THE RELATIONSHIP OF STUDENT DISPOSITIONS AND TEACHER CHARACTERISTICS WITH THE MATHEMATICS ACHIEVEMENT OF STUDENTS IN LEBANON AND SIX ARAB COUNTRIES IN TIMSS 2007

A Dissertation

by

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ABSTRACT

The present study is divided into two parts. The first part examines the performance of Lebanese students in public and private schools in Lebanon in 8^{th} grade using the TIMSS 2007 data. The effects of students' dispositions and teacher characteristics on the performance of students in public and private schools are also studied. Results indicate that private school students in Lebanon perform better than public schools students in each mathematics content and cognitive domain in TIMSS 2007. Having a positive affect towards mathematics is positively related to students' achievement in both public and private schools. Self-confidence has a positive relationship to students' achievement too in public and private schools; and the relationship is stronger in private schools. Most of the teacher characteristics have little or no relationship to students' achievement except for teachers' age and teachers' gender. On average, students with older teachers and female teachers usually perform better.

The second study examines the mathematics performance in TIMSS 2007 of 8^{th} grade students in seven Arab countries: Bahrain, Egypt, Jordan, Lebanon, Saudi Arabia, Syria, and Tunisia. The effects of positive affect towards mathematics, valuing mathematics, self-confidence in learning mathematics and some teacher characteristics on mathematics achievement are studied for each country. The results show that Data & Chance and Number are two mathematics content areas in which most of the seven countries have weaknesses. Some of the countries performed better in Reasoning than in

Knowing or Applying. In all the countries, positive affect towards mathematics, valuing mathematics, and self-confidence were positively related to students' mathematics performance. Neither teacher age, years of experience, degree, nor certification had any noteworthy relationship with students' achievement in all seven countries. Students with female teachers scored better than students with male teachers in Bahrain and Lebanon. In the other countries, students with female teachers and students with male teachers had similar performances. Policy makers should find ways to increase students' positive affect towards mathematics, how much students value mathematics, and students' self-confidence in learning mathematics.

To my parents whose support and endless love helped me through all the stages of my life.

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NOMENCLATURE

AHDR	Arab Human Development Report
HLM	Hierarchical Linear Model
IEA	International Association for Evaluation of Educational Achievement
MENA	Middle East and North Africa
MOE	Ministry of Education
PATM	Positive Affect towards Mathematics
TIMSS	Trends in International Mathematics and Science Study
UNESCO	United Nations Educational, Scientific, and Cultural Organization

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CHAPTER I

INTRODUCTION

Three main international assessments exist today: Trends in International Mathematics and Science Study (TIMSS), Program for International Students Assessment (PISA), and Progress in International Reading Literacy Study (PIRLS). Each of these programs attempts to measure different objectives.

TIMSS and PIRLS are both administered by the International Association for Evaluation of Educational Achievement (IEA). Whereas TIMSS tests students in mathematics and science, PIRLS tests students in reading achievement (International Association for Evaluation of Educational Achievement [IEA], 2012a). TIMSS has been administered every 4 years starting in 1995 and targets students in 4th and 8th grade. TIMSS advanced, which measures students' achievement in mathematics and physics in 12th grade, was administered in 1995, a second time in 2008, and will be administered in 2015. One of the goals of TIMSS is "to provide comparative information about educational achievement across countries to improve teaching and learning in mathematics and science" (Mullis et al., 2008, p. 14). TIMSS "measures trends in mathematics and science achievement", monitors curricular implementation, and identifies "promising instructional practices from around the world" (Mullis et al., 2008, p. 14). In addition, "TIMSS participants share the conviction that comparing education systems in terms of their organization, curricula, and instructional practices in relation to their corresponding student achievement provides information crucial for effective education policy-making" (IEA, 2012a, para. 2).

The number of countries participating in international assessments has been on the rise. For example, a little over 40 countries participated in TIMSS 1995, while over 60 countries participated in TIMSS 2011 (IEA, 2012a). International tests allow for objective comparison across time and countries. They are not meant to replace national tests but rather to complement the national tests. To understand an education or educational system in a country, it is better to both compare the educational system to that of other countries and to compare the educational system with itself over time.

Overview of the Dissertation

Chapter I includes a description of the problem and a brief description of each of the two studies in this dissertation. Chapter II includes an extensive literature review of the factors included in the study and of the educational systems in each of the countries included in this dissertation. Chapter III includes a description of the sample, data, and analysis methods used in the present study. Chapter IV presents the results of the analyses. Finally, Chapter V discusses the results and their implications.

Description of the Problem

In the last decade, several efforts and initiatives with the goal of improving the level of education and achievement have emerged in the Arab world. The initiatives include the Education Reform for the Knowledge Economy Program I (ERfKE I) project in Jordan, Mother Child Home Education Programme (MOCEP) in Bahrain, Qatar initiatives, Higher Education Enhancement Project in Egypt, and many others. The efforts and initiatives are based on the belief that education is a factor that helps countries develop in socially, politically, and economically. Most Arab countries have revised their entire or part of their curriculum in the last 15 years (United Nations Development Programme, Arab Fund for Economic and Social Development [AHDR], 2003). However, judging by the performance of the Arab countries in TIMSS 2007, these efforts do not appear to have been very fruitful.

> The bare facts of the 2007 TIMSS results reveal a startling picture for the Middle East. Of the 15 Arab countries to take part in the 2007 TIMSS cycle, none scored above the international scale average of 500 points. Of the bottom 15 countries in 8^{th} grade maths and science, 10 were Arab. Despite its extensive, and expensive, reforms programme, Qatar ranked last in 8^{th} grade maths, and second-to-last in 4th grade science and maths. Bahrain, Saudi Arabia and Egypt all scored less in 8th grade maths in 2007 than in 2003. (Slayman, 2009, para. 1)

Table 1 presents the mathematics achievement for the Arab countries participating in TIMSS 2007 along with each country's rank out of 48 countries. A total of 50 countries participated in eighth grade TMISS 2007. Two countries (Mongolia and Morocco) were not included in the official ranking because Morocco did not satisfy the guidelines for sampling and Mongolia's data quality was not up to standards (Mullis et al., 2008).

Table 1
Arab countries' scores and ranking in TIMSS 2007

Country	Mathematics Score	Rank (out of 48 countries)
Lebanon	449(4.0)	28
Jordan	427(4.1)	31
Tunisia	420 (2.4)	32
Bahrain	398 (1.6)	35
Syria	395 (3.8)	37
Egypt	391 (3.6)	38
Algeria	387 (2.1)	39
Oman	372 (3.4)	41
Palestine	367 (3.5)	42
Kuwait	354 (2.3)	44
Saudi Arabia	329 (2.9)	46
Qatar	307 (1.4)	48
Morocco[a]	381 (3.0)	NA
TIMSS scale Average	500	

Note. Data from Mullis et al. 2008.
[a]Morocco did not satisfy the guidelines for sample participation.

Actually all Arab countries are in the bottom 20 countries in mathematics in TIMSS 2007. After looking at these disappointing facts, it seems clear a closer and deeper examination of Arab countries' performance in TIMSS 2007 is needed. Moreover, factors that contribute to the poor performances of Arab countries should be identified. Otherwise, how can Arab countries move forward and improve their mathematics education without identifying their areas of strengths and weaknesses? If countries want to improve their performance in TIMSS, these countries should deeply investigate their results and not just look at the scores superficially. The TIMSS database contains a tremendous amount of information that can be used to identify a country's weaknesses and strengths.

Unlike the U.S., in Middle Eastern countries, public access to statistical information is scarce, and people are not used to looking at these statistics (Heyneman, 1997). Therefore, the TIMSS results are not known to most Arabs. Most of the people are not aware that students even participate in international tests. The media has no interest in reporting these scores, either.

Purpose of the Study

The present study is comprised of two parts. The first part focused on the performance of students in public and private schools in Lebanon in mathematics in TIMSS 2007, while the second part examined the performance of 7 Arab countries in mathematics in TIMSS 2007.

Part 1: Lebanon

It is important to examine the performance of Lebanon specifically, because Lebanon, though the highest scoring Arab country, did not even reach the TIMSS scale average of 500. Lebanon has one of the oldest education systems in the area and some of the highest ranked universities. Lebanon's performance in TIMSS 2003 and 2007 might shock many people in Lebanon. However, there is a lack of media coverage of the results, and, therefore, very few, if any, Lebanese are aware of TIMSS or Lebanon's performance in TIMSS. This lack of awareness might be one of the reasons why the results did not spark an outcry in Lebanon, because even though Lebanon's performance in mathematics was not too bad, Lebanon's science performance is one of the worst among all countries.

Moreover, the Lebanese curriculum had a major overhaul in 1998-2000 in all subject areas. Before the new curriculum was introduced, the old curriculum had been in effect for 30 years without change. One way to examine the effectiveness and material coverage of the new curriculum is by analyzing the TIMSS data because TIMSS is curriculum-independent and is not geared toward the Lebanese curriculum specifically but a general curriculum for the grade level. Because the new curriculum was fully implemented in all grades in 2000, students who participated in TIMSS 2007 would have been studying the new curriculum for 7 years. Therefore, analyzing the TIMSS 2007 data also helps to examine the longitudinal and long-term effects of the new curriculum. Furthermore, seeing that Lebanon has scored above the international average in mathematics in the Advanced TIMSS in 2008, which is administered to grade 12 students (International Association for the Evaluation of Educational Achievement [IEA], 2012b), it is also important to examine the areas of weaknesses of the eighth grade students in Lebanon and determine why these students in grade 8 were not able to reach the international average while students in grade 12 reached the international average.

One of the major factors defining education in Lebanon is the prevalence of private schools and parents' preference to send their children to private schools (Ayyash-Abdo, Alamuddine, & Mukallid, 2010). Lebanese believe private schools in Lebanon offer a higher quality of education and as a consequence will offer their children a better future. Public schools in Lebanon suffered much during the civil war. Several schools were transformed into shelters for people fleeing from the warzone. Several of the buildings, classrooms, and desks in public schools in Lebanon are very old and need to be updated or renovated, but public schools suffer from a lack of funding and resources. Recently, several efforts have been made to improve the situation of public schools' infrastructure in Lebanon.

Private school tuition in Lebanon is high, and many Lebanese spend a substantial part of their salaries to pay for sending their children to private schools. For parents to be convinced to send their children to public schools in Lebanon, fixing the condition of the buildings, classrooms, and desks is not enough. Public schools should be able to provide an education that matches what is offered in private schools.

The study answered the following questions about Lebanon:

1.1) Are there differences in Lebanese students' performance in each of the mathematics content and cognitive domains in TIMSS 2007?

1.2) Are there differences in achievement levels in mathematics between public and private school students in Lebanon in terms of TIMSS benchmarks, content domains, and cognitive domains?

1.3) What is the effect of school type (public, private) on mathematics achievement in Lebanon?

1.4) After controlling for SES, are the performances of students in public and private schools still different?

1.5) Can the students' dispositions toward mathematics (positive affect toward mathematics, valuing mathematics, and self-confidence in learning mathematics) *explain some of the difference in mathematics achievement between public and private schools in Lebanon?*

1.6) *Can some of the difference in mathematics achievement between public and private schools be explained by teacher characteristics (age, years of experience, gender, degree, and certification)?*

Importance of the First Study

First, in-depth studies about education in any subject in Lebanon are rare, especially studies on such a large scale with so many schools involved. The present study should help pinpoint the strengths and weaknesses of mathematics education in Lebanon in general and help with future planning for improvement of the mathematics curriculum. Second, the study will help flesh out any gaps, if these gaps exist, between public and private schools in Lebanon and attempt to shed light on the factors that need improvement in each sector. Otherwise, if there were no differences, then parents should probably not spend so much money to send their children to private schools. Third, hopefully, the present study will pave the way for additional analytical studies on mathematics and science education in Lebanon.

Part 2: Arab Countries

The second part of the study will examine the performance of Arab countries in TIMSS 2007, focusing on the Arab countries that had also participated in TIMSS 2003. The countries chosen to be included in the present study are: Bahrain, Egypt, Jordan, Lebanon, Saudi Arabia, Syria, and Tunisia. These countries were selected for several reasons. First, these countries also participated in TIMSS 2003; some even participated in TIMSS1999. Therefore, participation in TIMSS was not new to the countries and the organizers in the country. Second, the countries are not confined to one part of the Middle East and North Africa (MENA) region but are distributed within the MENA region. Tunisia and Egypt are located in North Africa; Bahrain and Saudi Arabia are located in the Gulf area; and Syria, Lebanon, and Jordan are located in West Asia with Syria and Lebanon bordering the Mediterranean Sea (see Figure1).

Since the discovery of oil, the populations in the Gulf countries have grown tremendously. As a result, many foreigners have come to these countries because of the availability of jobs and better pay than what they would receive in their countries (Kapiszewski, 2000). One of the aims of improving education in the Gulf countries, especially for the locals, is the need for these countries to replace the foreign workers with locals (Kapiszewski, 2000). Most of the Gulf countries have introduced laws forcing privately owned companies to hire a certain percentage of locals. However, hiring a local is not easy because of the low availability of highly qualified locals and the work ethic of the locals (Kapiszewski, 2000).

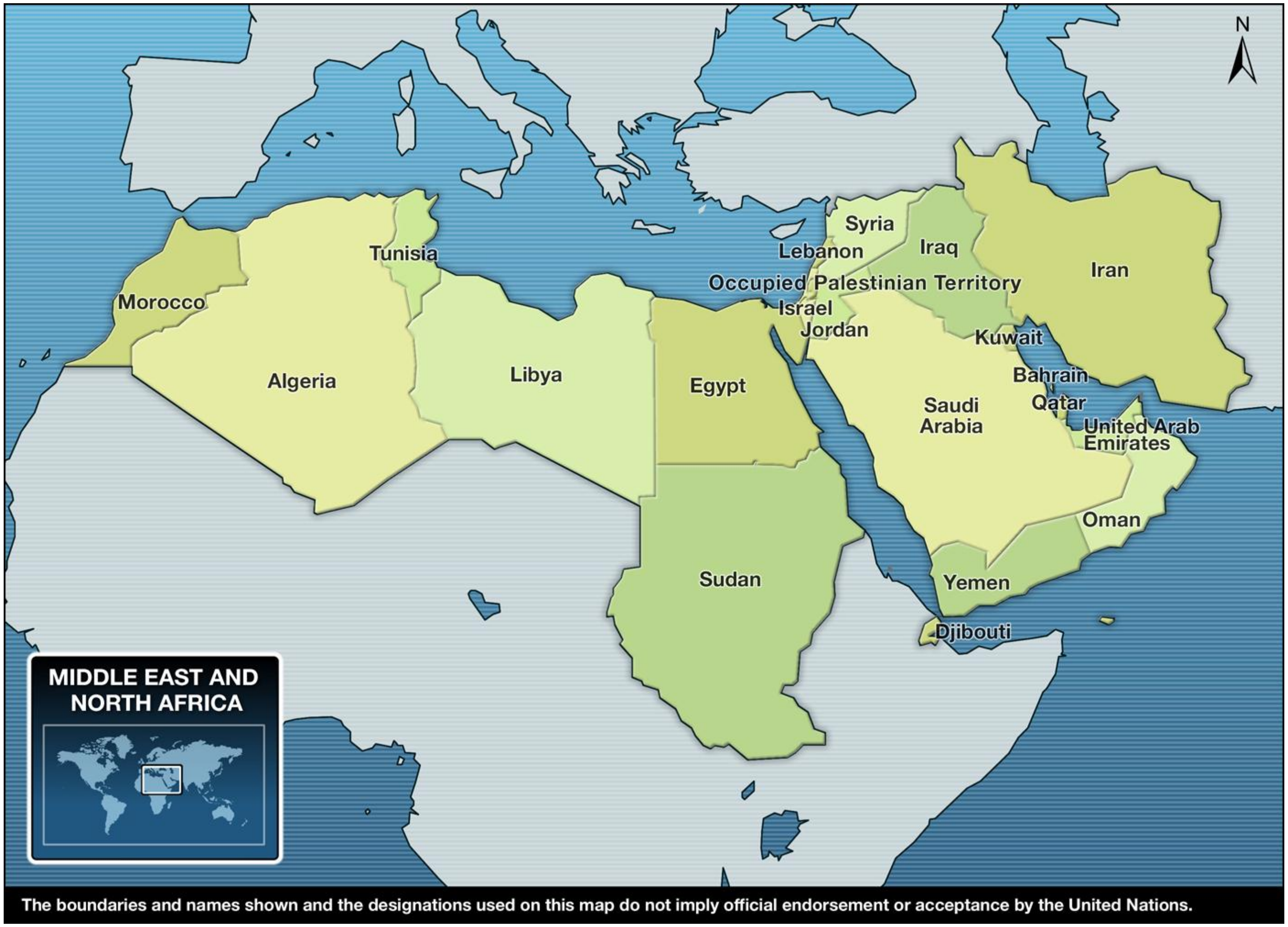

Figure 1. Map of the MENA region
Image from http://www.unicef.org/hac2011/hac_mena.html

The present study examined whether there are any factors in common that contributed positively or negatively to the performance of Arab students in TIMSS 2007 and came up with recommendations to improve the performance of these students. The second part of the study answered the following questions:

2.1) How did students in Bahrain, Egypt, Jordan, Lebanon, Saudi Arabia, Syria, and Tunisia perform in each mathematics content and cognitive domain in TIMSS 2007?

2.2) Do the students' dispositions about mathematics affect their mathematics performance in Arab countries? Is the relationship between students' dispositions and mathematics achievement similar across countries?

2.3) Are teachers' characteristics (age, years of experience, gender, degree, and certification) related to students' mathematics achievement in Arab countries? Is the relationship between teacher characteristics and students' mathematics achievement similar across countries?

Importance of the Second Study

The second study explored the effects of student attitudes and beliefs on mathematics achievement in Arab countries to determine whether student attitudes and beliefs are associated with mathematics achievement. If attitudes and beliefs are correlated with performance in mathematics, then the Arab countries might want to find ways to improve their student attitudes and beliefs.

Second, if certain teacher characteristics that are positively correlated with students' achievement in mathematics in the Arab countries are discovered, then maybe these characteristics should be a factor when hiring teachers. Moreover, if teacher characteristics were are not correlated with students' performance, then alternatives should be found to help guide teacher hiring and training programs. One suggestion might be to look at teacher classroom practices.

The "Arab Brain Drain" is a common phenomenon in most Arab countries and constitutes the immigration of the educated Arabs to study and work in non-Arab countries (AHDR, 2003). If education in Arab countries is improved, then maybe high intellectual achievers will be more likely to stay in their countries. As a consequence, these countries' highly qualified individuals could contribute to the advancement of the country.

In-depth study is imperative to help the countries strategically plan improvement in their education system, and to raise their education standards to be able to compete in the global market. Countries cannot improve their education systems without objectively analyzing students' performances. The present study does not claim to answer all the questions, but the study is a small step in the right direction.

CHAPTER II

LITERATURE REVIEW

Education in Lebanon

Lebanon is a very small country in the Middle East that lies on the Mediterranean Sea. Despite a history filled with wars and struggles, Lebanon has one of the highest literacy rates in the region. Adult literacy rate in Lebanon is 90% and youth literacy rate is 99% (World Bank, 2007). The 17 different religions in Lebanon (Central Intelligence Agency [CIA], 2012) contribute to the diverse culture and beliefs in Lebanon. Diversity in Lebanon, although a big part of the country's identity, is the essence of the destruction and wars in Lebanon (Tannous, 1997).

The civil war in Lebanon erupted in 1975 and did not come to an end until 1991. Despite all the bombings, shootings, and killings, education did not come to a complete halt, although students sometimes had extended vacations or postponed exams. Even though all students had to live through war for a long time, these students seemed able to cope with the war and focus on their studies at the same time (Oweini, 1998). The long civil war in Lebanon had a huge impact on education in Lebanon and "schools suffered from a drastic lack of material and human resources" (Tannous, 1997, p. 29) particularly public schools. Teacher preparation was not very efficient during the civil war. Because of the shortage of qualified teachers, many schools employed people with non-teaching degrees to come and teach. Some teachers even taught subject matters they were not experts in to cover for shortages. These teachers remained in the schools after the end of the war and some of them still teach in the schools today. As a result, many of the schools have unqualified teachers. For a long time after the civil war, the curriculum was outdated. The "old curriculum", as it is called, was taught without change for over 30 years. The new Lebanese curriculum in all subjects was implemented in 1998 – 2000 (El-Hassan, 1998; Osta, 2007).

The New Mathematics Curriculum

The old mathematics curriculum was geared towards the qualified elite and aimed at preparing the students for their college education. The old curriculum was very theoretical and was not concerned with applications and the use of mathematics in daily life. The old curriculum included a lot of prompting and a concentration on the rules and procedures and was not based on problem solving (Dagher, 1999). The new curriculum was supposed to be accessible to all students, not only the elite, easy to teach and learn, and more practical than theoretical. The new curriculum emphasizes problem solving and inquiry and is more student centered (Dagher, 1999).

