribution to society and importance in everyday life. This difference in attitudes between on the two subscales could be the reflection of society's beliefs about mathematics. In Lebanon, scientific careers are highly appreciated, and many parents coerce their children into becoming engineers, doctors, architects and other similar careers. Thus, students in this study might have perceived mathematics as a valuable subject because of their parents' belief about it, although they did not seem to be able to enjoy it.

One recommendation that stems from this study is that teachers could capitalize on this perceived value of mathematics that students have and build on it to make them realize the necessity of math in their lives and eventually encourage them to work harder and become more motivated to achieve in this subject matter.

Another interesting result is the difference in attitudes found between students' scores in grades 7 and 8 on the one hand and students' scores in grade 9 on the other. Although not statistically significant, girls in grade 7 had higher scores on attitudes in comparison to boys. In grade 8, the opposite was found true. In grade 9, boys' and girls'

scores on attitudes were similar and highest among all grades. These results could be related to one or all of the following factors:

First, boys and girls in grades 7 and 8 who are typically between the ages of 12 and 14 years are in the puberty stage. The changes in their body affect their behavior with family, friends, and their behavior at school as well. On the other hand, students in grade 9 usually have passed this phase and became more mature, and serious about their academic achievement (Bee & Boyd, 2010).

Secondly, at the end of grade 9 students in Lebanon have to take official exams for the first time in their school years. School administrations, teachers and parents highly emphasize the importance of these exams, as students have to pass them to go on to high school. Considering that mathematics is given one of the largest coefficients in these high-stakes exams, students find themselves forced to work hard in math even if they do not like the subject matter.

Thirdly, the results showed that while observing grade 8 there was a constant side-chatter in the classroom unrelated to mathematics. Boys exhibited a great deal of off-task behavior. Also, the teacher did not seem to mind the high level of noise in the classroom. This climate could have affected negatively girls' attitudes towards math and caused them to have lower scores than boys. As for grade 9, the teacher was managing the classroom properly, making sure to keep students on-task, which could have encouraged girls to participate more in class and have better attitudes towards math.

5.4 – Teachers' Beliefs and Behaviors

The results of this study showed that teachers accurately nominated the most successful boys and girls in their classes, but they were inaccurate mostly about boys, in their nomination of the least successful students. Also, the teachers attributed the boys' success mostly to ability and girls' success to effort, whereas the boys' failure was attributed to low effort and the girls' failure to low ability. Also, the characteristics chosen for the most successful male and female students did not reflect any gender bias on the teachers' part and were based on the students' behavior and attitudes towards math regardless of their gender. Finally, boys were given twice as much attention as girls by the teachers in all grade levels and sections through giving them more opportunities to participate in the classroom.

The results of this study were congruent with the results of other studies, namely studies by Fennema (1990), Li (1999), Tiedemann (2000), and Tiedemann (2002) whose results showed that: 1) teachers had higher performance expectations for boys. 2) Teachers attributed boys' success mostly to ability whereas girls' success was attributed to effort. 3) Teachers described the most successful boys as competitive, enjoyed math and were independent. Girls were given almost the same characteristics but in lower ratings. These findings were not surprising, given that the Lebanese society is patriarchal in nature. Thus, school teachers in this study were only reflecting the general beliefs that people in Lebanon have about males having higher innate ability in mathematics.

5.5 – Recommendations

This study contributed to the literature by challenging a widespread conviction about gender differences in math achievement and attitudes towards math. The results showed that girls' math achievement and attitudes towards math were equally well. Further research is needed to examine whether these results hold for a larger group of students from different public and private schools across regions in Lebanon.

Another recommendation is about investigating the reasons for the positive attitudes that students in this study were found to have towards mathematics. Identifying the factors that promote these positive attitudes could lead teachers to capitalize on them and create classroom environments that foster students' positive attitudes towards mathematics. Thus, future research must focus on identifying these variables, not only in middle school, but also in lower and higher grade levels.