The objectives of the new mathematics curriculum were a) to strengthen students' mathematical reasoning b) to enhance the students' ability to solve problems, c) to develop efficient workers and researchers and d) to develop students who value math and are able to communicate mathematically (Dagher, 1999). The main objectives of the new mathematics curriculum were to enable students to observe, analyze, classify, relate mathematics to everyday life, and use symbols to model information (Nahas, 1999). Students' reasoning ability is measured in TIMSS by looking at students' answers on Reasoning questions. Therefore, by analyzing the TIMSS data we can get an estimate of the students' mathematical reasoning ability. In the new mathematics curriculum, topics like sets and relations between sets were removed and topics like statistics, rounding and estimation, and linear programming were included (Dagher, 1999). The new mathematics curriculum also included the use of calculator starting in the second cycle and the use of computers. However, the new curriculum did not take into consideration the characteristics and needs of the Lebanese students (Nahas, 1999). With the new curriculum new testing strategies were supposed to be introduced. The new testing strategies aimed at exposing the students to different types of questions like multiple choice, fill in the blanks, and matching, instead of only long or short answer questions (Ayoub, 1999).

The major focus of the new curriculum in Lebanon was supposed to be problem solving. However, Lebanese students did not perform very well in TIMSS 2003, a test which mainly contained problem solving (Osta, 2007). Even though Lebanon did not do well on TIMSS 2003, there were no changes or revisions made to the curriculum when the students tested for TIMSS 2007 (Skaf & Habib, 2007). Therefore, investigating the results of Lebanese students in TIMSS 2007 is important to see whether students were still not performing up to the standards of the new curriculum in 2007.

Educational System Structure

When children are three years old, they are admitted into school in a class called nursery (Bahous, 1999). Preschool consists of 3 years: nursery, KGI (kindergarten 1) and KGII (kindergarten 2). Elementary schools consist of two cycles with each cycle extending over three years: cycle 1 includes grades 1, 2 and 3, and cycle 2 includes grade 4, 5 and 6. Middle school consists of grades 7, 8 and 9. At the end of grade 9 all Lebanese students have to sit for an official exam called Brevet. Education in Lebanon is mandatory until grade 9 (Vlaardingerbroek & El-Masri, 2008).

After the Brevet exam in grade 9, students have the option of continuing into high school or attending a technical/vocational school. Most students prefer to continue in a high school if their grades permit, because continuing in high school offers better chances of getting into university (Ayyash-Abdo , Bahous, & Nabhani, 2009, Vlaardingerbroek & El-Masri, 2008). Most of the students who go into vocational/technical education are those who have barely passed the Lebanese Brevet in grade 9 or those who had a difficult time in grade 10 at their schools (Vlaardingerbroek & El-Masri, 2008). In 2006, around 25% of the Lebanese students were in vocational/ technical education (Karam, 2006).

High school consists of grades 10, 11, and 12. Students continuing in high school have the option of choosing between one of four tracks in grade 12: General sciences, Life sciences, Economics, and Humanities. Choosing a track generally affects the college major of these students: students in general sciences usually end up majoring in engineering, those in life sciences usually go into biology or medicine, students in economics usually major in business or economics, and students in humanities usually major in social sciences like psychology, or philosophy (Sarouphim, 2010). At the end of grade 12, students have to sit for another official exam the “Lebanese Baccalaureate” which they have to pass in order to graduate and be allowed to attend college. After passing the Lebanese Baccalaureate exam, students enter universities as sophomores and not freshmen.

Students who attend vocational and technical schools can get a Baccalauréat Technique (BT) which is equivalent to having three years of high school and these students can continue to college. Attrition rates in vocational and technical schools are around 55% (Vlaardingerbroek & El-Masri, 2008).

Promotion and Retention

Retention in Lebanese schools starts as early as elementary school. In private schools, students have to meet the requirements set by the school to be promoted from one grade to the next. The promotion requirements for public schools are set by the Ministry of Education and also have to be met for a student to pass from one grade to the next. The percentage of retainees in public schools is higher than those in private schools and on average retainees came mostly from families with more than five children (El-Hassan, 1998). A high percentage of the students who were retained more than once had parents who worked in unskilled labor or low level jobs (El-Hassan, 1998). For the first three grades (1-2-3) promotion is automatic, students are not retained. In grade 3, if the teachers find a student does not have the basic competences, then this student is held back and asked to repeat grade 3. In the second cycle (grade 4-5-6) promotion from one grade to the next is not automatic, it is however facilitated. Promotion is based on both students' scores and their abilities to perform the competences assigned to their grade. In the third Cycle (grade 7-8-9) and in secondary school, promotion from one grade to the next depends only on the students' achievement and scores (Ayoub, 1999).

Public and Private Schools

About 70% of the Lebanese students attend private schools and 30% attend public schools. Because of the long civil war in Lebanon, the public schools conditions deteriorated (El-Hassan, 1998). Because of the bad state of public schools and the fact that private schools have a better reputation of students succeeding in official exams (Ayyash-Abdo, Bahous et al., 2009; Bahous & Nabhani, 2008), parents prefer to send their children to private schools (Ayyash-Abdo, Alamuddine, et al., 2010). Parents who can afford to send their children to private schools do so, because private schools have a better academic achievement and better teachers. That is why there is a difference between the socioeconomic status of the students attending private schools and public schools (Bahous & Nabhani, 2008).

In public schools, "principals are not involved in strategic planning that suits their schools and school communities. Such decisions come from the central offices of the MOE [Ministry of Education] for all the public schools alike" (Bahous & Nabhani, 2008, p. 5). Because decision making is centralized there is little room for public schools to improve individually.

Private schools in Lebanon are very diverse. Some of them are owned by certain sects or religions and teach these religions along with the curriculum (Tannous, 1997). Few of the Lebanese private schools are secular and do not pertain to a specific religion. All private schools have to teach the national curriculum; however, private schools are allowed to add to the curriculum what fits with their educational philosophies. Some private schools offer a foreign curriculum; however, these schools are not allowed to solely teach the foreign curriculum; they are required to teach the Lebanese curriculum along with the foreign curriculum (Skaf & Habib, 2007). Currently many of the parents in Lebanon spend a big part of their salaries to pay for their children's schooling. If public schools' achievement was improved, maybe more parents would be encouraged to send their children to public schools especially with the very low incomes families have. The differences in the education level between public and private schools education is just a reputation or based on personal experiences. Very few studies, if any, exist, that substantiate the claim that private school education is better than public schools education in Lebanon. The present study provided empirical data on the differences in achievement levels in mathematics between public and private schools in Lebanon.

Lebanon has only one public university with campuses all over Lebanon and many private universities. The language of instruction in most private universities is either English or French. Sometimes deciding what university the children are going to attend affects the parents' choice of what first foreign language their children are going to learn in schools.

Languages Taught

Schools in Lebanon teach at least two languages starting in preschool and sometimes a third. Social studies and Arabic language and literature are taught in Arabic. Mathematics, physics, chemistry, and biology, are taught in English or French, along with the English Language or French Language as a second language depending on the school. The second language is required by the national curriculum (Bahous, 1999;

Bahous & Nabhani, 2008; Diab, 2006). However, schools, whether public or private, are allowed to choose which second language (English or French) they want to teach (Diab, 2000). Arabic language and the first foreign language are given the same emphasis at schools and are taught the same number of hours per week (Shaaban & Ghaith, 1999). So Lebanese students end up being either “French educated” or “English educated” according to the foreign language that was emphasized in their schools (Diab, 2006). Schools also have to teach the third language, English or French, starting in grade 7 (Bahous, 1999; Bahous & Nabhani, 2008); some schools start teaching the third language earlier. However, there is no difference between the achievement of students who study English as a first foreign language and those who study French as the first foreign language in the national tests. Achievement is not usually a factor that helps shape the parents’ decisions.

English educated students do not take their French classes seriously however French educated students feel that it is important for them to learn English for their academic and professional future. Students agree that learning English is easier than learning French; that is why French should be learned first because English is easier to learn after French (Diab, 2006). Many parents send their children to schools where the French language is emphasized believing that their children will gain both the English and the French language. The acquisition of the first foreign language is not very hard for students because most of the parents communicate with their children at home in this foreign language (Bahous, 1999) or sometimes a mixture of spoken Arabic and the foreign language.

As for Arabic, the majority of students agreed that Arabic was harder than English or French (Diab, 2006). In schools, students learn formal Arabic which is very different from the language they speak every day (Akl, 2007), “hence students are introduced to yet another new language, which ignores all prior experiences that have shaped the student’s identity and cognitive functioning” (Akl, 2007, p. 99). A good example how complex the spoken language in Lebanon is the phrase: “ ‘*Hi, kifak, ça va*’? Translation: ‘Hi, how are you, fine?’ ” (Akl, 2007, p. 97). This phrase is a combination of the spoken Arabic, English and French. So if students speak English or French at home it is usually in combination with Arabic.

Again, there are no scientific studies that examine whether “English educated” students or “French educate” students perform better in mathematics or any other subject. Because in Lebanon students were allowed to take the TIMSS test in either English or French, the TIMSS data set provides an opportunity to test whether differences exist between students who took TIMSS in English or French.

National Official Testing

The national official tests are usually administered in June with a second session administered in September as a second chance for students who were not able to pass in the June exams (Osta, 2007). The grade 9 mathematics official test usually includes 3 major parts. One part focuses on sets and algebra, the second focuses on analytic geometry, and the third focuses on plane geometry (Osta, 2007). Therefore, teachers usually concentrate on these three parts when teaching and sometimes give very little attention to the remaining components of the curriculum.

Because Lebanese students have to take high stakes tests in grade 9, most teachers in grade 9 teach to the test (Osta, 2007). Moreover, most of the focus in previous grades, and especially grade 8, is on teaching the students what they need to be prepared for the grade 9 tests. The national official exams are not formed of multiple choice questions; questions in these exams usually require long answers (Osta, 2007). Teachers start preparing the students for the national exams early because the grade 9 exams include all content from the intermediate level. As a consequence, most of the tests and exams the students are exposed to include questions that need long answers. Lebanese students rarely encounter multiple choice items, which is the format of the questions adapted by TIMSS. Therefore, it is safe to assume that Lebanese students are not very familiar with multiple choice test taking strategies. Even though the new curriculum and new testing strategies require more variation in the types of exam questions (Ayoub, 1999), teachers want their students to pass the national tests, and therefore, prefer to get their students used to the forms they will encounter in the national tests. Even after 7 years of fully implementing the new curriculum, "there is a general feeling that the new official exams have not changed enough to reflect the drastic changes in the curriculum" (Osta, 2007, p. 176). The TIMSS test is made up of multiple choice questions and short answer questions which do not resemble the long answer questions the Lebanese students are used to.

Mathematics Instruction in Lebanon

All Lebanese students follow the same mathematics curriculum and are taught mathematics the same number of hours weekly up till grade 10. In grade 11 and 12, the number of hours of mathematics taught weekly and the mathematics content differs among fields of study and the emphasis students chose (Dagher, 1999). In middle school in Lebanon, students have on average 35 hours of instruction per week. Out of the 35 hours of instruction, 16% of these hours were devoted to math which amounts to 5.6 hours a week. The percentage of time spent on each content domain according to what the teachers reported for TIMSS 2007, in Lebanon is: Number 21%, Algebra 27%, Geometry 35%, Data & Chance 12%, other 5% (See Figure 2) (Mullis et al., 2008). Students in Lebanon are exposed to Geometry the most in 8th grade and Data & Chance the least. This study examined students' performance in each of the 4 content domains to see whether the amount of time spent on each content in class mirrors the students performance in the domain.

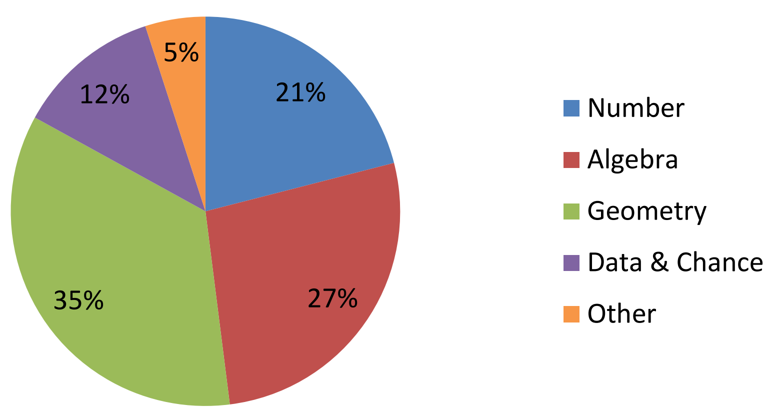

Figure 2. Time Spent on Each content Domain in Class in Lebanon.

Teachers in Lebanon

Teachers who have a degree in mathematics or a teaching Diploma for teaching mathematics are mostly secondary school mathematics teachers. The majority of elementary and middle school teachers do not have a degree in mathematics or a Teaching Diploma for teaching mathematics (Dagher, 1999). Public school teachers are generally older than private school teachers and public school teachers usually have more experience teaching than private school teachers (Dagher, 1999). Appendix B presents TIMSS information about the percentage of students in public and private schools who were taught by teachers who only completed secondary school, teachers who have a bachelors' degree, and teachers who had a Masters or a PhD degree.

Teachers' beliefs about teaching and learning affect the way they teach. Most of the beliefs and methods of Lebanese mathematics teachers are shaped by their experiences in learning mathematics when they were students. As a result, most of the teaching in mathematics classes is very traditional and consists of explaining a lesson, applications and practice, and then solving problems. Mathematics teaching in Lebanon is teacher centered (Dagher, 1999).

There is no alignment between the way teachers view mathematics and the way it is supposed to be taught and the philosophies of the new curriculum. Moreover, the means for the teachers to be more acquainted with the new curriculum and philosophies are not available (Dagher, 1999). Mathematics teachers in Lebanon have very little opportunities to improve because publications, conferences about mathematics education in schools, and professional developments are very rare. Moreover, there is no national council for mathematics teachers (Dagher, 1999). Recently schools and universities in Lebanon organized workshops and professional development sessions in an attempt to help with teachers' preparation. There are no general requirements for professional development from the Ministry of Education. Most professional developments and teacher training are funded by private entities, universities, or organizations like United Nations Development Programme (UNDP) and the World Bank (Skaf & Habib, 2007). Therefore, private schools mostly dictate what their teachers are supposed to attend. Most teachers feel there is no follow up to what they learned in the workshops and no one checks if what they are learning is being implemented (Nabhani & Bahous, 2010). However, teachers need to be exposed to the new philosophies and the nontraditional methods of teaching.

Homework in Mathematics

Lebanon has a policy on assigning mathematics homework. From the students who tested in TIMSS 2007, 45% of the students were in the high Emphasis on Mathematics Homework (EMH) (more than 30 minutes daily on average), 45% were in the middle EMH, and 10% in the low EMH (less than 30 minutes daily on average) (Mullis et al., 2008) where EMH is the index on how much emphasis is given to mathematics homework.

The percentage of students in TIMSS 2007 whose teachers monitored whether or not the homework was completed was 75%, and the percentage of students whose teachers corrected the assignment and gave feedback was 76%. Sixty five percent of students had teachers who made the students correct their own homework and 40% of students had teachers who used the homework as a basis for class discussion while 17% of the students had teachers who counted the homework towards the students grade (Mullis et al., 2008).

Calculator and Computer Use in Classrooms

In Lebanon, there is no national policy about the use of calculators in eighth grade. In TIMSS 2007, for 6% of the students their teachers reported that calculators were not permitted. The percentages of students whose teachers reported using calculators more than half of the time in lessons were as follows: 53% of these students used the calculator for checking answers, 34% for doing routine computations, 36% for solving complex problems, and 39% for exploring number concepts (Mullis et al., 2008).

Lebanon does not have a national policy for the use of computers in classrooms. In TIMSS 2007, the teachers of 28% of the students reported computers are available. The percentages of students whose teachers reported using computers in more than half of their lessons were: 8% of these students used the computers for discovering principles and concepts, 5% for practicing skill and procedure, 7% for looking up ideas and concepts, and 6% for processing and analyzing data (Mullis et al., 2008).

Effect of Culture on Schools and Students

Ninety percent of the students said they will go to university when they graduate although education is only mandatory until the age of 15 (Vlaardingerbroek & El-Masri, 2008). This high percentage is partially because parents encourage their children to attend universities and some even help with the tuition. Guidance about career choices usually comes from the parents or other family members and very rarely from schools.

Furthermore, “in Lebanon, traditional kinship attachments are still strong, and loyalty to one’s family is paramount” (Ghosn, 2009, p. 4) so sometimes students choose majors that will help them get into the family business.

Very few schools in Lebanon have counselors. Counseling in public schools is restricted to middle and elementary schools while counseling in private schools extends to secondary classes sometimes. Even counselors who work with secondary classes very rarely, if at all, provide counseling about careers (Ayyash-Abdo et al., 2010). Because of the shortage sometimes counselors have to work at more than one school. Moreover, counselors find their jobs have more stressors than rewards. Some stressors include not having a private room for counseling or lack of support from the administration. Counseling also has its rewards, like actually helping students and having an effect of their lives (Ayyash-Abdo et al., 2010). Schools in Lebanon generally do not cater to the gifted or disabled. Programs for the gifted in Lebanon are extremely rare and most of them are found in expensive schools and are accessible mostly to the rich people (Sarouphim, 2010). Recently a law was passed that gave equal rights of education to people with disabilities (Sarouphim, 2010); however, not all schools have easy access for the disabled and it will take some time before the disabled are fully integrated. Teachers in Lebanon do not get training on working with gifted and talented students or students with disabilities (Ayyash-Abdo, 2000).

TIMSS in Lebanon

Lebanon participated in TIMSS for the first time in 2003 and then in 2007. In TIMSS 2003, Lebanon’s performance was lower than the international average in both mathematics and science. In 2003, Lebanon's mathematics average score was 433 and average science score was 393. Among the participating Arab countries in 2003, Lebanon had the highest average score in mathematics and the lowest average score in sciences (Ministry of Education and Higher Education [LMOE], 2007). Even though Lebanon did not perform well in TIMSS 2003, there were no changes made to the curriculum between 2003 and 2007 (Osta, 2007).

Education in the Arab Countries

The education system in each of the Arab countries is different. Some similarities exist between countries that are geographically close to each other because of similar histories, traditions, and beliefs. One would think that because the 7 countries chosen are Arab countries, then at least the Arabic language would be common to all. However, that is not true. Even though students speak Arabic at home and in schools, the dialects differ tremendously between one country and the other (Bouhlila, 2011). The native language of most of the students in the MENA region is not the language they are taught in at school. In all Arab countries, the Arabic taught as a language in schools is the classical Arabic which is very different from the spoken Arabic. Moreover, "classical Arabic is not the language of cordial, spontaneous expression, emotions, daily encounters and ordinary communication. It is not a vehicle for discovering one's inner self or outer surroundings" (AHDR, 2003, p. 7). One problem with teaching science and mathematics in Arabic is that the translation or "Arabisation" of the technical terms is not as extensive as it should be (AHDR, 2003).

One common problem facing education in all Arab countries is that politics and powerful politicians play a big role in directing and influencing what is taught in schools. For example, ruling parties may only allow the teaching of materials that are in line with this party's ideology and may censor materials that are not. Many school textbooks, even math and science textbooks, in the Arab countries, might have a picture of the ruler on the first page (AHDR, 2003).

In most Arab countries, students are taught using the lecture style. Students are also expected to memorize and recite (AHDR, 2003). "Communication in education is didactic, supported by set books containing indisputable texts in which knowledge is objectified so as to hold incontestable facts, and by an examination process that only tests memorisation [sic] and factual recall" (AHDR, 2003, p. 54).

Arab Countries and TIMSS

Table 2 presents the percentage of students in the Arab countries reaching each benchmark in TIMSS 2003. All countries scored below the international median percentage, which means more than half of the participating countries have had higher percentages of students reaching each benchmark than all Arab countries. Table 3 presents the percentage of students in the Arab countries reaching each benchmark in TIMSS 2007. Even with some additional Arab countries to the ones testing in 2003, still none of the Arab countries even reached the 50^{th} percentile in percentages of student reaching each benchmark.

Table 2
Percentages of Students Reaching the Benchmarks in TIMSS 2003

Country 2003	Advanced (625)	High (550)	Intermediate (475)	Low (400)	2003 math average
Egypt	1	6	24	52	406
Bahrain	0	2	17	51	401
Lebanon	0	4	27	68	433
Saudi Arabia	0	0	3	19	332
Morocco	0	1	10	42	387
Tunisia	0	1	15	55	410
Palestine National Authority	0	4	19	46	390
Jordan	1	8	30	60	424
Syria	0	1	7	29	358

Note. Data from 2003 International Math Report (Mullis, Martin, Gonzalez, & Chrostowski, 2004)

Table 3
Percentages of Students Reaching the Benchmarks in TIMSS 2007

Country 2007	Advanced (625)	High (550)	Intermediate (475)	Low (400)	2007 math average
Egypt	1	5	21	47	391
Bahrain	0	3	19	49	398
Lebanon	1	10	36	74	449
Saudi Arabia	0	0	3	18	329
Morocco	0	1	13	41	381
Tunisia	0	3	21	61	420
Palestine National Authority	0	3	15	39	367
Jordan	1	11	35	61	427
Syria	0	3	17	47	395
Qatar	0	0	4	16	307
Kuwait	0	0	6	29	354
Oman	0	2	14	41	372
Algeria	0	0	7	41	387
International Median	2	15	46	75	

Note. Data from the TIMSS 2007 International Mathematics Report (Mullis et al., 2008)

Below is a brief description of the education in each of the countries selected for the study. For a more detailed description please refer to the TIMSS Encyclopedia Volumes 1 and 2, the ministry of Education websites of each county, or the World Data on Education published by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the International Bureau of Education (IBE).