Finally, research on teacher training programs in Lebanon might shed light on variables that contribute to bias in teachers' perceptions of boys' and girls' ability in mathematics and teachers' differential behavior favoring boys. Such research might be instrumental in introducing change in these programs in the direction of promoting egalitarian teachers' views and behaviors in math classrooms.

References

- Aiken, L. R. (1974). Two scales of attitude toward mathematics. *Journal for Research in Mathematics Education*, 5, 67-71.
- Alkhateeb, H. M. (2001). Gender differences in mathematics achievement among high school students in the united arab emirates, 1991–2000. *School Science and Mathematics*, 101, 5–9.
- Ambrose R., & Fennema E. (2004). Gender and school learning: Mathematics and science. *International Encyclopedia of the Social & Behavioral Sciences*, pp 5972-5976.
- Bee, H., & Boyd, D. (2010). *The developing child*. Boston: Pearson.
- Brandell, G., & Staberg, E.M. (2008). Mathematics: A female, male or gender-neutral domain? A study of attitudes among students at secondary level. *Gender and Education*, 20, 495-509.
- Burns, R. (2000). *Introduction to research methods*. London: Sage publications.
- Fraenkel, J.R., & Wallen, N.E. (2006). *How to design and evaluate research in education*. New York, NY: McGraw-Hill.
- Fennema, E., Carpenter, T.P. (1998). New perspectives on gender differences in mathematics: An introduction. *Educational Researcher*, 27(5), 4-5.
- Fennema, E., Peterson, P.L., Carpenter, T.P., & Lubinski, C.A. (1990). Teachers attributions and beliefs about girls, boys, and mathematics. *Educational Studies in Mathematics*, 21, 55-69.
- Georgiou, S.N., Stavrinides, P., & Kalavana, T. (2007). Is Victor better than Victoria at maths? *Educational Psychology in Practice*, 23, 329-342.
- Geist, E. & King, M. (2008). Different, not better: Gender differences in mathematics learning and achievement. *Journal of Instructional Psychology*, 35, 43-52.
- Hamzeh, E. (2009). *Lebanese middle school students' attitudes toward math as a subject and toward math teachers* (Unpublished master's thesis). Lebanese American University, Lebanon.
- Hanna, G. (2003). Reaching gender equity in mathematics education. *The Educational Forum*, 67, 204-214.
- Hassan, K. (2001). Gender issues in achievement in Lebanon. *Social Behavior and Personality*, 29, 113-124.

- Helwig, R., Anderson, L., & Tindal, G. (2001). Influence of elementary student gender on teachers' perceptions of mathematics achievement. *The Journal of Educational Research*, 95, 93-102.
- Herbert, J., & Stipek, D. (2005). The emergence of gender differences in children's perceptions of their academic competence. *Applied Developmental Psychology*, 26, 276-295.
- Ibrahim, N. (2009). *Gender differences in student participation and teacher responses in elementary Lebanese mathematics classrooms* (Unpublished master's thesis). American University of Beirut, Lebanon.
- Li, Q. (1999). Teachers' beliefs and gender differences in mathematics: A review. *Educational Research*, 41, 63-76.
- Muller, C. (1998). Gender differences in parental involvement and adolescents' mathematics achievement. *Sociology of Education*, 71, 336-356.
- Penner, A. (2003). International gender $\times$ item difficulty interactions in mathematics and science achievement tests. *Journal of Educational Psychology*, 6(3), 650-655.
- Preckel, F., Goetz, T., Pekrun, R., & Kleine, M. (2008). Gender differences in gifted and average-ability students. *Gifted Child Quarterly*, 52, 146-159.
- Sarouphim, K.M. (2009). The use of a performance assessment for identifying gifted Lebanese students: Is DISCOVER effective? *Journal for the Education of the Gifted*, 33, 276-296.
- Tapia, M., Marsh, G.E. (2004). An instrument to measure mathematics attitudes. *Academic Exchange Quarterly*, 8(2), 16-21.
- Tiedemann, J. (2000). Gender-related beliefs of teachers in elementary school mathematics. *Educational Studies in Mathematics*, 41(2), 191-207.
- Tiedemann, J. (2002). Teachers' gender stereotypes as determinants of teacher perceptions in elementary school mathematics. *Educational Studies in Mathematics*, 50, 49-62.
- Tsui, M. (2007). Gender and mathematics achievement in China and the United States. *Gender Issues*, 24, 1-11.
- United Nations Economic and Social Commission for Western Asia (2002). *Women and men in Lebanon: A statistical portrait*. Beirut: ESCWA.