Education in Bahrain

In Bahrain, students can enter preschool at the age of 3 and stay there until the age of 5. Preschool, however, is not compulsory and has no grade levels (e.g. kindergarten). Basic education is compulsory and ranges from grade 1 until grade 9. Basic education in the public schools is divided into three cycles: 1-3, 4-6, and 7-9 (Al-Awadhi, 2007; UNESCO-IBE, 2012). High school is from grade 10 until grade 12 (UNESCO-IBE, 2012). Private schools can divide the cycles differently and can have their own curricula except in a few subjects like Arabic language, Islamic studies, Bahrain history, and geography where the books used to teach these subjects have to be approved by the Ministry of Education. Basic education is compulsory until grade 9. In 2007, Bahrain had 205 public schools and 66 private schools (Al-Awadhi, 2007). In the Gulf area, in Bahrain specifically, education in K-12, is segregated. Male students go to all male schools and female students go to all female schools (Alkhalifa, 2007). Students have to sit for national exams in grade 3 (mathematics and Arabic), and grades 6 and 9 (mathematics, science, Arabic, and English). In 2012, exams for grade 12 will be piloted (UNESCO-IBE, 2012). The language of instruction is Arabic in public schools but all students also learn English as a second language. In most private schools the language of instruction is English (Al-Awadhi, 2007; UNESCO-IBE, 2012).

Bahrain suffers from the local and foreign workers dilemma most of the Gulf countries suffer from. In Bahrain, in 2000, the population was formed of about 39% of foreigners and the rest locals (Kapiszewski, 2000). The problem is that the locals and foreigners rarely mix and there is always a distinction between a local and a foreigner.

In government schools (i.e. public schools) most of the teachers are Bahraini nationals (90%) while in private schools only about 8.5% of the teachers are Bahraini nationals (Kapiszewski, 2000). To be allowed to teach mathematics in grade 8 in Bahrain, teachers must have a mathematics degree and then obtain a diploma in education (Al-Awadhi, 2007). Teacher qualifications and work conditions are not ideal. Here is how Hadeed (2011) portrays the teachers' situation:

> 62% of teachers employed in the pre-school sector have secondary-level certification only, and most lack any official teaching qualifications; teaching salaries are low (76% earn below 300 BD [less than $800] per month); staffing ratios in the classroom on average is one teacher to 23 children and there is a lack of in-service training for staff and parenting support programmes. (p. 1310)

In grade 8, students have 5 periods of mathematics weekly where each period is 50 min. One of the main goals of the mathematics curriculum in grades 7-8 in Bahrain is for students to "enjoy the beauty of mathematics through discovering the consistency of patterns and samples; develop self-esteem and accept success; and develop confidence in mathematical means and aims" (Al-Awadhi, 2007, p. 89). Most of the terms of the goal cannot really be measured except for the students' confidence. Self-confidence in learning mathematics is measured in TIMSS and the relationship between students' self-confidence in learning mathematics and students' achievement was examined in the present study.

Education in Egypt

Education in Egypt is divided into 4 stages: kindergarten (2 years), primary school (6 years), preparatory school (3years) and secondary school (3 years). Kindergarten is not compulsory while primary and preparatory schools are (Khouzam, 2007). The language of instruction is Arabic. In some schools, English is learned as a language. Some private schools choose to teach mathematics and science in English, French, or German (Khouzam, 2007).

At the end of preparatory school, grade 9, students have to take a governmental exam called the Basic Education Certificate (Khouzam, 2007). Students who perform well on the exam get into the general secondary school, the rest get into technical education (Khouzam, 2007). In the general secondary school, students can choose between a concentration on sciences or humanities and literature (Sabry, 2010). At the end of secondary school, students have to pass the Secondary School Certificate Examination (thanawiyya amma) in order to be accepted in universities (Sobhy, 2012). The students' performances on the grade 12 government exam also determines whether they get accepted into colleges, which colleges they will be accepted into, and the majors into which they are accepted into (Khouzam, 2007; Sabry, 2010). Students in Egypt usually want to try to do as well as possible to get into good universities because they think that getting a university degree will help them get better jobs (Al Harthi, 2011).

Students have to sit for a government exam in grades 3, 6, 9, and 12, and the results of these exams decide whether students will be promoted to the next grade or not. In other grades, the school's final grades determine whether the students are promoted or not (Khouzam, 2007). However, passing the government exams is not very hard because cheating is very common. Moreover, many students resort to private tutoring to pass these exams (Sobhy, 2012). Tutoring is usually "structured around memorizing only what was enough to pass the exam" (Sobhy, 2012, p. 58).

Tutoring is prevalent in Egypt. In secondary school, almost 80% of the students are tutored all year long. Some students even leave school and rely solely on tutoring (Sobhy, 2012). Because teachers do not make much money – some get as low as $40 per month – teachers resort to private tutoring as a means to get more funds. Some even try to coerce students into tutoring (Sobhy, 2012). According to Sobhy (2012), "the growth of tutoring in Egypt has intertwined with various forms of corruption, exam cheating and emotional and physical harm to students" (p. 48).

In 8^{th} grade in Egypt students have five periods of mathematics a week, each period being 45 minutes long (Khouzam, 2007). Pre-service mathematics teachers have to take courses in mathematics, science, and pedagogy at university in a 4 year program (Khouzam, 2007).

Education in the public schools in Egypt has declined to the extent that some students say it is non-existent. Some of the issues public schools face are: overcrowded classrooms where classrooms might have up to 60 students, unqualified teachers, and poorly paid teachers (Sobhy, 2012). Even though change is needed in the mathematics classrooms in Egypt, some of the factors that inhibit change include examinations, school resources, textbooks, and students' and parents' attitudes (Monk, Swain, Ghrist, & Riddle, 2002). Several efforts have been made to improve the quality of the mathematics teachers and teaching. In the late 1990's, select mathematics teachers were sent for training in the U.K. and the U.S. (Monk et al., 2002). Furthermore, in early 2000's several teacher reform projects were launched (Ginsburg & Megahed, 2011).

In Egypt, the need to perform well on the national exams has led teachers to teach solely for the tests, students to focus on the national tests, and has led to the prevalence of cheating and tutoring. On one hand, TIMSS scores might be a better measure of the students' abilities than the national tests because TIMSS is not part of the students' "cheat sheets". On the other hand, students might not take the TIMSS tests seriously because the results do not affect their future.

Education in Jordan

Education in Jordan starts with two years in preschool. Kindergarten is not mandatory but first grade is (Al-Hassan, Obeidat, & Lansford, 2010). After preschool, students get into a 10 year basic education that is compulsory. At the end of the 10 years students either move into secondary school or vocational education. Secondary school is only two years. At the end of two years the students have to sit for an exam, which if they pass, they will receive a secondary school certificate (Tawjihi) (The Hashemite Kingdom of Jordan Ministry of Education [JMOE], 2010). Gifted students are allowed to complete the basic education phase in a minimum of 8 years instead of 10. Gifted students are also allowed to complete secondary school in at least three semesters (JMOE, 2010). Jordan has public and private schools. Education is free for all students in public schools while tuitions in private schools are high.

Arabic is the official language in Jordan and the main language of instruction. Jordanian students also learn a foreign language (usually English) starting usually in 5^{th} grade all the way through secondary school (JMOE, 2010; United Nations Educational, Scientific, and Cultural Organization, the International Bureau of Education [UNESCO-IBE], 2012).

The female literacy rate in Jordan is 82%, despite the fact that "females are often directed into generalist streams. This situation deprives girls from taking part in learning that will serve them in the workforce. It also creates significant gaps in future employment and income as compared with their male peers" (USAID in Jordan, 2006, p.26).

Starting in 2003, the Jordanian government came up with the initiative for Education Reform for the Knowledge Economy Program I (ERfKE I) which was intended to improve the learning environment and promote education. ERfKE I ended in 2009 and was followed by ERfKE II that aimed at improving teacher quality and making sure the curriculum is aligned with the country's goals (Bataineh & Al-Barakat, 2009). A Better Parenting Program was also implemented nationwide in Jordan to provide parents with the knowledge they need to better promote the development of their children cognitively and physically (Al-Hassan & Lansford, 2011).

Education in Jordan suffers from outdated teaching whether in the methods used or in the technology used (USAID Jordan, 2006). Teacher education received much criticism in Jordan because teachers were inadequately prepared neither in subject matter knowledge nor in pedagogy. Therefore, in 2002, the Board of Higher Education Council suspended all field based training programs for teachers. Currently new graduates are being assigned to schools without having any practical experience (Abu Naba'h, Al-Omari, Ihmeideh, & Al-Wa'ily, 2009). As of 1998, teachers in Jordan are required to have a bachelor's degree to be allowed to teach. Secondary school teachers must have a bachelor's degree and a higher diploma in education (World Bank, 2003). However, "the current system of pre-service and in-service training, necessary for improving and standardizing teaching methods and sector-specific expertise, does not fully meet the challenges of preparing students for the modern work place" (USAID Jordan, 2006, p. 27).

Jordan had participated in TIMSS in 1999 and 2003 before participating in 2007. Analyzing the performance of Jordan in TIMSS 2007 and helps in evaluating the extent to which reforms, which started in 2003, have helped improve education in Jordan. Moreover, finding teacher characteristics that are related to higher performance in mathematics might help the policy makers in Jordan design better training systems.

Education in Saudi Arabia

Primary school in Saudi Arabia is from grade 1 until grade 6, intermediate school is from grade 7 to grade 9, and secondary school is from grade 10 to grade 12. Education is compulsory until the age of 15. The ministry of education controls everything from curricula, to teacher training and teacher appointments (Alshumrani, 2007). Kindergarten is not obligatory in Saudi Arabia, however, students who attended kindergarten were found to outperform their peers in mathematics and science in grade 1, 2 and 3 (Kashkary & Robinson, 2006). Students have to sit for a national exam in grade 6. If students pass the grade 6 national exam they receive the elementary education certificate. In grade 9 and grade 12, students also have to sit for national exams to receive the intermediate and secondary school certificates (UNESCO-IBE, 2012). Arabic is the language of instruction in all subjects including mathematics and science. Starting in the 2011-2012 academic year, English will be taught in schools starting in grade 5 (UNESCO-IBE, 2012).

Education in Saudi Arabia is segregated even at the university level (Onsman, 2011). The General Administration of Girls' Education, which is part of the Ministry of Education, oversees the education of females in Saudi Arabia (Alshumrani, 2007). Even though universities specifically for women were opened recently, some majors, like engineering and law, are still restricted to men. In 2009, King Abdullah University for Science and Technology, the only coed university in Saudi Arabia, was opened (Onsman, 2011). Saudi Arabia has vocational and technical schools. However, vocational and technical education in Saudi Arabia does not seem to provide the students the skills needed in the job market; thus, making the situation harder for private companies to replace the foreigners with Saudi locals (Baqadir, Patrick, & Burns, 2011).

When initially developing the mathematics and science curriculum, Saudi Arabia used curricula from other Arab countries, especially Lebanon and Egypt (Alshumrani, 2007). One of the main goals is “Developing school curricula according to Islamic values and with the aim of building students’ character and providing them with knowledge and systematic thinking skills” (Alshumrani, 2007, p. 506). One of the reasons Saudi Arabia participated in TIMSS was to improve mathematics and science education in Saudi Arabia (Alshumrani, 2007).

In Saudi Arabia, one must have at least a bachelors’ degree to be allowed to teach (UNESCO-IBE, 2012). Teachers “also must hold a practicing teacher’s certificate and reach or exceed a designated score on the teacher minimum competency test, which is administered twice a year. Every year, the Ministry of Education announces the number of teachers needed for schools in all subjects” (Alshumrani, 2007, p. 510).

In Saudi Arabia, there is also a movement towards replacing foreign teachers, which in 1998 represented about 15% of the work force in public schools, with Saudi teachers. As a consequence, for example, someone who had taught for 10 years and was a foreigner would be replaced by a Saudi who just graduated from university (Kapiszewski, 2000). The situation is reversed in private schools where only about 7% of the teachers were locals in 1998 (Kapiszewski, 2000). In 2006, “King Abdullah bin Abdul-Aziz's project for developing public education” (p. 5) was launched, and the project aims to improve public education in Saudi Arabia, including teacher training (Alghamdi, 2011). The King Abdullah professional development project is continuous and targets both in-service teachers and pre-service teacher programs (Alghamdi, 2011).

Using the TIMSS 2007 data, Al-Ghamidi (2010) compared the school characteristics between 2 high achieving countries (Chinese Taipei and Singapore) and a low achieving country (Saudi Arabia) in an attempt to determine the characteristics that mostly affect students' achievement. In her study Al-Ghamedi (2010) found schools in high achieving countries were better equipped especially with the presence of computers containing various helpful software in the classrooms. Moreover, in the high achieving countries parents were more supportive of their children's education and participated more in schools' activities. Low achieving countries have more behavior problems in the schools. Principals in high achieving countries spent more time in education development while principals in low achieving countries mostly supervised. Furthermore, high achieving countries focused more on strengthening students' abilities in mathematics and sciences and offered more opportunities for teachers to develop their skills. Low achieving countries' teachers have a low motivation. Availability of computers and students' diligence accounted for 74% of explained variance of the differences in mathematics.

Education in Syria

In Syria, the Ministry of Education is responsible for setting and controlling the curriculum and educational goals (Alkhatib & Abouawn, 2007; Parker, 1978). The Ministry of Education controls much of what happens in the schools especial in grades 1-9. The Ministry decides when each term begins and ends, what should be taught in each term and the requirements for students to pass from one grade to the next (Alkhatib & Abouawn, 2007).

Education is compulsory and free until grade 9. Basic education is divided into two cycles the first cycle includes grades 1 – 4 and the second cycle includes grades

5 – 9 (Alkhatib & Abouawn, 2007). At the end of grade 9, students have to take a government exam and pass it to finish the basic education stage. This exam, called kifa'a or Brevet, is administered on the same days and the same time for all students and lasts for 6 days (Alkhatib & Abouawn, 2007; Parker, 1978). At the end of grade 12, all students also have to take another government exam (Syrian Baccalaureate) and pass this exam to be accepted into universities (Alkhatib & Abouawn, 2007; Parker, 1978). In 2007, 98% of the schools in Syria were public, 1.8% were private and the rest were United Nations Relief and Works Agency schools for refugee children (Alkhatib & Abouawn, 2007).

Arabic is the main language of instruction. English is taught starting in grade 1 and French is taught starting in grade 7 (Alkhatib & Abouawn, 2007; Parker, 1978). Mathematics is taught in Arabic. Students take four periods of mathematics a week in grades 1- 8 and five periods of mathematics a week in grade 9 (Alkhatib & Abouawn, 2007). "In 2005, mathematics and pedagogical experts from schools and universities in Syria established the international criteria for mathematics …the fundamental change in the mathematics curriculum began in grade 1 in 1997 and was extended to grade 12 in 2006" (Alkhatib & Abouawn, 2007, p. 586). Most students in Syria have big educational goals and ambitions and know early on that they have to work hard to get the grades needed to reach their goals (Rabo, 2000). Analyzing Syria's performance in TIMSS 2007 will help Syria evaluate whether the recent changes in the mathematics curriculum were adequate or whether the recent changes still need improvement.

Education in Tunisia

Education in Tunisia is divided into 4 cycles starting with preschool which accepts children from ages 3 to 6 (Ministry of Education Tunisia [TMOE], 2009). The first cycle of basic education consists of grades 1 – 6, and the second cycle of basic education consists of grades 7 to 9. The secondary school which consists of four years and is divided into two cycles (UNESCO-IBE, 2012). In secondary school, students can choose between different emphases: mathematics, language arts, experimental sciences, technical sciences, information science, economics and sports (TMOE, 2009; Smida, 2007).

In grade 4, students have to take a regional exam that determines whether the students are promoted to the next grade or not. In grade 6, students have the option of taking a national exam and students who do well in these exams are allowed to attend schools for the gifted (Smida, 2007). At the end of grade 9, students have to take the Diplôme de Fin d'Etudes de l'Enseignement de Base (DEFB) examinations, a nationwide examination, to be allowed to continue to secondary schools (Ministry of Education and Training [NR-T], 2008 ; Smida, 2007; UNESCO-IBE, 2012). Even though these exams are optional students cannot get into secondary school without passing them (Smida, 2007). Students can get into technical schools starting in grade 8 (TMOE, 2009). Students who opted for the vocational track also have to sit for an exam which if they pass they will receive the Cetificat d'Aptitude Professionnelle (NR-T, 2008). At the end of the four year secondary school students have to sit for the Examen National Du Baccalaureat. Students have to pass this exam to get into higher education

(NR-T, 2008; Smida, 2007). Not passing the exam may result in students dropping out of school or attending a private school (Smida, 2007). In 2010-2011 school year, 5% of students in the second cycle attended private schools while 95 % students in the second cycle attended public schools (TMOE, 2009). Enrolment in higher education increased tremendously from 2000 on in Tunisia. However, the unemployment rate of graduates increased (Abdessalem, 2011).

School is compulsory for students from age 6 to 16 (NR-T, 2008; Smida 2007). The language of instruction is Arabic in the first two cycles. In secondary school, sciences are taught in French; French is taught as a language starting in grade 3. English is taught starting grade 6. In grade 8, mathematics is taught in Arabic and students take 4 hours of mathematics per week (Smida, 2007). The new reform curricula were introduced gradually starting in 2005 (NR-T, 2008) and inclusive education was launched in 2003/2004 school year (NR-T, 2008). For Tunisia too, analyzing the TIMSS 2007 data will allow policy makers in Tunisia to compare the scope of the reformed mathematics curriculum to other countries.

In Tunisia, becoming an elementary teacher requires 3 years of university studies, passing a written exam prepared by the MOE, and then one year of training. For secondary teachers, after the written exam, the candidates also have to pass an oral exam and then undergo 3 weeks of training in summer. Middle and secondary school teachers have to attend 6 days of professional development per year (Smida, 2007).

Table 4
Summary of the Education in Arab Countries

Country	Compulsory Education	Language of mathematics Instruction	School Stages	National tests	Segregated Education
Bahrain	Grade 1-9	• Arabic (public) • English (private)	Preschool (ages 3-5) Basic education (grade 1-9) High school (grade 10-12)	Grade 3 (mathematics - Arabic) Grade 6 and 9 (mathematics – science – Arabic – English)	Yes
Egypt	Primary and Preparatory school	• Arabic mainly • English, French, or German (in some private schools)	Kindergarten (2 years) Primary School (grade 1-6) Preparatory School (grade 7-9) Secondary School (grade 10-12)	Grade 3 and 6 Grade 9 Basic education Certificate Grade 12 Secondary School Certificate (thanawiyya Amma)	No
Jordan	Grade 1 - 10	• Arabic	Preschool (2 years) Basic education (grade 1-10) Secondary School (grade 11-12)	Grade 12 Secondary school Certificate (Tawjihi)	No
Lebanon	Until Grade 9	• English or French	Preschool Elementary School Middle School High School	Grade 9 Brevet Grade 12 Lebanese Baccalaureat	No

Table 4 Continued

Country	Compulsory Education	Language of mathematics Instruction	School Stages	National tests	Segregated Education
Saudi Arabia	Until age 15	• Arabic	Primary School (grade 1-6) Intermediate School (grade 7-9) Secondary School (grade 10-12)	Grade 6 Elementary education certificate Grade 9 Intermediate school certificate Grade 12 secondary school certificate	Yes
Syria	Grade 1- 9	• Arabic	Basic Education (grade 1-9) Secondary School (grade 10-12)	Grade 9 Kifa'a or Brevet Grade 12 Syrian Baccalaureat	No
Tunisia	Ages 6 -16	• Arabic (Basic) • French (Secondary)	Preschool Basic Education [Cycle 1 (grade 1-6), Cycle 2 (grade 7-9)] Secondary School (grade 10-13)	Grade 9 Diplome de Fin d'Etudes de l'Enseignement de Base (DEFB) Grade 13 Examen National De Baccalaureat	No

Table 4 presents a summary of the education in all 7 countries included in the present study. As seen in Table 4, in all countries except Jordan, students have to take a national exam in grade 9, which determines whether these students continue to secondary school. Therefore, most of the grade 8 education is geared towards getting the students ready for the grade 9 national test. In all countries except Lebanon, students learn mathematics in Arabic in public schools. Actually in Jordan, Saudi Arabia, Syria, and Tunisia students learn mathematics only in Arabic. Education is segregated in Bahrain and in Saudi Arabia but not in the other 5 countries. Education is compulsory until at least grade 9 or age 15 in all countries.

The answers to the teacher questionnaire in TIMSS 2007 provided a look at the topics covered in grade 8 in mathematics and how much of the class time is spent on each topic in each country. Figure 3 presents the time spent on each of the TIMSS content domain as reported by the teachers. In all of the countries, according to what the teachers reported, at least 7% of class time was spent on mathematics content that was not tested in TIMSS 2007. Between the four content domains the least time is spent on Data & Chance in all countries. Bahrain, Egypt, Jordan, and Syria had very similar time distribution between the four content domains. In Bahrain, Egypt, Jordan, Lebanon, and Syria about 26% or 27% of the class time was spent on Algebra, while in Saudi Arabia only 23% of the class time was spent on Algebra and in Tunisia only 17%. In Tunisia a majority of the class time (65%) was split between Number and Geometry.

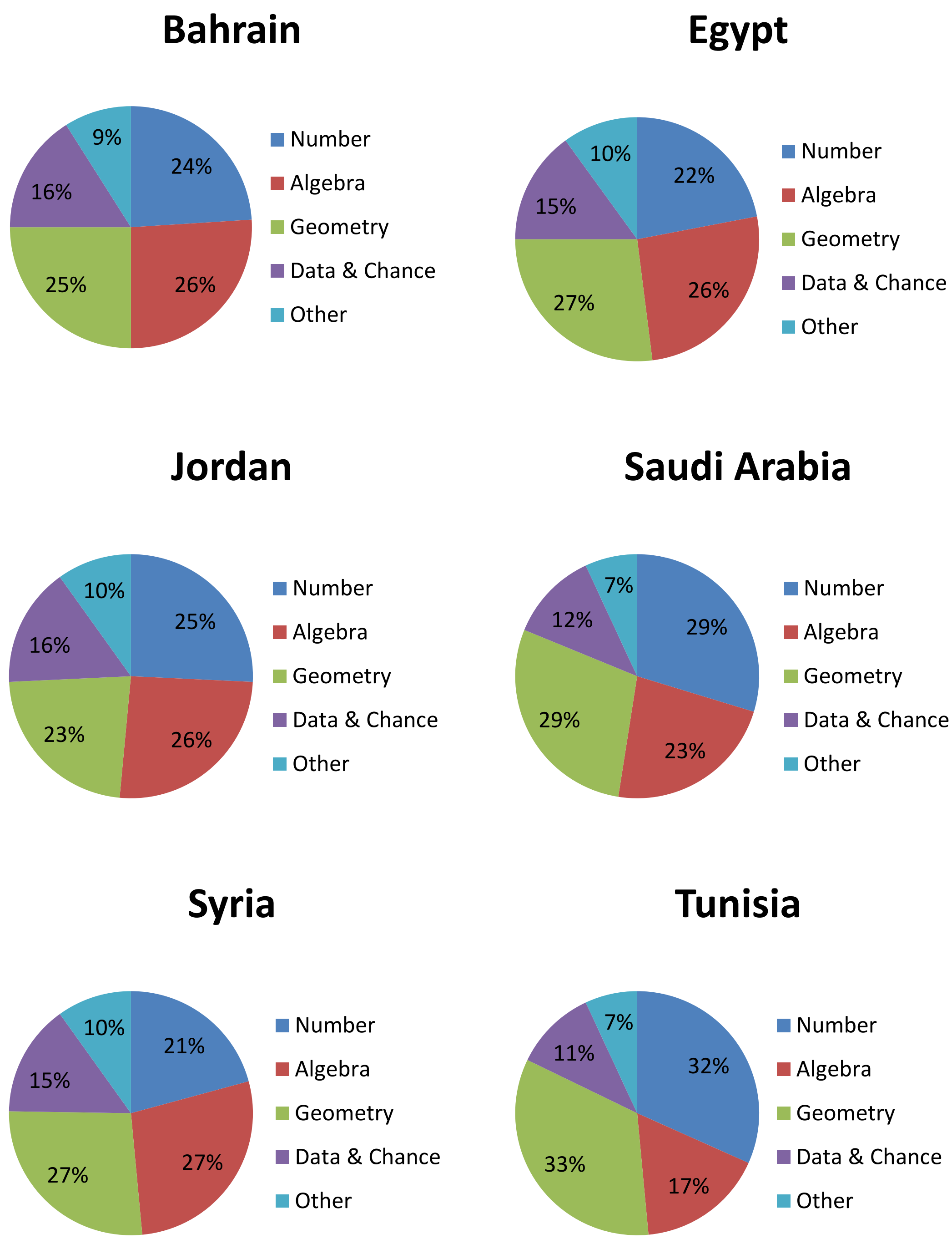

Figure 3. Time spent on each of the TIMSS content domains. Data was retrieved from the TIMSS 2007 International Mathematics Report (Mullis et al., 2008). The data for Lebanon was reported in Figure 2.

Teachers' Background and Mathematics Achievement

Schools make decisions about hiring teachers, and teachers' salary, based on teachers' experience, degrees and certifications, and credentials. When making a decision about a teacher, the people hiring hope that they are hiring a teacher who would help boost achievement and consequently improve the school's reputation. However, it seems that no overall consensus has been reached as to whether teachers' background like degree attained, certifications, and years teaching have an effect on students' achievement in mathematics.

In the United States, Nye, Konstantopoulos, and Hedges (2004) found the variance of teacher effects in mathematics is nearly twice as large as the variance of teacher effects in reading scores. Nye and her colleagues suggested that this difference is because most of the mathematics is learned at school, which is not the case for reading; therefore, mathematics teachers may have more influence on the mathematics score.

Teachers' Degree

In the United States, several studies tried to link teachers' degrees (e.g. Bachelors degree, Masters degree) to students' achievement in mathematics at various grade levels (Croninger, Rice, Rathbun, & Nishio, 2007; Goldhaber, 1998; Goldhaber 2000; Leak & Farkas, 2011; Palardy & Rumberger, 2008; Rowan, Chiang, & Miller, 1997). The results varied according to the students' grade level but were not very consistent.

In elementary school, having an advanced degree (e.g. Masters Degree) had a negative relationship with mathematics achievement (Croninger et al., 2007). The effects of teacher education on how much students gained in achievement was positive for grades 1 and 3 and negative for grade 2 but only statistically significant for grade 3 and the effects of teacher education on students' performance was positive for grades 1 and 3 and negative for K and grade 2 but not statistically significant for any (Nye at al., 2004). On the other hand, Palardy and Rumberger (2008) found that, in first grade, students' performance in mathematics is not associated with whether a teacher held an advanced degree or not. Moreover, teacher coursework had no effect on mathematics achievement in Kindergarten whether the coursework was in mathematics or child development (Leak & Farkas, 2011).

Winters, Dixon, and Greene (2012) examined the relation of teachers' degrees and courses taken with students' performance in mathematics for students in grade 3 to grade 10. They found that having a Masters degree was not related to students' mathematics achievement; however, there was a positive relation between students' mathematics achievement and teacher training in pedagogy. The pedagogy training had to be non-mathematics specific. When teachers took courses that focused on behavior or curriculum or classroom management, these courses had a negative relationship with the students' achievement (Winters et al., 2012).

In high school, having advanced degrees in the subject matter had an impact on students' scores in mathematics and science (Goldhaber, 1998, 2000). However, obtaining an advanced degree not in the subject matter like in education instead of mathematics had no effect on achievement (Goldhaber, 1998), and having an education degree had a negative impact on math scores (Goldhaber, 2000). Rowan, Chiang, and Miller (1997) also found that if teachers had degrees in mathematics, their students performed better in mathematics in high school, even though the better performance had small effects (0.015 SD). However, Rowan, Chiang, and Miller (1997) did not distinguish between Bachelors and a Masters degree. Students' performance in Algebra I, in high school, had no relation to their teachers' education background (Larson, 2000). In general, it seems in high school having a degree in mathematics leads to better student achievement (Goldhaber, 1998, 2000; Rowan, Chiang, & Miller, 1997).

Certification

In many countries teachers need to be certified before they are allowed to teach. The question is whether certification has an effect on students' achievement. Again studies about certification and mathematics achievement have not been consistent. Teachers' elementary certification had a positive impact on mathematics achievement in kindergarten (Leak & Farkas, 2011). In first grade, there were no links between teachers' certification and mathematics achievement (Palardy & Rumberger, 2008). In high school, students' performance had no or almost no relation to teacher certification (Goldhaber, 1998; Larson , 2000).

Years Teaching

Croninger and his colleagues (2007) found that the achievement in mathematics in elementary school of students who were taught by teachers with 2-5 years of experience was similar to the achievement of students who were taught by teachers with more than five years of experience. In elementary school, teachers' level of experience was unrelated to students' achievement in mathematics (Palardy & Rumberger, 2008;

Winters et al., 2012). Similarly, in middle and high school more years teaching was not associated with higher achievement scores (Goldhaber, 1998; Winters et al., 2012).

However, when dividing by grade levels or years of experience, other researchers did not have the same results. Nye and her colleagues (2004) found that the effects of teacher experience on achievement gains in mathematics was positive for grades 2 and 3 and negative for grade 1 but only statistically significant for grade 3. Moreover, the effects of teacher experience on achievement status was positive for all grades (K, 1, 2, and 3) but not statistically significant for any. Rivkin and his colleagues (2005) found that students of beginning teachers do worse than students of second and third year teachers who do worse than students of more experienced teachers.

Rivkin and his colleagues (2005) suggested that the variation in teaching quality cannot be attributed to measurable teacher characteristics like degrees, years teaching, and teachers' scores. Moreover, according to Palardy and Rumberger (2008), teachers' instructional practices have more associations with achievement gains than do teachers' backgrounds. Palardy and Rumberger (2008) recommended that educational policies should be geared towards instructional policies rather than qualifications. Rivkin et al. (2005) concluded "achievement gains are systematically related to observable teacher and school characteristics, but the effects are generally small and concentrated among younger students" (p. 428).

Teachers in MENA

Most of the studies mentioned above have been carried out in the U.S. I have not been able to locate similar studies on relationship between teachers' background and students' achievement in mathematics in any of the Arab countries in the present study. Therefore, even though the effects of teachers' background seem to be minimal it would be interesting to examine if the same holds for the Arab countries in the study.

Nye and her colleagues (2004) found that the teacher a student gets "within a school matters more than which school the student happens to attend" (p. 247). Rivkin and her colleagues (2005) also found that a big part of the achievement gain variation occurs between teachers and within rather than between schools. In the U.S., some students are assigned to teachers according to ability and not randomly (Nye et al., 2004) especially in mathematics where students can choose to take advanced courses like Algebra in middle school and Calculus in high school. Usually the students who opt to take advanced courses in mathematics are the students who have performed relatively well on previous mathematics courses. Moreover, teachers who teach these advanced courses are usually the ones with the higher qualifications. However, in the Arab countries all students have to take all mathematics courses, and teachers have students from all ability levels within the same classroom. Therefore, examining how teachers' characteristics are related to student performances in the Arabic countries is important.

In most MENA countries, perceptions of teachers' qualifications are different, especially in countries where culture and religion are dominant. For example, Al-Mussawi and Karam (2011) found that observing the existing traditions, and humility, are some of the qualities university students in Kuwait and Bahrain thought effective teachers should have. Moreover, in Kuwait and Bahrain, students think that the teacher should not admit their mistakes in public, as this act could undermine their credibility and reputation in the eyes of students, which might cause a real threat to the existing system of norms, because if students experience a different set of norms and expectations at home and at university. (Al-Mussawi & Karam, 2011, p. 194)

According to Chapman and Miric (2009), students are performing poorly in the MENA region because of the ineffectiveness of the teacher preparation programs and because these programs teach the wrong skills or because the teachers do not apply what they learn in their classrooms.

Teacher salaries in most MENA countries are based on degrees and years of teaching. Usually salaries increase every one or two years. The average monthly salary in 2000 for teachers was $200 in Lebanon, $300 in Jordan, $350 in Tunis, and $100 in Syria (Ayyash-Abdo, 2000) and can be as low as $40 in Egypt (Sobhy, 2012). The salaries in all most of these countries did not increase parallel to the inflation rate. As a result, “many male and some female teachers are forced to take on a second and/or third job to provide for their family’s basic needs” (Ayyash-Abdo, 2000, p. 199) and most resort to tutoring (Sobhy, 2012).

Students’ Attitudes and Beliefs

Beliefs about mathematics start as early as second or third grades (Kloosterman & Cougan, 1994). Several researchers have found that students’ attitude towards mathematics has an impact on students’ learning. Some examined correlations between attitude and performance in mathematics while others explored causal relationships.

Mathematics attitudes explained 25% to 32% of the variance in mathematics achievement (Lipnevich, MacCann, Krumm, Burrus, & Roberts , 2011). In their study, Hemmings, Grootenboer, and Kay (2011) combined prior achievement and students' attitudes and found that together they explained 69% of the variance. Adding attitude to the empty HLM model reduced the variance by 12% at the students' level, 30% at the class level, and 8% at the school level (Van Den Broeck, Opdenakker, & Van Damme, 2005). In Jordan, using the TIMSS 2007 Rasch scores, an increase of 1 SD in attitude towards mathematics was accompanied by a 3.38 points increase in mathematics achievement (Sabah & Hammouri, 2010). When examining the attitudes of 4th grade students in Kuwait, Alomar (2007) found that attitudes towards learning in general was indirectly related to mathematics achievement and the relations was statistically significant.

Areepattamannil (2012) used the TIMSS 2007 data of the Gulf Cooperation Council (GCC) to examine the relation between student science belief and students performance in science. Areepattamannil (2012) found that students who thought science was one of their strengths generally performed well while students who indicated that science was not one of their strengths had lower scores in general. Schrieber (2002) examined students' attitude and achievement in mathematics in the TIMSS advanced and concluded that "the more a student believed that success in mathematics was caused by natural ability, the higher the score on the test" (p. 274).

In reviewing previous literature on attitudes and achievement in mathematics in elementary school, Aiken (1970) concluded that even when researchers found statistically significant correlations the correlations were not large. Later, Aiken (1976) also examined dissertations and articles on attitude and mathematics between 1970 and 1976 and concluded that “when attitude scores are used as predictors of achievement in mathematics, a low but significant positive correlation is usually found” (Aiken 1976, p. 295). This applied to all school levels and even to college students.

Ma and Kishor (1997) performed a meta-analysis on the relationship between attitude towards mathematics (ATM) and achievement in mathematics (AIM). They examined 113 studies: 71 published in refereed journals, 25 dissertations and the rest unpublished. Of these studies, 108 examined correlations while only 5 used causal modeling and 101 had non random sampling while only 12 studies had random sampling. They concluded that, in elementary school, the relationship between ATM and AIM might not be meaningful but is “practically meaningful” in secondary school. Moreover, the random sampling studies were “more powerful in detecting the ATM-AIM relationship” (p. 38). When sample size exceeded 300 the correlation between ATM and AIM was between .14 and .16. Combining all sample sizes in general the correlation was .12. Effect sizes were low before 1976 and increased between 1976 and 1980 and then decreased from 1981 until 1993.

In most of the studies, there were no gender differences in the associations between attitudes and mathematics achievement in school (Hemmings et al., 2011; Ma & Kishor, 1997; Ma & Xu, 1994; Nicolaidou & Philippou, 2003). When looking at college students Behr (1973) found that attitude was negatively correlated with mathematics achievement for males (*r* =-.12) but positively correlated with mathematics achievement for females (*r* =.51)

The definition of attitudes towards mathematics varied between studies. Some studies divided attitude into three components: positive attitudes, confidence, and valuing mathematics.

Positive Attitudes

The correlation of attitude and performance in mathematics was not similar across studies and ranged from .09 for females and .13 for males (Fenema & Sherman, 1977) to .37 (Nicolaidou & Philippou, 2003). The discrepancy might be due to the differences in questions when measuring attitude. In all cases though, the correlation was positive. Even though attitude was a predictor of performance; self-efficacy was a better predictor (Nicolaidou & Philippou, 2003). Fenema and Sherman (1977) suggested that positive attitudes towards mathematics may be an important factor for girls when selecting math courses.

Self-Confidence

Low achievers in mathematics have low confidence in their mathematics abilities as early as in third grade (Kloosterman & Cougan, 1994), while students with better scores in mathematics had a greater tendency to be confident (Hackett & Betz, 1989). However, the relationship between confidence and achievement in mathematics may not be causal but cyclical (Yee, 2010). The correlation of confidence in learning mathematics and mathematics achievement seems to be around .4: in Fenema and

Sherman's (1977) study the correlations was .41 for males and .40 for females, in Hackett and Betz's (1989) study the correlation was .43.

Valuing Mathematics

In one study, almost all elementary students in the study felt that mathematics was useful (Kloosterman & Cougan, 1994). Fenema and Sherman (1977) asked high school students in four different schools about how useful they thought mathematics was. Mathematics was perceived as more useful by boys than by girls in two schools and similarly useful by boys and girls in the other two schools. However, Hackett and Betz (1989) concluded that students with better scores had a greater tendency of seeing mathematics as useful. Actually students who believe math is useful try to get deeper understanding when studying which leads to a better performance in mathematics (Eleftherios & Theodosios, 2007).

In their study, Hackett and Betz (1989) found that the correlation of students' mathematics performance with how much students thought mathematics is useful was .28. Fenema and Sherman's (1977) results were quite similar; in their study, the correlations of mathematics achievement with usefulness of mathematics was .26 for males and .31 for females. Ma (1997) cautions that if students see math as important this does not mean they might have a better attitude towards math, therefore, the importance of mathematics may be independent of other attitudinal measures.

CHAPTER III

METHODOLOGY

TIMSS

Trends in International Mathematics and Science Studies (TIMSS) is an international test that examines students' abilities in mathematics and sciences. This test is administered to students in grade 4 and grade 8 in countries all over the world. The administration of TIMSS started in 1995 when TIMSS stood for The Third International Mathematics and Science Study. Since 1995, TIMSS has been administered every 4 years in 1999, 2003, and 2007. In 2007, 37 countries participated in TIMSS at the 4th grade level and 50 countries participated at the 8th grade level in addition to 7 benchmarking countries in each level (Mullis & Martin, , 2008). In 8th grade students are tested in mathematics and sciences. To ensure that the students being tested are about the same age and not too young, TIMSS' policy is that the average age of students being tested in 8th grade should not be less than 13.5 years old (Mullis & Martin, 2008).

The TIMSS tests are developed in a 2 year period and the process includes expert mathematics and science educators (Ruddock, O'Sullivan, Arora, & Erberber, 2008). To insure that trends can be measured, unreleased items from previous tests are re-administered in subsequent testing. TIMSS tests are divided into blocks with each block containing either mathematics or science items. In 2007, there were 14 mathematics blocks and 14 science blocks. Out of the 14 mathematics blocks, 7 blocks contained unreleased items from previous TIMSS tests and 7 blocks contained new items that were specifically constructed for TIMSS 2007 (Ruddock et al., 2008).

Language

Test items were originally written in English and were later translated to the appropriate language(s) for each country. English and Arabic were the two most common languages of testing with 16 countries testing in English and 14 countries testing in Arabic.

> Countries testing in English and Arabic did not have to translate the instruments but were required to adapt the international version (English) or the generic Arabic version to the vernacular and make adaptations necessary for national reasons. The Arabic-speaking countries had to adapt the generic translation to their national context, comparing introduced adaptations to the international (English) version for international comparability (Johansone & Malak, 2008, p. 65).

Background Questionnaires

Before starting the actual testing students, teachers, and administrators had to independently answer several items. These items were intended to help form an idea about the background of each student. The background questionnaires in TIMSS 2007 were divided into four parts: Curriculum Questionnaire, School Questionnaire, Teacher Questionnaire, and Student Questionnaire. The Curriculum Questionnaire included questions about the topics covered in each subject at each grade level and were answered by country representatives or coordinators. The School Questionnaire was filled out by the school principals and covered the schools and available resources. The Teachers Questionnaire was completed by the teachers about these teachers' backgrounds, the activities they used in class, and the topics they taught. The Students Questionnaire was administered to students and asked about their attitudes, experiences, and aspirations (Erberber, Aora, & Preuschoff, 2008).

Students' attitudes and beliefs questions. Students were asked about how they feel about mathematics. TIMSS administrators divided these questions into three indices: the index of positive affect towards mathematics, the index for students valuing mathematics, and the index for students' self-confidence in learning mathematics Each index was coded as 1=low, 2=medium, 3=high.

Positive affect towards mathematics is based on 3 questions: (a) "I enjoy mathematics", (b) "mathematics is boring", and (c) "I like mathematics". Students valuing mathematics was based on 4 questions: (a) "I think learning mathematics will help me in my daily life", (b) "I need mathematics to learn other school subjects", (c) "I need to do well in mathematics to get into the university of my choice", and (d) "I need to do well in mathematics to get the job I want". Student self-confidence in learning mathematics was based on four questions: (a) "I usually do well in mathematics", (b) "mathematics is harder for me than for many of my classmates", (c) "I am just not good at mathematics", and (d) "I learn things quickly in mathematics" (Martin & Preuschoff, 2008).

PATM, VALUEMATH, and SELFCONF are the composite variables used in the present study formed of students' answers to these questions. PATM measured whether the students have a positive affect towards mathematics. VALUEMATH measured how much the students value mathematics and think mathematics is important. SELFCONF measured how confident students are in their abilities in mathematics. PATM, VALUEMATH, and SELFCONF were recoded from the TIMSS indices as 0=low, 1=medium, 2=high to facilitate interpretation.

Teacher characteristics questions. The questions about the teacher characteristics included in the present study are: age, gender (male or female), teaching experience, certification (yes or no), and teachers' formal education. For the age variable, teachers were asked in the TIMSS questionnaire to specify to which of the following age groups they belong (a) under 25 , (b) 25-29, (c) 30-39, (d) 40-49, (e) 50-59, and (f) 60 or older. For teaching experience teachers were asked to enter the number of years they would have been teaching by the end of the school year. Then, teachers had to answer how far they went in formal education: if they stopped before high school, in high school, they completed high school, received a bachelor's degree, or received a masters or a PhD degree.

Scoring

The international reliability coefficient was computed as the median of Cronbach's reliability coefficient across all 14 booklets; for eighth grade it was 0.88 in mathematics and 0.84 in science (Olson et al., 2008). To ensure that comparisons can be made across the years, the grade 8 TIMSS data is rescaled so that the mean score of all countries is 500 and the standard deviation is 100 (Olson et al., 2008).