- U.S. Department of Education, National Center for Education Statistics, Institute of Education Sciences (2008). *Highlights From TIMSS 2007: Mathematics and Science Achievement of U.S. Fourth- and Eighth-Grade Students in an International Context*. (NCES Publication No. 2009001). Retrieved from <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2009001>
- Villalobos, A. (2009). The importance of breaking set. *Theory and Research in Education*, 7, 27-45.

Appendix A

Attitudes Toward Mathematics Scale (ATM)

Attitudes Toward Mathematics Scale

Grade:

Gender: F M

Scale of attitude toward mathematics

Draw a circle around the letter(s) indicating how strongly you agree or disagree with each statement: SD (Strongly Disagree), D (Disagree), U (Undecided), A (Agree), SA (Strongly Agree).

1	Mathematics is not a very interesting subject.	SD	D	U	A	SA
2	I want to develop my mathematical skills and study this subject more.	SD	D	U	A	SA
3	Mathematics is a very important and necessary subject.	SD	D	U	A	SA
4	Mathematics makes me feel nervous and uncomfortable.	SD	D	U	A	SA
5	I usually enjoy studying mathematics in school.	SD	D	U	A	SA
6	I don't want to take any more mathematics than I have to.	SD	D	U	A	SA
7	Other subjects are more important to people than mathematics.	SD	D	U	A	SA
8	I am very calm when studying mathematics.	SD	D	U	A	SA
9	I rarely like studying mathematics.	SD	D	U	A	SA
10	I am interested in learning more information in mathematics.	SD	D	U	A	SA
11	Mathematics helps to develop the mind and teaches a person to think.	SD	D	U	A	SA
12	Mathematics makes me feel uncomfortable and confused.	SD	D	U	A	SA
13	Mathematics is enjoyable and interesting to me.	SD	D	U	A	SA
14	I don't want to take more than the necessary amount of mathematics.	SD	D	U	A	SA

15	Mathematics is not very important in everyday life.	SD	D	U	A	SA
16	When I study mathematics I don't get nervous.	SD	D	U	A	SA
17	Mathematics is dull and boring.	SD	D	U	A	SA
18	I plan to take as much mathematics as I can during my education.	SD	D	U	A	SA
19	Mathematics has contributed greatly to the development of society.	SD	D	U	A	SA
20	Mathematics is one of my most hated subjects.	SD	D	U	A	SA
21	I like trying to solve new problems in mathematics.	SD	D	U	A	SA
22	I am not motivated to work very hard on mathematics lessons.	SD	D	U	A	SA
23	Mathematics is not one of the most important subjects for people to study.	SD	D	U	A	SA
24	I don't get upset when trying to do mathematics lessons.	SD	D	U	A	SA

Appendix B

Attributions Interview

Attributions Interview

Teacher's Name:

Grade:

Most Successful student

Name	Reason of success

Reasons of success:

- a. Student's high ability
- b. Student's effort
- c. Teacher's help
- d. Student's intrinsic motivation
- e. Others' help (e.g. parents or peers)
- f. Good luck
- g. Other

Least Successful student

Name	Reason of difficulty

Reasons of difficulty:

- a. Student's low ability
- b. Student's lack of effort
- c. Lack of teacher help
- d. Lack of student's intrinsic motivation
- e. Lack of others help (e.g. parents or peers)
- f. Bad luck
- g. Other
- h. **Describe your MS boy**