Item difficulty was assessed by looking at the percentage of all the students who solved the item and got a correct answer (Barth & Neuschmidt, 2008).

To be able to cover all the material for grade 8, a large amount of items was prepared. However, answering all the items takes too much time. Therefore, the items are divided into booklets and each student receives a booklet with only a portion of the items. In TIMSS 2007, 14 different versions of booklets were used. Each booklet contained two mathematics and two science blocks. Two booklets may have one of the math sections in common or one of the science sections in common but never both math sections or both science sections in common. The mathematics items were divided into 14 blocks and the 14 sections were combined into booklets as shown below.

Booklet	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Block	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Block	B	C	D	E	F	G	H	I	J	K	L	M	N	A

Students were given 22.5 minutes to complete each block in grade 8. Each student would take either the 2 mathematics blocks first or the 2 science blocks first and get a break. Then the students would take the remaining two blocks. The total assessment time for grade 8 students was 90 minutes. In each block of mathematics, the students had between 11 and 18 items (Ruddock et al., 2008).

The mathematics test examined three cognitive domains: Knowing (35%), Applying (40%), and Reasoning (25%). The eighth grade content was distributed over four content domains with each domain allocated a certain percentage of the items:

Number (30%), Algebra (30%), Geometry (20%), and Data & Chance (20%). Number included whole numbers, fractions, integers, ratio, proportion and percent. Algebra included patterns, algebraic equations, equations, formulas, and functions. Geometry included geometric shapes, geometric measurement, and location and movement. Data & Chance included data organization and representation, data interpretation, and chance (Ruddock et al., 2008).

TIMSS testing contains two types of questions: multiple choice and constructed response questions. The final counts for the 2007 items was for Number 35 multiple choice and 28 constructed response, for Algebra 34 multiple choice and 30 constructed response, for Geometry 31 multiple choice and 16 constructed response, and for Data & Chance 17 multiple choice and 24 constructed response. Multiple choice items were scored either right or wrong and were worth one point if correct and 0 if wrong. Constructed response items were worth either 1 or 2 points depending on the complexity of the answer. For the items worth 1 point the point was given to the student if "the response indicates that the student has completed the task correctly" (Ruddock et al., 2008, p. 30) and the students was given a score of 0 if the answer was "incorrect, irrelevant, or incoherent" (Ruddock et al., 2008, p. 30). For the items worth 2 points, students were rewarded the 2 points if their answers were procedurally correct, their explanations were clear and their answer showed that they understood the mathematical concepts of the items. Students were rewarded 1 point if only part of their answer is correct, and 0 points if the answer was completely wrong. To insure reliability in scoring the constructed response questions country representatives were trained on how to score these types of questions and then each country representative trained their scoring staff (Ruddock, et al., 2008).

Not all students answered the same TIMSS questions and not all students answered the same number of questions. Therefore, the students' raw scores which represent the scores of the students on the items they answered cannot be used for comparisons within or between countries. Neither can the individual's standardized raw scores. In order to enable comparisons between countries, population, or subpopulations, Item Response Theory (IRT) was used and plausible values were created. A plausible value is a probable score for the student on the entire set of items, including items the student did not take. A plausible value estimates a probable score or a plausible range for the student had the student taken all items (Von Davier, Gonzalez, & Mislevy, 2009). Estimating the plausible value takes into account the student's background information, the difficulty of each item, and the performance of the students on the items to which this student responded to (Foy, Galia, & Li, 2008). The variability between the five plausible values reflects the error in the estimates analysis (Foy et al., 2008). In TIMSS 2007, in addition to the five plausible values for achievement in mathematics, five plausible values were also calculated for each student in each cognitive (Knowing, Applying, Reasoning) and content (Number, Geometry, Algebra, Data & Chance) domain.

For comparisons and analyses within the same country the Rasch scores or the standardized Rasch scores may be used. However, the Rasch scores cannot be used for comparisons between countries because all countries have a mean of 150 and a standard deviation of 10 (Foy & Olson, 2009).

Using Plausible Values

TIMSS and other large scale data sets are not intended to measure individual scores but to describe populations or groups within these populations. Plausible values can help us get unbiased estimates of the performance of a group of students and not a single student (Von Davier et al., 2009).

If we repeatedly calculate several plausible values, these plausible values will differ for each individual, however, each time we will obtain "unbiased estimates of the mean and the standard deviation of the distribution overall" (Von Davier et al., 2009, p. 23). Therefore, plausible values should not be treated or analyzed as traditional individual scores (Carstens & Hastedt, 2010; Rutkowski, Gonzalez, Joncas, & von Davier, 2010; Von Davier et al., 2009).

Even though researchers sometimes prefer taking shortcuts when using plausible values like using one plausible value only or averaging the plausible values for each individual and then using this average to analyze the data, these shortcuts can lead to underestimating standard errors. Using the plausible values incorrectly can result in having statistically significant differences when there truly are not statistically significant differences and consequently leading to incorrect conclusions (Carstens & Hastedt, 2010). The best method to analyze results using plausible values is to run the analysis for each of the plausible values and then average the results or use software like the IDB analyzer and HLM that are already programmed to allow users to use plausible values (Carstens & Hastedt, 2010; Rutkowski et al., 2010; Von Davier et al., 2009).

Other Considerations When Using the TIMSS Data Set

> We can only generalize to students, not to their teachers. Practically speaking, any analysis that examines teacher attributes should employ teacher data that are merged to student-level data, and investigations should proceed as student-level analyses with teacher-level variables interpreted as student attributes. (Rutkowski et al., 2010, p. 143)

Benchmarks

The TIMSS 2007 research teams also identified what in general students who reach or surpass a certain benchmark are able to do. In mathematics, at the Advanced International Benchmark "students can organize and draw conclusions from information, make generalizations, and solve non-routine problems" (Mullis et al., 2008, p. 69). At the High International Benchmark "students can apply their understanding and knowledge in a variety of relatively complex situations" (Mullis et al., 2008, p. 69). At the Intermediate International Benchmark "Students can apply basic mathematical knowledge in straightforward situations" (Mullis et al., 2008, p.69). At the Low International Benchmark "students have some knowledge of whole numbers and decimals, operations, and basic graphs" (Mullis et al., p. 69). In the high scoring countries, like Singapore, Korea and Chinese Taipei, 40% to 45% of the students scored at or above the Advanced International Benchmark in mathematics in 8th grade.

The median of the percentages of the students reaching each benchmark in mathematics in TIMSS 2007 were as follows: Advanced International Benchmark 2%, High International Benchmark 15 %, Intermediate International Benchmark 46%, and Low International Benchmark 75%. This means, for example, for the Low International Benchmark half of the countries had more than 75% of their students reaching the Low Benchmark and the other half of the countries had less than 75% of their students reached the Low International Benchmark. The best performing countries, like Korea and Singapore, have 98% and 97% respectively of their students reaching the Low International Benchmark and the low performing countries like Ghana and Botswana have only 17% and 32% of their students reaching the Low International Benchmark (Mullis et al., 2008).

School and Class Sampling

Schools in a country satisfying the "national desired target populations", which were defined by the country, were sampled randomly to participate in the TIMSS study. Before the schools were sampled, the schools were divided into sampling frames or lists depending on the populations or groups that the country wanted represented. The probability for each school to be sampled was directly proportional to the size of the schools. Therefore larger schools had a higher probability of being sampled. If the participations rate of schools in a country was not 100%, then replacement schools were added to the sample. If a school did not participate, then this school would be replaced by the school preceding it or following it in the sampling frame. After the schools were sampled, if a school had more than one class in grade 4 or grade 8, then classes were sampled from within the school. When a class was sampled, all the students within that class participated in TIMSS 2007 (Joncas, 2008).

Part 1: Lebanon

TIMSS 2007 Sampling

The schools in Lebanon were stratified by school type into two categories: public school and private schools. If the schools had at least 60 students then two classes were sampled from that school, otherwise only one class was sampled from the school. Very small schools were excluded from the study, but there were no within schools exclusions in Lebanon. In total, 150 schools were sampled out of 1,574 schools, 64 public and 86 private. Two of the schools were found to be ineligible. Of the 150 sampled schools, 120 (59 public, 61 private) participated in the study in addition to 13 (1 public, 12 private) first replacement schools and 3 (private) second replacement schools. Therefore, the total number of participating schools was 136 which included 60 public schools (44%) and 76 private schools (56%) (Appendix B, 2008). Between all the participating countries, only Lebanon and Armenia had no students withdrawn from class and no students excluded from the study.

TIMSS 2007 Participants

The number of students in Lebanon who took the TIMSS grade 8 test was 3,786 students (54% girls, 46% boys) chosen from a population of 63,755. The average age of the Lebanese grade 8 students who took the test was 14.4 years. Lebanon was one of the few countries where more than half of the students came from disadvantaged backgrounds. Only 14% of the students attended schools where only 0 to 10% were economically disadvantaged and more than 56 % of the students attended schools with more than 50% economically disadvantaged students (see Table 5). From the participating students, 87% of the students had both parents born in the country, 10% had only one parent born in the country and 3% had neither of the parents born in the country. Moreover, 20% of the students have parents with a university degree, 19% have parents who completed post-secondary but not university, 16% have parents who completed secondary education, 32% have parents who did not complete secondary, and 13% answered that they do not know. Only, 77% of the students reported having a computer and 23% did not. Furthermore, 36% of the students reported having an internet connection and 64% did not have internet connection (Mullis et al., 2008).

Table 5
Percentage of Students in Schools with Different Percentages of Economically Disadvantaged Students

Variable	Schools with (0-10%) economically disadvantaged	Schools with 11-25% economically disadvantaged	Schools with 26-50% economically disadvantaged	Schools with more than 50% economically disadvantaged
2007 students percentage	14%	16%	15%	56%
Average Achievement	481	470	446	429

Note. Data the TIMSS 2007 International Mathematics Report (Mullis et al., 2008)

The average class size for the Lebanese students participating in TIMSS was 26 students. The division of the Lebanese students according to class size was as follows: 38% of the students were in classes that had between 1 – 24 students, 58% of the students were in classes that had between 25 and 40 students, and 4% of the students were in classes with more than 41 students (Mullis et al., 2008).

In Lebanon, 58% of the students who participated in TIMSS 2007 had male teachers and 42% had female teachers. In addition, 33% of the students had teachers who were 29 years old or younger, 27% of the students had teachers between 30 and 39, 22% of the students had teachers between 40 and 49, and 19% of the students had teachers who were 50 or older. Moreover, 9% of the students had teachers with post graduate degrees, 63% of the students had teachers who completed university but did not have a post graduate degree, 28% of the students had teachers who only completed upper secondary, and none of the students had teachers who did not complete upper secondary school. The percentage of students whose teachers feel very well prepared to teach the TIMSS mathematics content was: Number 91%, Algebra 90%, Geometry 84%, Data & Chance 77%, and overall 85% (Mullis et al., 2008).

TIMSS 2007 Testing

Lebanese students were administered TIMSS in English or French. None of the Lebanese students took the TIMSS in Arabic, their first language. In fact, Lebanon was the only country where more than half of the students tested in two languages that were not native languages (Johansone & Malak, 2008). According to what the students reported in TIMSS 2007, 20% of the students spoke the language of the test at home either always or almost always, 64% of the students spoke the language of the test sometimes at home, and 16% of the students never spoke the language of the test at home. The reliability coefficient for TIMSS 2007 in mathematics for Lebanon was 0.84.

In TIMSS 2003, teachers reported less than 50% of the topics in TIMSS were included in the Lebanese curriculum (UNDP, 2007, Mullis et al., 2004). Even though the Lebanese Curriculum did not change between 2003 and 2007 (Osta, 2007; Skaff & Habib, 2008), in TIMSS 2007, the teachers in Lebanon reported that on average about three quarters of the TIMSS topics were included in the Lebanese curriculum: Number 94%, Algebra 76%, Geometry 75%, and Data & Chance 49% (Mullis et al., 2008). Table 6 presents the percentage of topics tested in TIMSS 2007 that are included in the Lebanese curriculum.

Table 6
Percentage of Tested Material in the Lebanese Curriculum

	All Mathematics	Number	Algebra	Geometry	Data & Chance
Percentage of students taught each content	74%	93%	76%	75%	49%

Note. Data from the TIMSS 2007 International Mathematics report (Mullis et al., 2008)

Part 2: Arab countries

Choosing what Arab countries to include in the present study was imperative. Thirteen Arab countries participated in TIMSS 2007, while 9 Arab countries participated in TIMSS 2003. The choice was made only to include in the present study the Arab countries that have participated in both TIMSS 2003 and TIMSS 2007. The reasoning behind the choice was that the NRC and those responsible for administering the test in the countries would be more experienced and better prepared to administer the test and talk with various school administrators and would more familiar with managing the implementation, while countries who are taking the test for the first time would be learning the procedure for the first time. Moreover, choosing countries that were located in different areas of the MENA region was imperative because of the differences between educational systems in each area. All the Arab countries that participated in TIMSS 2003 participated again in 2007. Morocco did not satisfy the sampling criteria for 2007, and therefore, was not included. Thus, the countries included in the study were Bahrain, Egypt, Jordan, Lebanon, Saudi Arabia, Syria, and Tunisia. Table 7 presents the countries and the language(s) in which students in each country took the test.

Table 7
Languages of TIMSS Testing

Country	Language
Bahrain	Arabic/ English
Egypt	Arabic/English
Jordan	Arabic
Lebanon	English/French
Saudi Arabia	Arabic
Syria	Arabic
Tunisia	Arabic

Note. Data from the International Mathematics report (Mullis et al., 2008).

TIMSS Sampling in the Arab countries

Bahrain. All of the 74 schools in Bahrain participated in TIMS 2007. The schools were divided as follows: 17 private, 10 public in the capital, 12 public in the central governorate, 11 public in the Muharraq governorate, 15 public in the northern governorate, and 9 in the southern governorate. Moreover, each of the public schools was coded either as a boys school or as a girls school. Within the schools 4,230 (36%)

students were chosen to participate in TIMSS out of the 11,667 students in grade 8. The average age of the participating students was 14.1 years old (Appendix B, 2008).

Egypt. In Egypt, 237 schools were sampled out of a total of 8,179 schools. Out of the 237 sampled schools, 4 were ineligible and 231 participated in addition to 2 first replacement schools. The schools were divided into 4 groups: public (160), experimental language (25), free private (2), private (25), and private language (25). The public schools were then divided by region (Cairo, Alexandria, and other), urban or rural, shift (morning, noon, afternoon, and full day), and gender (boys, girls, and mixed). The total number of grade 8 students participating in TIMSS 2007 was 6,582 (.5%) from a population of 1,342,127. The average age of the students was 14.1 years old (Appendix B, 2008).

Jordan. In Jordan, 200 schools were sampled out of 1,691 and all 200 schools participated in the study. The schools were divided as 61 Discovery schools, 110 public schools, 17 UNRWA (United Nations Relief and Works Agency for Palestinian Refugees in the Near East) schools, and 12 private schools. The schools were further stratified as urban or rural, boys, girls, or mixed, and basic or secondary. A total of 5,251 (4.8%) students out of an 8^{th} grade population of 108,856 participated in the study. The average age of the students was 14.0 years (Appendix B, 2008).

Saudi Arabia. In Saudi Arabia, 167 schools were sampled out of 6,271 schools. Out of the 167 sampled schools 1 was ineligible, and 165 participated. The schools were divided as government boys (75), public boys (9), government girls (75), and public girls (6). The schools were further stratified as rural, suburban, or urban, and general or

Quranic. A total of 4,243 (1.3%) students participated out of an 8th grade population of 332,479. The average age of the participating students was 14.4 years (Appendix B, 2008).

Syria. In Syria, 150 schools were sampled out of a total of 3,756 schools. All the sampled schools participated in the study. The schools were divided into boys urban (20), boys rural (13), girls urban (20), girls rural (13), mixed urban (13), and mixed rural (70). The schools were further stratified into public or private and according to their governorates (14 governorates). A total of 4,650 (1.7%) students participated out of the 8th grade population of 270,389 students. The average age of the participating students was 13.9 years (Appendix B, 2008).

Tunisia. In Tunisia, 150 schools were sampled out of 804 schools. All the sampled schools participated in the study. The schools were divided as public or private, Priority Education Programme (PEP) or non PEP and by geographic location (northeast, northwest, southeast, southwest). A total of 4,080 (2.3%) students out of a population of 176,555 participated in the study. The average age of the participating students was 14.5 years (Appendix B, 2008).

Analyses

IDB Analyzer

The IDB analyzer is a plugin for SPSS and can be downloaded for free from the International Association for the Evaluation of Educational Achievement (IEA) website. The IDB analyzer can be used to combine data from different files or from different countries. The IDB analyzer can also be used to analyze data from the large scale tests like TIMSS and PIRLS. Users of the IDB analyzers just have to point and click to decide what variables they want to use and what methods of analysis they want without having to write the SPSS code. The methods of analyses available within the IDB analyzer are: percentages only, percentages and means, regression, benchmarks, and correlations.

> All statistical procedures offered within the analysis module of the IEA IDB Analyzer make appropriate use of sampling weights and standard errors are computed using the jackknife repeated replication (JRR) method… When achievement scores are used, the analyses are performed five times—once for each plausible value—and the results are aggregated to produce accurate estimates of achievement and standard errors that incorporate both sampling and imputation errors. (Foy & Olson, 2009, pp. 13-14)

Weights

Weights need to be included when analyzing the TIMSS data to account for the different probabilities of selecting a school or a student. The TIMSS database provides weights for each student, school, and teacher depending on the probability of the students, school, or teacher to be chosen. However, these weights are only included to be used with 1-level analyses. Analyzing the data with multilevel models requires weights to be computed by hand and then included in the analysis (Rutkowski et al., 2010).

For the analyses where students were nested within schools, the school weight was computed by multiplying WGTFAC1 (School Weight Factor) and WGTADJ1 (School Weight Adjustment) and was used as the level-2 weight. The students' weight was calculated by multiplying WGTFAC2 (Class Weight Factor), WGTADJ2 (Class

Weight Adjustment), WGTFAC3 (Student Weight Factor), and WGTADJ3 (Student Weight Adjustment) (Rutkowski et al., 2010) and was used as the level-1 weight.

For the analyses where students were nested within teachers, that is the analyses that examined teachers characteristics, different weights were calculated. The second level weights were calculated as the product of the school weights and the classroom weights: WGTFAC1xWGTADJ1x WGTFAC2xWGTADJ2. The first level weights were calculated by multiplying the students' weights WGTFAC3xWGTADJ3.

Part 1: Lebanon

First, Lebanese students' achievement in each cognitive (Knowing, Applying, and Reasoning) and content domain (number, geometry, algebra, and data and probability) were calculated using the IDB analyzer. Then these results were presented with 95% confidence intervals around the mean. Confidence intervals for a statistic are an interval or a range around the sample's statistic point estimate, in which the population parameter *may* lie. Confidence intervals "communicate both the point estimate, and information about the precision of the estimate" (Thompson, 2008, p. 206). According to the APA 6^{th} manual, confidence intervals are considered "the best reporting strategy" and "the use of confidence intervals is therefore strongly recommended" (American Psychological Association[APA], 2010, p. 34).

Then, the focus of part 1 shifts to the differences in achievement of public and private school students in Lebanon. The percentages of students in private and public schools reaching each of the TIMSS benchmarks were calculated and compared. Then, using the IDB analyzer one more time, the achievement of public and private schools in

Lebanon in each cognitive and content domain were calculated and were presented along with 95% confidence intervals estimates around the mean.

To examine the relationship of some of the factors with students' performance a Hierarchical Linear Model (HLM) was fit with students nested within schools or teachers. HLM takes into account the nested form of the data. Analyzing nested data as one level data is not favorable because analyzing the data in one level only means either the groups are entered into the analysis or individuals are entered into the analysis. Entering the groups only in the analysis ignores individual differences while analyzing the individuals only violates the independence of cases assumption because two individuals belonging to the same group are not fully independent (Hox, 2010; Raudenbush & Bryk, 2002). HLM allows the analysis of nested data and accounts for both individual differences and the grouping of the data. The software HLM7 was used to analyze the data (Raudenbush, Bryk, & Congdon, 2004).

The HLM analysis for the data included both students and teacher factors. To examine the relationship of student factors and mathematics achievement in public and private schools an HLM model with students nested within schools was used. First, a random effects model or a fully unconditional model with students nested within schools was analyzed (Raudenbush & Bryk, 2002). The unconditional model does not include variables in any of the 2 levels and helps determine whether analyzing the data as 2 levels is appropriate (Raudenbush & Bryk, 2002). The equations of the unconditional model are presented below:

Level-1 Equation:

$$MAchievement_{ij} = \beta_{0j} + r_{ij}$$

Level-2 Equation

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

Mixed Model equation

$$MAchievement = \gamma_{00} + u_{0j} + r_{ij}$$

where γ_{00} represents the average student achievement for the students in Lebanon, i = (1,….., n_j) represents the number of students, and j= (1, …, J) represents the number of schools, u_{0j} is the level-2 residual error, and r_{ij} is the level-1 residual error (Hox, 2010)

Then, the intraclass correlation ρ was calculated using the following formula

$$\rho = \frac{\tau_{00}}{\sigma^2 + \tau_{00}}.$$

where τ_{00} is level-2 variance, and σ^2 is the level-1 variance (Raudenbush & Bryk, 2002). The intraclass correlation ρ is the measure of the variance in the outcome variable that is between the level-2 groups (Raudenbush & Bryk, 2002). In the case where students are nested within schools the intraclass correlation represents how much of the variance in mathematics achievement (outcome) is between schools. If there is no variance between the second level groups in HLM, then there is no need to have groups and the data can be analyzed as one level only. The rule of thumb for the size of intraclass correlations is: 5%, 10% and 15% can be used as low, medium and large values respectively (Hox, 2010). Hox (2010) adds that in research where a large intraclass correlation are expected from previous research, one could consider intraclass correlations of 10%, 20%, and 30% as low, medium, and high instead.