	Not at all	Rarely	Somehow	Mostly	Extremely
Aggressive					
Independent					
Objective					
Easily influenced					
Dominant					
Active					
Competitive					
Logical					
Direct					
Adventurous					
Loud					
Makes decision easily					
Always acts as a leader					
Has strong need for security					
Self-confident					
Volunteers to answer questions					
Enjoys math					
Dependent in math					
Persists on hard math tasks					

Describe your MS girl

	Not at all	Rarely	Somehow	Mostly	Extremely
Aggressive					
Independent					
Objective					
Easily influenced					
Dominant					
Active					
Competitive					
Logical					
Direct					
Adventurous					
Loud					
Makes decision easily					
Always acts as a leader					
Has strong need for security					
Self-confident					
Volunteers to answer questions					
Enjoys math					
Dependent in math					
Persists on hard math tasks					

Appendix C

Classroom Observation

Observation

Grade:

Every time one of the following actions occurs in class an X will be placed in the second column.

The Teacher

Actions	Boy	Girl
Asks a math question to a ...		
Chooses a ... to answer		
Gives attention to a ... (gives a remark, did you get it?, pay attention,...)		

The Student

Actions	Boy	Girl
A Raises their hand to answer.		
A ... exhibits off-task behavior.		
A ... asks a question.		
A ... does not seem to enjoy the class		

Observations:

Table 1
Distribution of Boys and Girls per Grade Level

	Grade 7	Grade 8	Grade 9	Total
Girls	41	43	28	112 (65%)
Boys	21	24	14	59 (45%)
Total	62 (36%)	67 (39%)	42 (25%)	171(100%)

Table 2
Students' Mean Attitudes Toward Mathematics

	Grade 7		Grade 8		Grade 9		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	9	21.89	15.17	20.32	18.07	17.72	13.66	20.32
Female	14.34	16.3	8.14	21.1	16.71	20.11	12.55	19.38
Total	12.53	18.38	10.66	20.94	17.17	19.15	12.93	19.66

Note. -48 to -30 negative attitude
 -29 to -10 moderately negative attitude
 -9 to +9 neutral attitude
 +10 to +29 moderately positive attitude
 +30 and +48 positive attitude

Table 3
Students' Attitudes Towards Mathematics by Gender and Grade Level

Source	df	Mean Square	F	Sig.
Grade	2	465.01	1.21	0.30
Gender	1	37.93	0.10	0.75
Grade * Gender	2	558.74	1.45	0.24
Error	165	384.35		

Table 4
Enjoyment of Mathematics by Gender and Grade Level

Source	df	Mean Square	F	Sig.
Gender	1	4.074	.020	.887
Grade	2	236.813	1.186	.308
Gender * Grade	2	414.056	2.073	.129
Error	165	199.745		

Table 5
Enjoyment of Mathematics

		Grade 7		Grade 8		Grade 9		Total	
		Male	Female	Male	Female	Male	Female	Male	Female
Liking of Mathematics	Mean	-0.1	1.02	0.63	-0.07	1.14	1.11	0.49	0.63
	SD	2.66	2.29	2.1	2.7	1.99	2.2	2.31	2.48
Developing Mathematical Skills	Mean	0.62	1.76	2.67	0.97	2.36	2.28	1.86	1.68
	SD	3.28	2.79	2.7	3.25	2.09	2.77	2.93	2.99
Stress Related to Mathematics	Mean	0.19	2.07	1.75	0.77	1.21	2.07	1.06	1.57
	SD	4.67	4.62	5.07	4.85	5.17	4.94	4.92	4.79
Extending Mathematical Knowledge	Mean	1.76	1.9	2.08	0.58	3.5	2.64	2.3	1.58
	SD	4.57	4.01	3.88	4.88	2.92	4.17	3.94	4.44
Emotions Towards Mathematics	Mean	0.43	1	0.79	-0.11	1.07	1.1	0.73	0.59
	SD	2.16	2.05	2.15	2.46	2.81	2.42	2.29	2.35
Total	Mean	2.9	7.76	7.91	2.14	9.28	9.21	6.45	5.96
	SD	14.7	12.46	13.48	15.83	12.98	14.3	13.8	14.5