Then, the variable PRIVATE representing whether a school is public or private was added to the random effects model at the school level (level-2) to measure how much of variance is explained by a school being public or private and to help quantify the difference in achievement between public and private school students. Therefore, the level-2 equation became

$$\beta_{0j} = \gamma_{00} + \gamma_{10} \text{ (PRIVATE)} + u_{0j}$$

and the mixed model became

$$\text{MAchievement}_{ij} = \gamma_{00} + \gamma_{10} \text{ (PRIVATE)} + u_{0j} + r_{ij}$$

Because the intent was to examine the differences between the mathematics achievement in public and private schools in Lebanon, the random effect model with PRIVATE in the second level was considered as the *base model*. Then variables were added to the base model either separately or combined.

Based on the literature, the socio-economic status of students in private schools is expected to be better than the socio-economic status of students in public schools, because parents prefer to send their children to private schools if they can afford it. To check whether public and private schools' mathematics achievement was still different when controlling for the schools socio-economic status, the variable SES, representing the school's socio-economic status, was added to the base model at the school level (level-2).

Next, to answer whether students' attitudes and dispositions have an effect on mathematics achievement in each of the school types (public, private), the variables PATM, VALUEMATH, and SELFCONF were entered into base model separately at the student level (level-1). PATM represents whether students have a positive affect towards mathematics, VALUEMATH represents whether students value mathematics, and SELFCONF represents whether students are self-confident in learning mathematics. Each of the variables was coded as 0=low, 1=medium, and 2=high.

When PATM was entered at the level-1, the level-1 and level-2 equations became

Level-1:

MAchievement = $\beta_{0j} + \beta_{1j}*(PATM_{ij}) + r_{ij}$

Level-2 Equations:

$\beta_{0j} = \gamma_{00} + \gamma_{01}*(PRIVATE_j) + u_{0j}$

$\beta_{1j} = \gamma_{10} + \gamma_{11}*(PRIVATE_j) + u_{1j}$

The mixed model was:

MAchievement = $\gamma_{00} + \gamma_{01}*PRIVATE_j + \gamma_{10}*PATM_{ij} + \gamma_{11}*PRIVATE_j*PATM_{ij} +$

$u_{0j} + u_{1j}*PATM_{ij} + r_{ij}$.

Then, VALUEMAT and SELFCONF were added instead of PATM separately. The equations were similar to the PATM equations with VALUEMATH or SELFCONF instead of PATM. The within school variance explained by each of PATM, VALUEMATH, and SELFCONF was calculated when each of these variables was entered into base model by the following formula:

Variance explained = $\frac{\sigma_1^2 - \sigma_2^2}{\sigma_1^2}$

where σ_1^2 represents the level-1 variance in the base model and σ_2^2 represents the new level-1 variance in the model after one of the variables was entered at level-1. Then, all three variables (PATM, VALUEMATH, SELFCONF) were entered simultaneously into the HLM base model to check the relationship of all three together with mathematics achievement in each of public and private schools and to calculate the percent of within school variance explained by all three variables. The equations for the final model were the following:

Level-1 Model

$$MAchievement_{ij} = \beta_{0j} + \beta_{1j}*(PATM_{ij}) + \beta_{2j}*(VALUMATH_{ij}) + \beta_{3j}*(SELFCONF_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(PRIVATE_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(PRIVATE_j) + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21}*(PRIVATE_j) + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + \gamma_{31}*(PRIVATE_j) + u_{3j}$$

Mixed Model

$$MAchievement_{ij} = \gamma_{00} + \gamma_{01}*PRIVATE_j + \gamma_{10}*PATM_{ij} + \gamma_{11}*PRIVATE_j*PATM_{ij} + \gamma_{20}*VALUMATH_{ij} + \gamma_{21}*PRIVATE_j*VALUMATH_{ij} + \gamma_{30}*SELFCONF_{ij} + \gamma_{31}*PRIVATE_j*SELFCONF_{ij} + u_{0j} + u_{1j}*PATM_{ij} + u_{2j}*VALUMATH_{ij} + u_{3j}*SELFCONF_{ij} + r_{ij}$$

Similarly, to examine the relationship between teacher characteristics and mathematics achievement in public and private schools, a second HLM model with students nested within teachers was used. First, a fully unconditional model was used to determine model fit and the proportion of variance between and within teachers. Next, a base model, the unconditional with the variable PRIVATE, was run. Then, each of the teacher characteristics variables were entered in to the base model at the teacher level (level-2). The teacher characteristics variables included: teacher age, years of experience, degree level, teaching certification (yes, no), and gender. The between teacher variance explained by each of the variables was calculated using the following formula:

$$\text{Variance explained} = \frac{\tau_{a00} - \tau_{b00}}{\tau_{a00}}$$

where τ_{a00} represents the level-2 variance in the base model and τ_{b00} represents the level-2 variance after each of the variables were added.

Part 2: Arab countries

First, the results of the Arab countries in each content and cognitive domain were presented and compared. Areas of weaknesses and strengths that were common to several countries were identified. Then, to examine whether students' attitudes and beliefs are related to students' performance in mathematics in Bahrain, Egypt, Jordan, Lebanon, Saudi Arabia, Syria, and Tunisia an HLM model was fit for each of the countries. Similar to the analysis for public and private schools in Lebanon, a random effects model was fit for each of the countries with students nested within schools. Then, the percentage of within and between school variance was calculated for each country. Next, PATM, VALUEMATH, and SELFCONF were added separately to the model for each country separately and the amount of within school variance explained by each of the variables was calculated for each country. Then, a model containing all three variables together was run for each country to check how much of the within school variance could be explained by all three variables together.

Another random effects model was fit, with students nested within teachers for each country, to examine the effects of teachers' characteristics on students' mathematics achievement. Then, each of the teachers, characteristics (age, gender, years teaching, degree, certification) were added separately to the unconditional model to measure how much of the between teacher variance each of the variables accounts for and which teacher variables are related to students' mathematics achievement in each country.

CHAPTER IV

RESULTS

Part 1: Lebanon

Students' Performance in TIMSS 20007

The Lebanese students took the TIMSS 2007 test in either English or French. There was no difference between the performance of students in English or French (*p*=.34); therefore, the language of the test was not a determining factor of the students' mathematics performance and was not included in further analyses.

Table 8
The Average Achievement of Lebanese Students

	Area	Mean proficiency	SD
	Mathematics Overall	449	75
Content	Number	454.44	71.25
	Algebra	464.79	75.43
	Geometry	462.13	75.20
	Data & Chance	407.27	85.23
Cognitive	Mathematics Knowledge	464.07	74.59
	Mathematics Applying	448.02	74.53
	Mathematics Reasoning	429.41	91.27

Note. n = 3786. Results were calculated using the IDB analyzer.

Table 8 presents the achievement of the Lebanese students in mathematics overall, in each content domain, and in each cognitive domain with standard deviations.

As indicated in Table 8, the means for the Lebanese students were below the TIMSS 2007 international mean of 500, overall, and in each content domain and cognitive domain. The average of percentage of correct answers for Lebanese students in mathematics was 36%. When disaggregated into each content and cognitive domain, the average correct answers were as follows: Number 38%, Algebra 37%, Geometry 39% and Data & Chance 29%, Knowing 46%, Applying 35%, Reasoning 23%. Boys performed statistically significantly better than girls in all 3 cognitive domains. In the 4 content domains boys also performed better than girls; however, the difference was only statistically significant in Number and Data & Chance (Olson, Martin, & Mullis, 2008). In 2003, boys also performed statistically significantly better than girls (UNDP, 2007). However, the difference in gender performance was not the focus of this study.

Figure 4 presents the average achievement of students in each content domain for all participating schools in Lebanon with 95% confidence intervals around the mean. Students in Lebanon performed best in Algebra and then Geometry; however, the difference in student performance in Algebra and Geometry was not statistically significant. The students' average performance in Number was statistically significantly lower than both Geometry and Algebra. Students' average performance in Data & Chance was much lower than these students' performance in the other 3 content domains.

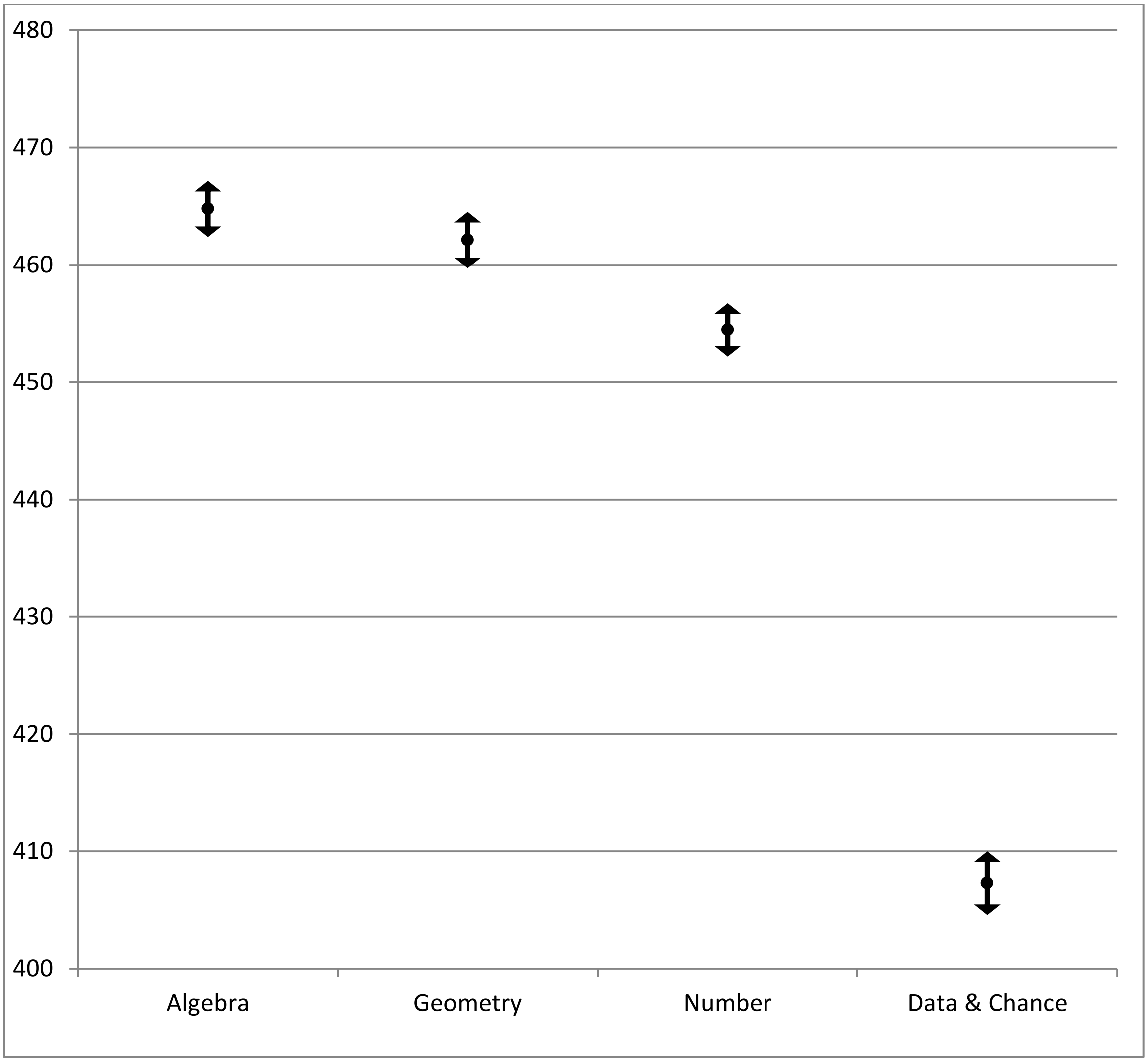

Figure 4. Lebanese students' achievement in content domains. The circles represent the mean of each content domain and the arrows represent the upper and lower limits of the 95% confidence intervals around the mean.

Figure 5 presents the average achievement of students in each cognitive domain for the participating schools in Lebanon with 95% confidence intervals around the mean. Lebanese students performed best in Knowing which is the lowest demanding cognitive level, then in Applying and then in Reasoning. All three cognitive domains were statistically significantly different from each other.

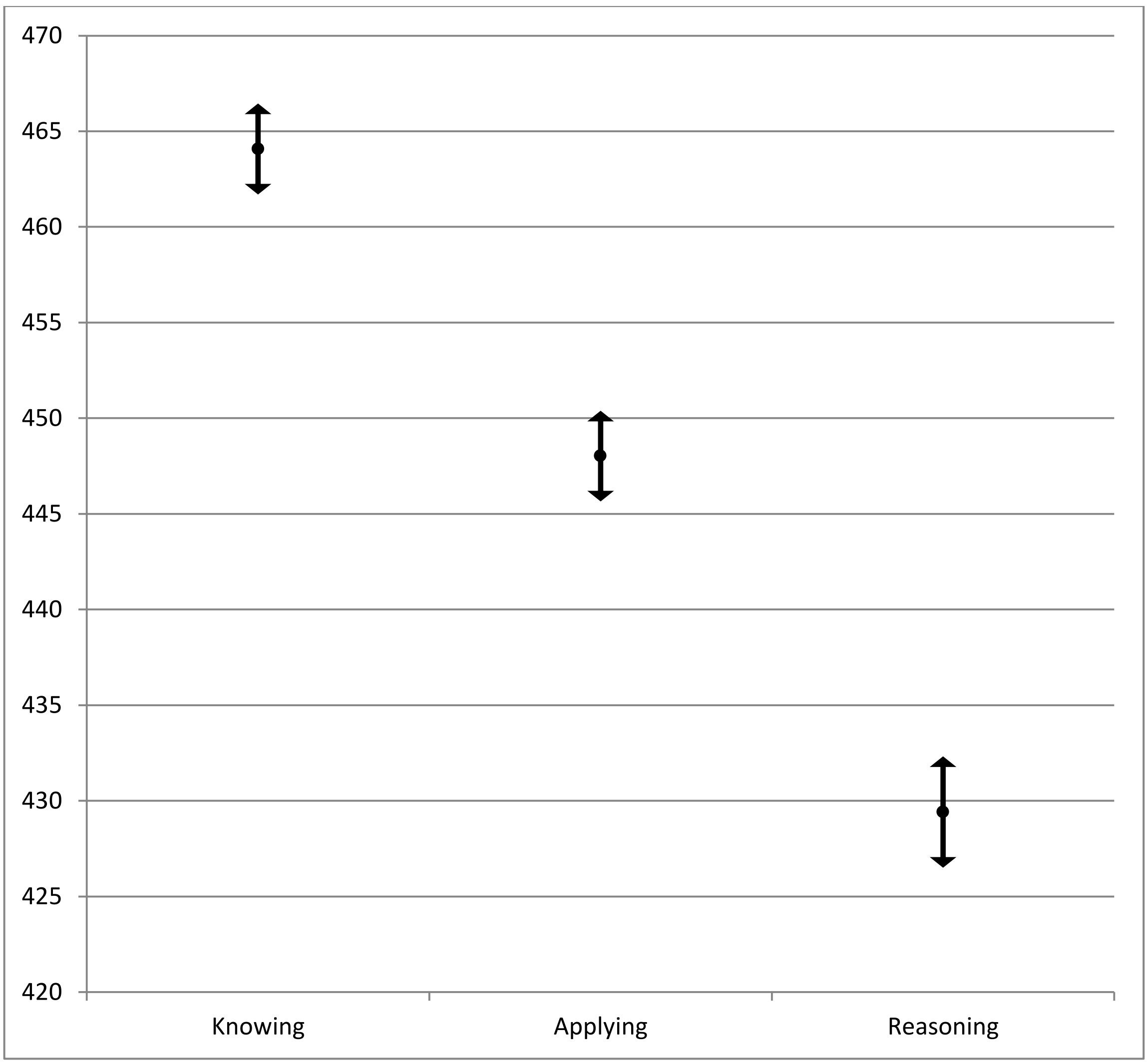

Figure 5. Lebanese students' achievement in cognitive domains. The circles represent the mean of each content domain and the arrows represent the upper and lower limits of the 95% confidence intervals around the mean.

Public and Private Schools

Question 1.2: Are there differences in achievement levels in mathematics between public and private school students in Lebanon in terms of TIMSS benchmarks, content domains, and cognitive domains?

The total number of Lebanese students taking the TIMSS 2007 was 3786, 1461 (38.6 %) in public schools and 2325 in private schools. Figure 6 shows the percentage of students reaching each of the TIMSS benchmarks in public schools compared to students reaching the TIMSS benchmarks in private schools. Only 15% of the students in public schools scored above the second benchmark while 53% of the students in private school scored above the second benchmark. An alarming 85% of the students in public schools scored at or below the second benchmark compared to only 47% of the students in private schools.

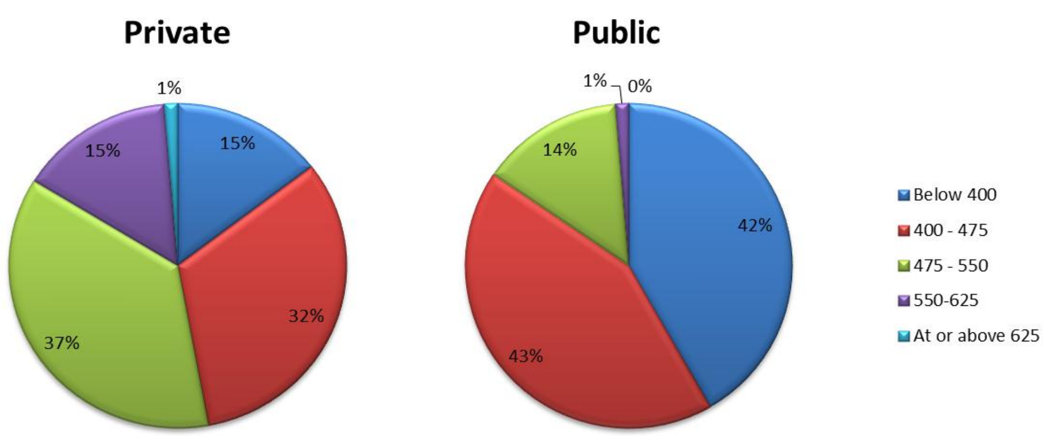

Figure 6. Percentage of students reaching each benchmark in public and private schools in Lebanon. In private schools 15% of the students scored below 400, 32% of the students scored between 400 and 475, 37% scored between 475 and 550, 15% scored between 550 and 625, and 1% scored above 625. In public schools 42% of the students scored below 400, 43% scored between 400 and 475, 14% scored between 475 and 550, 1% scored between 550 and 625, and no students scored above 625.

Figure 7 presents the achievement of students in Lebanon in each content domain segregated by public and private schools. Clearly, students in private schools performed better than students in public schools in Algebra, Geometry, Number, and Data & Chance. In the content domains, in both public and private schools, students scored the lowest by far in Data & Chance. Number was the second lowest content domain for both public and private school students. In public schools, the students' performance in Algebra and Geometry was similar, but in private schools the students performed slightly better in Algebra than in Geometry. Although the performance of students in private schools was much lower in Data & Chance than these students' performance in the other content areas, still private school students' performance in Data & Chance closely matches public schools students' performance in Algebra and Geometry and is higher on average than public school students' performance in Number.