Table 6
Value of Mathematics by Gender and Grade Level

Source	df	Mean Square	F	Sig.
Gender	1	17.144	.394	.531
Grade	2	39.856	.916	.402
Gender * Grade	2	13.679	.314	.731
Error	165	43.525		

Table 7
Value of Mathematics

		Grade 7		Grade 8		Grade 9		Total	
		Male	Female	Male	Female	Male	Female	Male	Female
Importance of Mathematics as a Subject	Mean	1.95	2.46	2.2	1.41	3	2.28	2.3	2.01
	SD	3.42	2.08	3.16	3.21	2.44	2.99	3.08	2.8
Implications of Maths Outside the Classroom	Mean	2.9	2.87	3.2	3.69	3.78	3.57	3.23	3.67
	SD	3.03	2.59	2.7	2.23	3.11	1.93	2.89	2.31
Interest in Mathematics	Mean	1.23	1.24	1.83	0.88	2	1.64	1.66	1.2
	SD	2.64	1.94	2.46	2.52	2.07	2.4	2.42	2.29
Total	Mean	6.09	6.59	7.25	6	8.78	7.5	7.2	6.59
	SD	8.1	5.02	7.52	6.83	6.12	6.43	7.38	6.09

Table 8
Students' Achievement in Mathematics

	Grade 7		Grade 8		Grade 9		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
Mean*	12.95	12.32	11.62	12.29	12.00	12.41	12.19	12.33
SD	4.11	3.96	3.60	3.93	4.31	5.10	3.94	4.22

Note. *Math is graded over 20 pts

Table 9
Students' Achievement in Mathematics by Gender and Grade Level

Source	df	Mean Square	F	Sig.
Gender	1	1.05E-005	.000	.999
Grade	2	6.336	.387	.680
Gender * Grade	2	4.828	.295	.745
Error	165	16.368		

Table 10

Accuracy of Teachers' Choice Of Most Successful (MS) Student

		MS Student's Gender	Class Rank Based on Average	Accuracy of Choice	Remarks
Grade 7A	MS	Boy	1	Accurate	Negligible difference between 2 nd and 3 rd
	Second MS	Boy	2	Accurate	
Grade 7B	MS	Girl	1	Accurate	
	Second MS	Girl	3	Accurate	
Grade 8A	MS	Girl	1	Accurate	Difference is negligible between 1 st and 2 nd
	Second MS	Girl	2	Accurate	
Grade 8B	MS	Girl	1	Accurate	
	Second MS	Boy	5	Not Accurate	
Grade 9A	MS	Girl	2	Accurate	Difference is negligible between 1 st and 2 nd
	Second MS	Girl	1	Accurate	
Grade 9B	MS	Boy	2	Not Accurate	
	Second MS	Girl	4	Not Accurate	

Table 11

Accuracy of Teachers' Choice Of Least Successful (LS) Student

		MS Student's Gender	Class Rank Based on Average	Accuracy of Choice
Grade 7A	LS	Girl	32/32	Accurate
	Second LS	Boy	25/32	Not Accurate
Grade 7B	LS	Girl	29/32	Not Accurate
	Second LS	Boy	27/32	Not Accurate
Grade 8A	LS	Boy	34/34	Accurate
	Second LS	Boy	30/34	Not Accurate
Grade 8B	LS	Boy	34/34	Accurate
	Second LS	Girl	33/34	Accurate
Grade 9A	LS	Girl	22/22	Accurate
	Second LS	Boy	18/22	Not Accurate
Grade 9B	LS	Girl	21/21	Accurate
	Second LS	Girl	20/21	Accurate