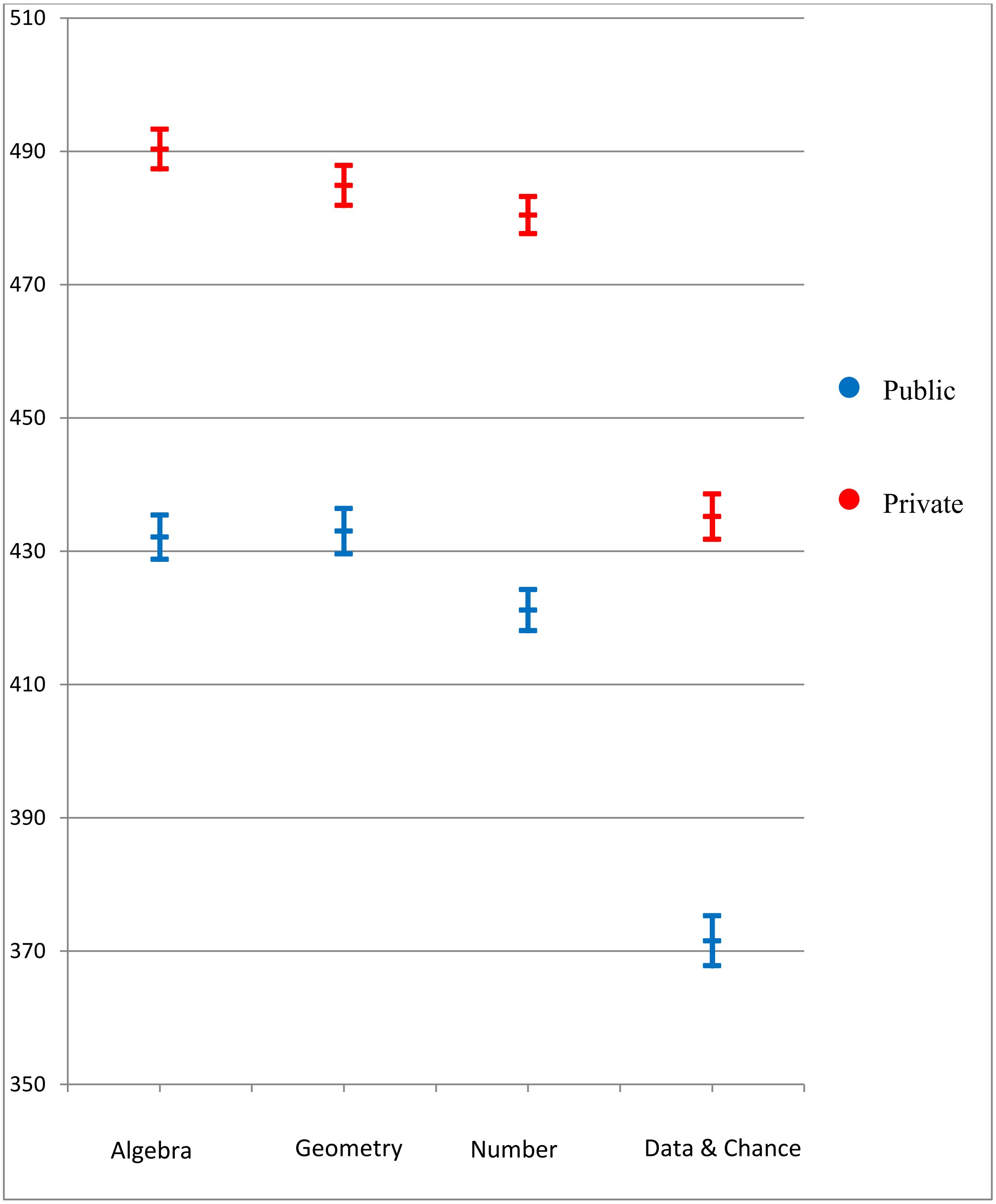

Figure 7. Content Domains Achievement of Public and Private Schools. The middle bar represents the mean and the top and bottom bar represent the upper and lower limits for the 95% confidence interval around the mean.

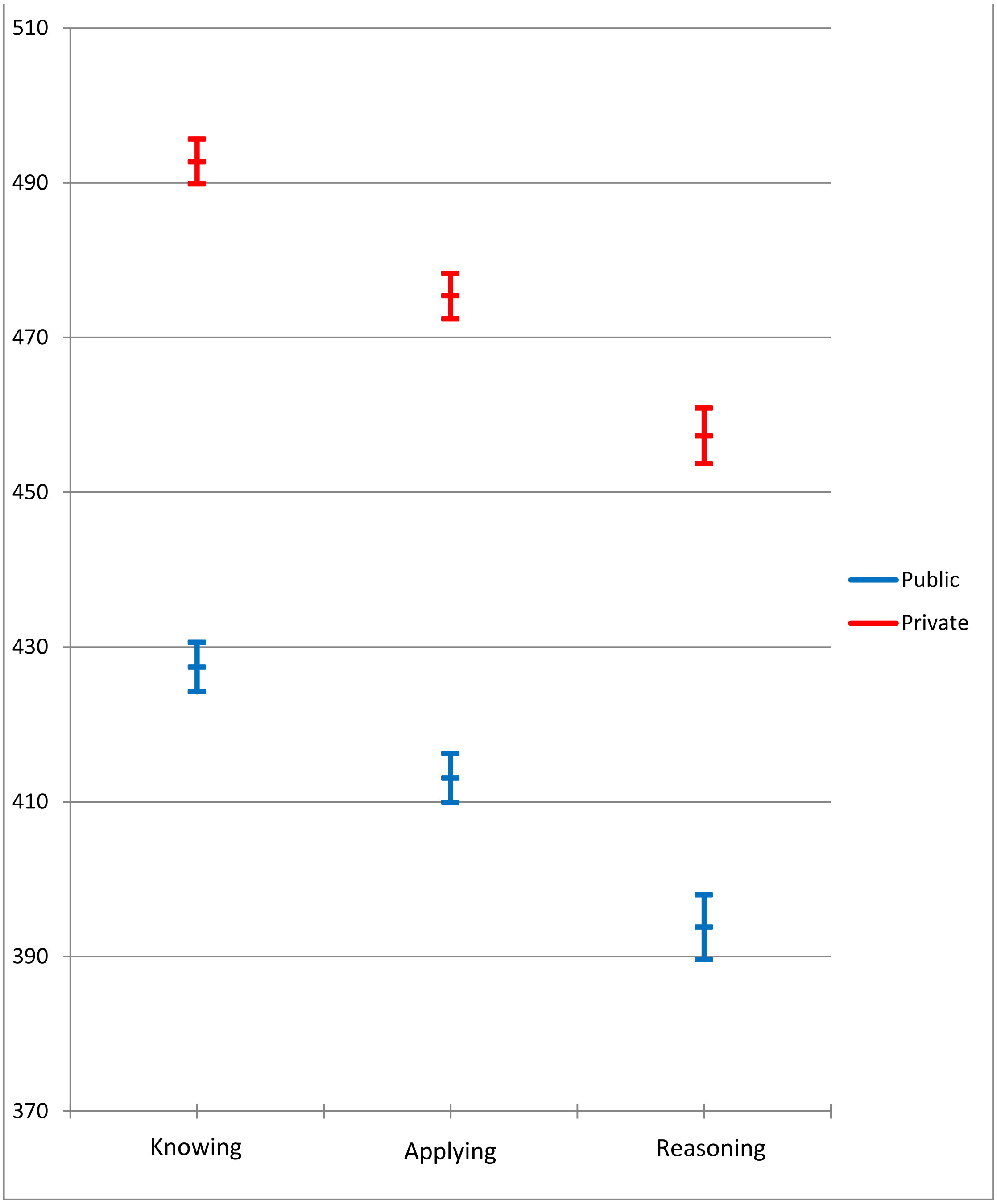

Figure 8. Cognitive Domains Achievement of Public and Private Schools. The middle bar represents the mean and the top and bottom bar represent the upper and lower limits for the 95% confidence interval around the mean.

Figure 8 presents the achievment of students in Lebanon in each cognitive domain segrated by public and private schools. Students in private schools scored on average higher than public school students in each cognitive domain. Students in both public and private schools performed better in Knowing, then in Applying, and had the lowest score in Reasoning. However, students in private schools even scored better, on average, in Reasoning than students in public schools scored in Knowing.

Question 1.3: What is the effect of school type (public, private) on mathematics achievement in Lebanon?

The results above indicate, in Lebanon, students in private schools performed better in mathematics than students in public schools. To investigate the differences in achievement in public and private schools in Lebanon I constructed HLM models. First, an HLM fully unconditional model was fit with students nested within schools and with no variables at any level. The unconditional model helps us understand whether the data should be analyzed as two levels, or if the data should be analyzed as one level only. In addition, the unconditional model provides information about how much of the variance in mathematics achievement is between school and how much of the variance in mathematics achievement is within schools. The mixed equation of the unconditional model was

$$MACHIEVMENT_{ij} = \gamma_{00} + u_{0j} + r_{ij}$$

The reliability estimate for the unconditional model using the Lebanon data was .95. The intraclass correlation ρ = 40%; therefore, 40% of the variance in the mathematics achievement in Lebanon is between schools; while 60% of the variance in mathematics achievement in Lebanon is within schools. Moreover, an intraclass correlation of 40% indicated that enough variance exists between the groups top analyze the data as two levels.

Base Model: To calculate the effect of school type (public, private) on mathematics achievement the variable PRIVATE (0=public, 1=private) was added to the unconditional model at the school level. The mixed equation became

$$MACHIEVMENT_{ij} = \gamma_{00} + \gamma_{01}*PRIVATE_j + u_{0j} + r_{ij}$$

Table 9
Effect of School Type on Mathematics Achievement

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	416.477867	5.445821	76.477	94	<0.001
PRIVATE, γ_{01}	44.545378	7.206888	6.181	125	<0.001

The average performance of students in private schools was different than the average performance of students in public schools in Lebanon ($p < .001$). On average, students in private schools scored 45 points higher than students in public schools (see Table 9). The average achievement for students in public schools was 416.48 points while the average achievement for students in private schools was 461.03 points.

$\frac{\tau_{a00} - \tau_{b00}}{\tau_{a00}} = 0.2669$. Therefore, 26.69% of the between school variance is explained by the type of school students attend. Because the intention was to discover student and teacher characteristics that decrease the mathematics score gap between public and private schools in Lebanon, the base model was chosen as the unconditional model with the variable PRIVATE added at the school level.

Question 1.4: After controlling for SES, are the performances of students in public and private schools still different?

Because parents who can afford to send their children to private schools in Lebanon usually prefer private schools over public schools (Bahous & Nabhani, 2008), we expect, in general, public schools in Lebanon to have more socioeconomically disadvantaged students than private schools in Lebanon. Therefore, socioeconomic differences between the two school types cannot be disregarded. The variable SES was added at the school level to the base model.

Table 10
Effect of Socioeconomic Factors in Public and Private Schools

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	412.877999	5.610940	73.584	101	<0.001
PRIVATE, γ_{01}	40.581827	7.376983	5.501	124	<0.001
SES, γ_{02}	7.340545	3.408732	2.153	124	0.033

Controlling for SES reduced the score gap between private and public schools by 4 points (see Table 10). Although SES reduced some of the effects of public/private schools on mathematics achievement, the difference between public and private schools' achievement cannot be attributed to just socio-economic factors. Socio-economic factors accounted for 4.47% of the between school variance. Together PRIVATE and SES accounted for 30% of the between school variance.

Student Factors

Question 1.5: Can the students' dispositions towards mathematics (positive affect towards mathematics, valuing mathematics, and self-confidence in learning mathematics) explain some of the difference in mathematics achievement between private and public schools in Lebanon?

First, each of the variables positive affect, valuing mathematics, and self-confidence was examined separately. To check whether students' positive affect towards mathematics (PATM) explains some of the differences between public and private schools' achievement, the variable PATM was added to the base model at the student level. The mixed equation became

$$MACHIEVMENT_{ij} = \gamma_{00} + \gamma_{01}*PRIVATE_j + \gamma_{10}*PATM_{ij} + \gamma_{11}*PRIVATE_j*PATM_{ij} + u_{0j} + u_{1j}*PATM_{ij} + r_{ij}$$

Table 11
Effects of Students Positive Affect Towards Mathematics

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	397.080983	6.063749	65.484	76	<0.001
PRIVATE, γ_{01}	37.313634	8.160004	4.573	124	<0.001
For PATM slope, β_1					
INTRCPT2, γ_{10}	14.969644	2.292264	6.531	27	<0.001
PRIVATE, γ_{11}	3.872865	2.877192	1.346	70	0.183

Positive affect towards mathematics reduced the effect of PRIVATE on mathematics achievement. The gap between the achievement of students in public schools and private schools was reduced to 37 points from 45 points in the base model. However, the achievement between public and private schools was still different (p<.001) (see Table 11).

Students with higher positive affect towards mathematics tend to have a better performance on average. The coefficient of the interaction of PATM and PRIVATE is relatively low (3.87; p=.183); this means that the relationship between mathematics achievement and positive affect towards mathematics is pretty similar in public and private schools. PATM accounted for 5.2% of the within school variance.

To check if the degree to which students value mathematics explains some of the differences between public and private schools' achievement, the variable VALUMATH was added at the students level to the base model. The mixed equation became

$$MACHIEVMENT_{ij} = \gamma_{00} + \gamma_{01}*PRIVATE_j + \gamma_{10}*VALUMATH_{ij} + \gamma_{11}*PRIVATE_j*VALUMATH_{ij} + u_{0j} + u_{1j}*VALUMATH_{ij} + r_{ij}$$

Table 12
Effects of How Much Students Value Mathematics

Fixed Effect	Coefficient	Standard error	t-ratio	Approx. $d.f.$	p-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	403.957837	8.196014	49.287	27	<0.001
PRIVATE, γ_{01}	28.727435	10.866265	2.644	83	0.010
For VALUMATH slope, β_1					
INTRCPT2, γ_{10}	7.962169	4.271904	1.864	13	0.085
PRIVATE, γ_{11}	9.254547	5.200276	1.780	36	0.084

The degree to which the students value mathematics reduced the points gap between public and private schools from 45 to 29 points. However, the achievement between public and private schools was still different (*p*=.010) (see Table 12). Students with different levels of valuing mathematics, on average, do not have very different performances and the relationship between mathematics achievement and valuing mathematics is not very different across school types. Valuing mathematics explained 2.86% of the within school variance.

To check whether self-confidence in learning mathematics explains some of the differences between public and private schools' achievement the variable SELFCONF was added at the student level to the base model. The mixed equation became

$$MACHIEVMENT_{ij} = \gamma_{00} + \gamma_{01}*PRIVATE_j + \gamma_{10}*SELFCONF_{ij} + \gamma_{11}*PRIVATE_j*SELFCONF_{ij} + u_{0j} + u_{1j}*SELFCONF_{ij} + r_{ij}$$

Table 13
Effects of Self-Confidence in Learning Mathematics

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	387.660001	5.394896	71.857	112	<0.001
PRIVATE, γ_{01}	28.562095	7.649002	3.734	124	<0.001
For SELFCONF slope, β_1					
INTRCPT2, γ_{10}	24.126549	2.326038	10.372	40	<0.001
PRIVATE, γ_{11}	9.549345	3.380263	2.825	28	0.009

Adding self-confidence to the equation reduced score gap between public and private schools from 45 points to 29 points. However, the achievement in public and private schools was still different (*p*<.0001) (see Table 13). The relationship between mathematics achievement and self-confidence in learning mathematics varied across school types, in private schools this relationship tends to be stronger. Students with high self-confidence in learning mathematics scored, on average, 48 (24 + 24) points higher in public schools and 67 ([24+9.5] x 2) points higher in private schools than students with low self confidence in learning mathematics. Self-confidence accounted for 13.4% of the within school variance.

Figure 9 represents the relationship between self-confidence and mathematics achievement in public and private schools in Lebanon. Although in both public and private schools, students with higher self-confidence in learning mathematics have a better mathematics performance, the growth rate is higher for private school students.

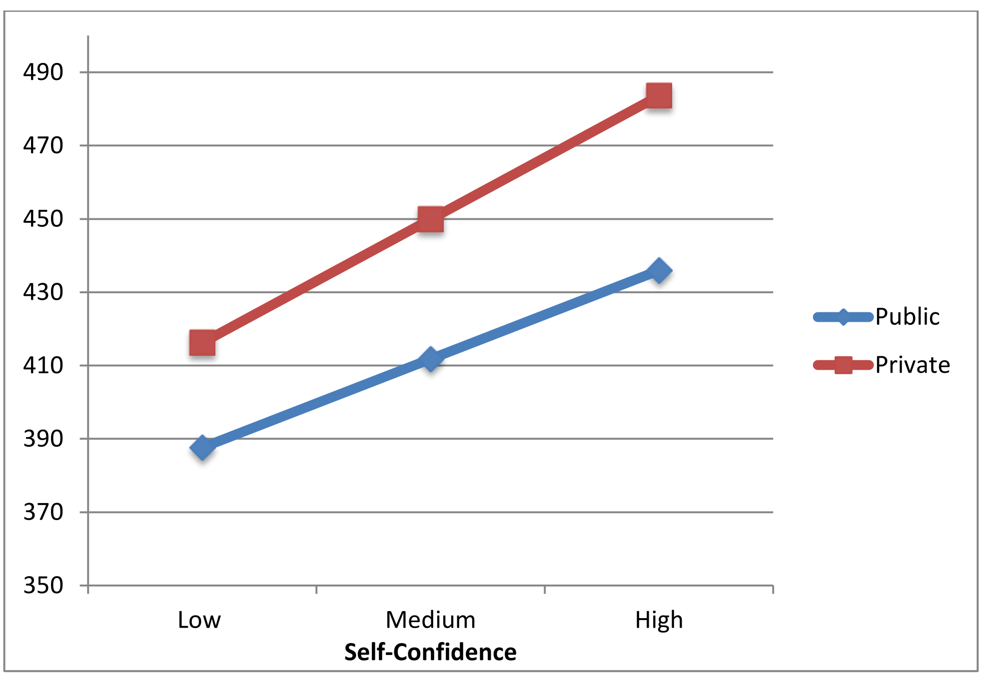

Figure 9. Relationship between self-confidence and math achievement in public and private schools in Lebanon. For public schools, PubAch = 387.66 + 24.13*SELFCONF and for private schools PrivAch = 416.22 + 33.68*SELFCONF.

When all three variables were taken into consideration together the effect of each of the variables on students' mathematics achievement was reduced because of correlations between the variables. The effect of positive affect towards mathematics and self-confidence was still statistically significant (p=.009 and p<.001, respectively) while the effect of VALUE was not statistically significant anymore (p=.332).

Table 14
Effects of Students' Dispositions

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	377.055342	7.621109	49.475	46	<0.001
PRIVATE, γ_{01}	26.908135	11.159412	2.411	47	0.020
For PATM slope, β_1					
INTRCPT2, γ_{10}	6.402540	2.356342	2.717	59	0.009
PRIVATE, γ_{11}	-2.038772	3.191469	-0.639	118	0.524
For VALUMATH slope, β_2					
INTRCPT2, γ_{20}	3.793062	3.806599	0.996	19	0.332
PRIVATE, γ_{21}	1.500947	4.994633	0.301	41	0.765
For SELFCONF slope, β_3					
INTRCPT2, γ_{30}	20.837823	2.374650	8.775	124	<0.001
PRIVATE, γ_{31}	10.079626	3.465484	2.909	86	0.005

After including all three variables in the same model (see Table 14) the performance of students in private and public schools in Lebanon was still different (p=.02). However, the achievement score gap was decreased from 45 points to 27 points. All three variables together account for 16.2% of the within school variance (60%); which means students dispositions explain about 10% (16.2% of 60%) of the variance in mathematics achievement. Only self-confidence had a noteworthy coefficient (about 21 points) and had a different relationship with mathematics achievement in public and private schools.

Teacher Factors

Question 1.6: Can some of the difference in mathematics achievement between public and private schools be explained by teacher characteristics (age, years of experience, gender, degree, and certification)?

To examine the teacher characteristics that help reduce the effect of public and private schools on mathematics achievement. First, an unconditional model with students (level-1) nested within teachers (level-2) was constructed. The students' weight was used for the student level variables while the teacher weight for this model was calculated as the class weight. In the unconditional model ρ= 49%, which means that 49% of the variance in mathematics achievement in Lebanon is between teachers while 51 % of the variance in mathematics achievement is within classes.

Because the intention was to discover teacher characteristics that decrease the public and private school effect on mathematics achievement, the base model was chosen as the unconditional model with the variable PRIVATE added at the teacher level. PRIVATE accounted for 31% of the between teacher variance that is 15.2% of the total variance in mathematics achievement. Then, each of the variables AGE, GENDER, CERTIFICATION, DEGREE, and YRSEXP, was added separately to the base model at the school level to check whether each variable explained some of the differences of PRIVATE on mathematics achievement. Table 15 presents the results of the addition of each of the above variables to the base model.

Table 15
Effects of Teacher Characteristics on Mathematics Achievement in Lebanon

Variable added to the base model	Variables in the model	Coefficient	*p*-value
Base model	Private	59.15	<.001
Teacher's Age	Private Age	62.39 8.29	<.001 .010
Teachers' Gender	Private Gender	57.81 19.19	<.001 .021
Certification	Private Certification	60.5 6.81	<.001 .452
Teachers' Years of Experience	Private Years Experience	61.53 .93	<.001 .016
Teachers' Degree Level	Private Degree Level	59.26 4.12	<.001 .539

Students with female teachers scored, on average, 19 points higher than students with male teachers. Moreover, students with older teachers or teachers with more experience performed better. Only AGE, GENDER, and YRSEXP had a statistically significant effect; therefore, only these variables were chosen to be added to the final model at the teacher level. Because AGE and YRSEXP are highly correlated, only one of them was included in the final model. The choice was to include AGE because AGE had a higher coefficient and the coefficient of years of experience was not noteworthy. The equation of the final mixed model was

$$MACHIEVEMENT_{ij} = \gamma_{00} + \gamma_{01}*AGE_j + \gamma_{02}*GENDER_j + \gamma_{03}*PRIVATE_j + u_{0j} + r_{ij}$$

Table 16
Combined Teacher Effects

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	378.152670	11.070816	34.158	100	<0.001
AGE, γ_{01}	9.950727	3.170111	3.139	133	0.002
GENDER, γ_{02}	23.740365	8.147377	2.914	133	0.004
PRIVATE, γ_{03}	61.370926	8.078906	7.596	133	<0.001

As shown in Table 16, students with female teachers scored on average 24 points higher than students with male teachers. Students with older teachers also scored higher than students with younger teachers. However, neither teacher age nor teacher gender was able to reduce the score gap between public and private school students.

Part 2: Arab Countries

Overall Results

First, students' performance in content and cognitive domains for each country was examined. In Egypt, Syria, Tunisia, and Lebanon, Data & Chance was the content area where students scored the lowest. In Bahrain, Jordan, and Saudi Arabia, Number was the content area the students scored the lowest on. In Egypt, Jordan and Lebanon, the content domain where the students scored the highest was Algebra. In Syria, Saudi Arabia, and Tunisia the content domain the students scored the highest in was Geometry. Bahrain was the only Arab country where students performed in Data & Chance better than all other content domains (See Appendix A). In short, in all 7 countries, students scored the lowest in either in Data & Chance or in Number and students scored the highest either in Algebra or in Geometry except in Bahrain.

All countries except Lebanon, scored lower in Knowing than either Applying or Reasoning or both. Lebanon was the highest scoring country; therefore, maybe increasing the knowledge of students in the other countries might improve the performance of students in these countries. Applying was the cognitive domain where students scored the lowest in Jordan and Reasoning was the content domain where students scored the lowest in Lebanon. In Bahrain, Egypt, Jordan and Tunisia students performed better in the Reasoning cognitive domain than other cognitive domains. The performance in Reasoning was only statistically significantly higher for Bahrain and Jordan (See Appendix A). In Bahrain, Egypt, and Tunisia despite the fact that students do not have much content knowledge, these students can reason well. With some more knowledge these students should be performing at a higher level. The number of answers of Saudi Arabian students was insufficient to calculate an average for Reasoning.

In all content domains, Saudi Arabia had the lowest average of all countries. Lebanon's performance was higher than all countries in Number, Algebra, and Geometry. In Data & Chance, however, Lebanon's average was lower than Jordan and Bahrain and similar to Tunisia's performance (See Appendix A). Egypt and Syria's performance was pretty similar in Number, Algebra, and Data & Chance. In Geometry, however, students in Syria performed better than students in Egypt and Geometry was what helped Syrian students outperform Egyptian students.

Student Factors

Question 2.2: Do the students' dispositions about mathematics affect their mathematics performance in Arab countries? Is the relationship between students' dispositions and mathematics achievement similar across countries?

First, an unconditional model with students nested within schools was fit for each country. The unconditional model did not include any variables at any level. The results from each unconditional model are presented in Table 17, and include the student mathematics average, the reliability of the model, and the percentage of variance in mathematics achievement that is between school and within schools for each country. As shown in the Table 17, between 60% and 82% of the variance in mathematics achievement is within schools, that is between students. Because more than 60% of the variance in achievement is within schools, there is a need to discover what student factors affect this variance. The reliability estimates and intraclass correlations of all the models indicate that analyzing the data as two levels with students nested within school was a good choice.

Table 17
Unconditional Model for Arab Students

Country	Unconditional model Student Average	Reliability	ICC (between school variance)	Within school variance
Bahrain	408.60	.93	22%	78%
Egypt	397.87	.90	27%	73%
Jordan	429.26	.93	30%	70%
Lebanon	437.97	.95	40%	60%
Saudi Arabia	327.18	.85	18%	82%
Syria	398.97	.95	39%	61%
Tunisia	418.56	.83	16%	84%

Positive Affect towards Mathematics. First, the relationship between students' positive affect towards mathematics and these students' mathematics achievement was examined. Table 18 presents the coefficients for PATM, the *p*-values, the difference in performance on average between students who had a high positive affect towards mathematics and students who had a low positive affect towards mathematics, and the percentage of within school variance explained by PATM.

The relationship between mathematics achievement and positive affect towards mathematics was positive ($p<.001$) for all Arab countries. PATM was coded as 0=low, 1=medium, and 2=high, therefore, the difference on average between students with low PATM and high PATM ranged from 28 (Saudi Arabia) to 65 (Jordan). In four countries (Tunisia, Syria, Egypt, Bahrain), the difference on average between Low and High PATM was pretty similar (41, 43, 43, 45). As shown in Figure 10, the lines representing the relationship between positive affect towards mathematics and mathematics achievement are almost parallel for Tunisia, Syria, Egypt, and Bahrain. Moreover, the relationship between mathematics achievement and positive affect towards mathematics was strongest in Jordan. Positive affect towards mathematics explained between 2.31% (Egypt) and 7.74% (Jordan) of the within school variance.

Table 18
Relation of Students' Positive Affect Towards Mathematics with their Mathematics Achievement

Country	Coefficient	*p*-value	Average point difference between Low PATM and high PATM	Percentage of within school variance explained by PATM
Bahrain	22.28	< .001	45	6.21%
Egypt	21.7	< .001	43	2.31%
Jordan	32.65	< .001	65	7.74%
Lebanon	16.95	< .001	34	5.13%
Saudi Arabia	14.03	< .001	28	3.08%
Syria	21.31	< .001	43	5.36%
Tunisia	20.52	< .001	41	6%

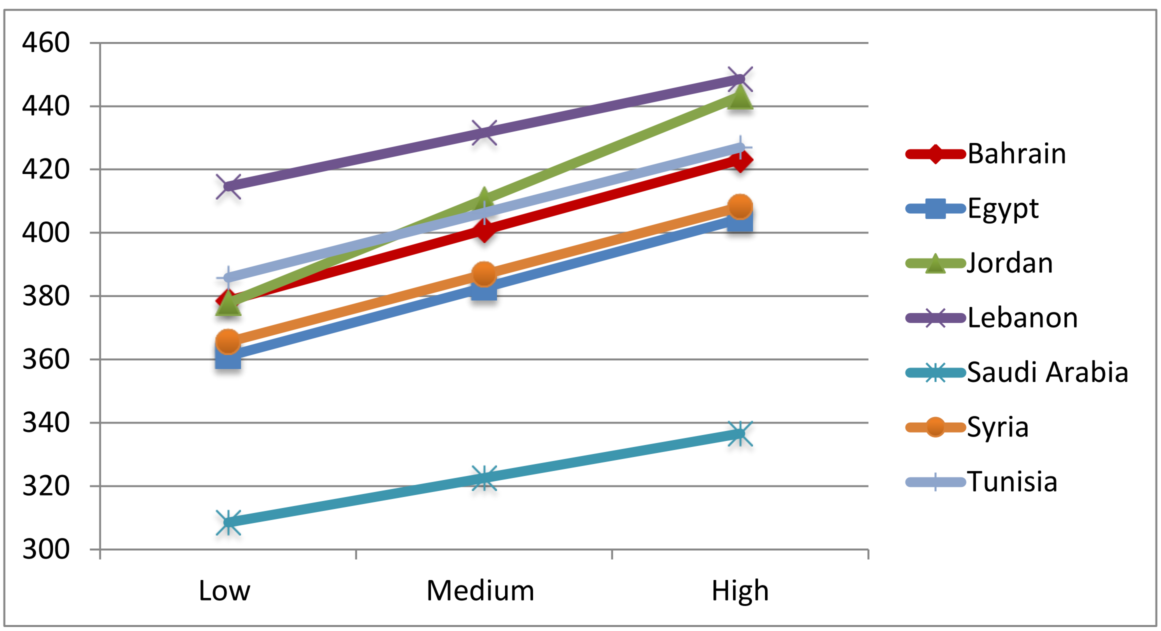

Figure 10. The relationship of positive affect towards mathematics with mathematics achievement in Arab countries.

Valuing Mathematics. Next, the variable VALUE was added to examine whether the degree to which the students value mathematics affected these students' mathematics achievement. Table 19 presents the coefficients for VALUE, the p-values, the difference on average between students who value mathematics highly and students who do not value mathematics much, and the percentage of within school variance explained by VALUE.

The relationship between mathematics achievement and valuing mathematics was positive for all countries and statistically significant for all countries except Bahrain. VALUE was coded as 0=low, 1=medium, and 2=high, the difference in performance, on average, between students with low VALUE and high VALUE ranged from 25 points (Lebanon) to 65 points (Jordan). The relationship between mathematics achievement and valuing mathematics was weakest in Bahrain and again strongest in Jordan (see Figure 11). Valuing mathematics explained between 1% (Syria) and 3.49% (Jordan) of the within school variance.

Table 19
Relation between How Much Students Value Mathematics and Their Mathematics Achievement

Country	Coefficient	*p*-value	Average point difference between Low VALUE and high VALUE	Percentage of within school variance explained by VALUE
Bahrain	3.34	.29	NA	NA
Egypt	27.84	< .001	55	1.7%
Jordan	32.58	< .001	65	3.49%
Lebanon	12.46	.006	25	2.83%
Saudi Arabia	14	.018	28	1.75%
Syria	14.28	< .001	29	1%
Tunisia	21.2	< .001	42	2.05%

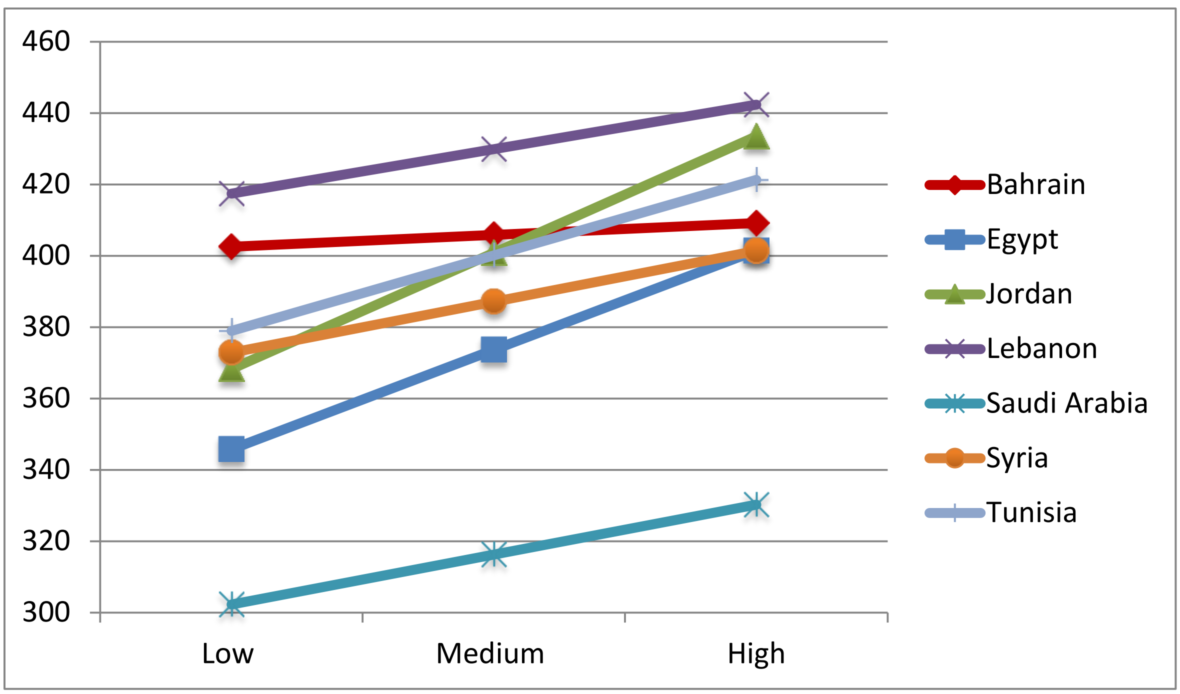

Figure 11. The Relationship between Valuing Mathematics and Mathematics Achievement in Arab Countries.

Self-Confidence in Learning Mathematics. Next, self-confidence was added to examine whether how confident students are in learning mathematics affected these students' mathematics achievement. Table 20 presents the coefficients for self-confidence, the *p*-values, the difference in performance, on average, between students who have high self-confidence in learning mathematics and students have a low self-confidence in learning mathematics, and the percentage of within school variance explained by self-confidence.

The relationship between self-confidence in learning mathematics and mathematics achievement was positive (p<.001) for all the countries. Students with high self confidence in learning mathematics scored at least 57 points higher (Lebanon), on average, than students with a low self-confidence in learning mathematics. In Jordan, students with high self-confidence in learning mathematics scored, on average, 113 points higher than students with low self confidence in learning mathematics. The relationship between mathematics achievement and self-confidence was similar in Bahrain, Syria, and Tunisia and strongest in Jordan (see Figure 12). Self-confidence explained between 7.5% (Egypt) and 17.25% (Jordan) of the within school variance in mathematics achievement.

Table 20
Relation between Students' Self-Confidence in Learning Mathematics and their Mathematics Achievement

Country	Coefficient	*p*-value	Average point difference between Low self-confidence and high self-confidence	Percentage of within school variance explained by SELFCONF
Bahrain	31.34	< .001	63	12.83%
Egypt	37.98	< .001	76	7.5%
Jordan	56.34	< .001	113	17.25%
Lebanon	28.58	< .001	57	13.37%
Saudi Arabia	37.34	< .001	75	13%
Syria	32.43	< .001	65	12.64%
Tunisia	30.64	< .001	61	15.21%

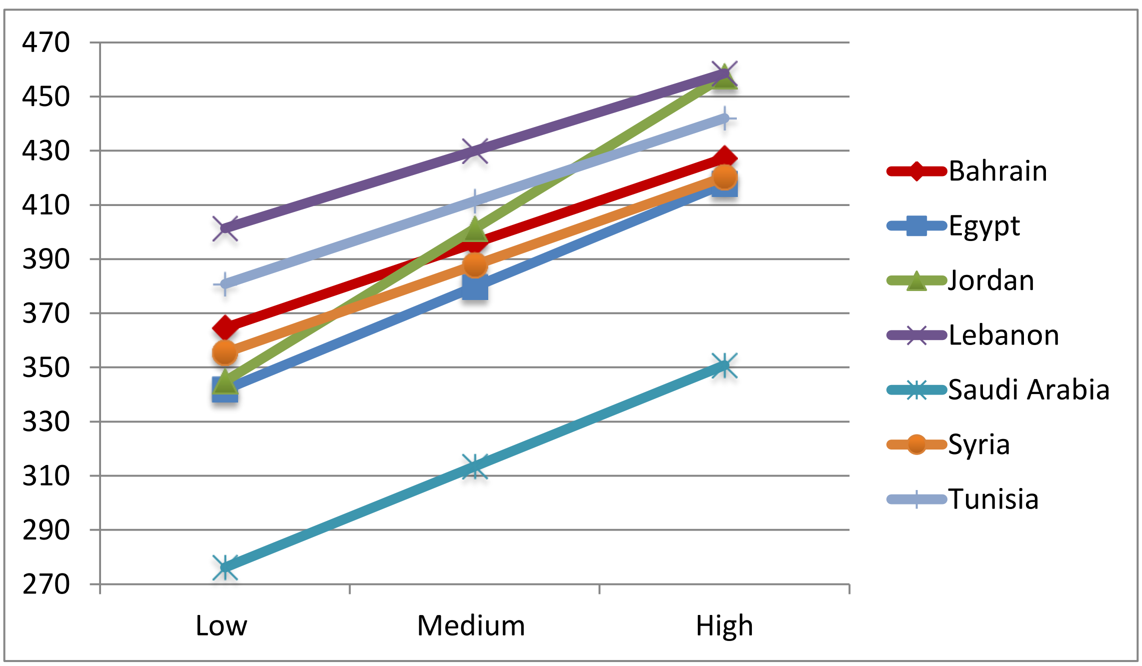

Figure 12. The Relationship between Self-Confidence in Learning Mathematics and Mathematics Achievement in Arab Countries

When all three variable were included in the model together, the relationship between the students' self confidence in learning mathematics and these students' performance was still statistically significant in all countries (p<.001) (See Table 21). Moreover, the difference on average between students who had high self confidence in learning mathematics was at least 51 (25.4*2) points (Lebanon) and as high as 102 (51*2) points (Jordan), on average. The relationship between students' positive affect towards mathematics and their performance was also statistically significant for all countries except Saudi Arabia (p=.217). Valuing mathematics was not related to students' performance in Lebanon (p=.184), Saudi Arabia (p=.214) and Syria (p=.33); but was related to students' performance in Bahrain (p=.08), Egypt (p<.001), Jordan (p=.24), and Tunisia (p=.003). Students' dispositions towards mathematics all together explained between 9% (Egypt) and 21% (Jordan) of the within school variance.

Table 21
Relationship between Student Disposition and Mathematics Achievement in Arab Countries

Country	Variables	Coefficient	*p*-value	Percentage of within school variance explained
Bahrain	PATM	12.66	< .001	15.28%
	VALUE	-4.33	.08	
	Self-conf	28.06	< .001	
Egypt	PATM	6.29	.037	9%
	VALUE	18.12	< .001	
	Self-conf	34.37	< .001	
Jordan	PATM	11.15	.012	20.97%
	VALUE	15.4	.024	
	Self-conf	50.8	< .001	
Lebanon	PATM	5.65	.004	16.02%
	VALUE	4.94	.184	
	Self-conf	25.42	< .001	
Saudi Arabia	PATM	3.21	.217	14.8%
	VALUE	6.2	.214	
	Self-conf	35.51	< .001	
Syria	PATM	10.32	< .001	14.51%
	VALUE	3.03	.330	
	Self-conf	28.45	< .001	
Tunisia	PATM	4.89	.047	16.97%
	VALUE	9.66	.003	
	Self-conf	27.94	< .001	

Teacher Factors

Question 2.3: Are teachers characteristics (age, years of experience, gender, degree, and certification) related to students' mathematics achievement in Arab countries? Is the relationship between teacher characteristics and students' mathematics achievement similar across countries?

Table 22
Unconditional Model for Teachers of Arab Students

Country	Unconditional model Student Average	Reliability	ICC (between teacher variance)	Within teacher variance
Bahrain	397.55	.85	17%	83%
Egypt	392.05	.91	27%	73%
Jordan	428.58	.92	31%	69%
Lebanon	445.92	.95	49%	51%
Saudi Arabia	329.27	.834	18%	82%
Syria	396.24	.94	36%	64%
Tunisia	418.80	.820	16%	84%

An unconditional model with students nested within teachers was first fit for each country. The students' mathematics average ranged between 329 (Saudi Arabia) and 446 (Lebanon) (see Table 22). The data should be analyzed as two levels (.82<reliability<.95, and ICC>>15%). The between teacher variance is less than 20% for Bahrain, Saudi Arabia, and Tunisia and was as high as 49% for Lebanon. Next, teacher characteristics like age, gender, years of experience, degree level, and certification were entered separately into the unconditional model to examine the relationship between each characteristics and the students' mathematics achievement in these 7 Arab countries.

As shown in Table 23, teachers' age has no noteworthy relationship to students' mathematics achievement. Even in Tunisia, the score difference between each age group is only about 4 points, which means the difference on average between students with a teacher under 25 years and students taught by a teacher over 60 is less than 20 points.

Table 23

Relation of Teachers' Age and Students' Mathematics Achievement

Country	Coefficient	*p*-value	Percentage of between teacher variance explained
Bahrain	1.9	.628	.34%
Egypt	1.3	.571	.31%
Jordan	6.29	.11	1.5%
Lebanon	4.84	.2	1.2%
Saudi Arabia	1.19	.421	.55%
Syria	5.38	.073	2.36%
Tunisia	3.74	.036	3.23%

Although the relationship between gender and the students' mathematics achievement is statistically significant for four countries (Bahrain, Jordan, Lebanon, Saudi Arabia), judging by the coefficients, the difference is only meaningful for two countries (Lebanon and Bahrain). In Bahrain, students with female teachers scored on average 33 points higher than students with male teachers. In Lebanon, students with female teachers also scored on average 23 points higher than students with male teachers (see Table 24).

Table 24
Relation of Teachers' Gender and Students' Mathematics Achievement

Country	Coefficient	*p*-Value	Percentage of between teacher variance explained
Bahrain	33.33	<.001	23.10%
Egypt	-.32	.86	.02%
Jordan	-7.31	.042	2.6%
Lebanon	23.32	.016	4.69%
Saudi Arabia	2.82	.032	3.13%
Syria	1.30	.731	.08%
Tunisia	-1.20	.510	.36%

Neither years of experience nor teachers' degree was statistically significantly related to students' mathematics achievement in any of the countries in 8th grade (see Table 25). All the coefficients of years of experience are less than 1. The coefficients of teachers' degree were not noteworthy either.

Table 25
Relation of Teachers' Years of Experience and Degree with Students' Mathematics Achievement

	Country	Coefficient	*p*-value	Percentage of between teacher variance explained
Years of Experience	Bahrain	-.22	.631	.25%
	Egypt	.06	.706	.16%
	Jordan	.08	.658	.13%
	Lebanon	.59	.193	1.30%
	Saudi Arabia	.059	.530	.315%
	Syria	.043	.833	.05%
	Tunisia	.07	.269	.97%
Degree	Bahrain	-3.93	.56	.44%
	Egypt	-1.85	.476	.28%
	Jordan	2.4	.663	.16%
	Lebanon	2.97	.709	.13%
	Saudi Arabia	1.98	.388	.48%
	Syria	2.24	.438	.37%
	Tunisia	-3.95	.066	2.56%

Table 26
Relation of Teachers' Certification and Students' Math Achievement

Country	Coefficient	*p*-value	Percentage of between teacher variance explained
Bahrain	-.8	.988	.001%
Egypt	-.72	.596	.27%
Jordan	-2.20	.535	.3%
Lebanon	-7.07	.502	.32%
Saudi Arabia	NA	NA	NA
Syria	-1.68	.550	.26%
Tunis	-3.42	.013	4.84%

There were no teacher data for certification in Saudi Arabia. The only country where certification was statistically significantly related to students' mathematics performance was Tunisia (see Table 26). But even in Tunisia students with teachers who did not get certification scored on average 3 points higher than students with teacher with certification which is not really meaningful in the TIMSS scale. In conclusion, none of the teacher characteristics had a noteworthy relationship to students' mathematics achievement in any of the Arab countries. The only exception was teachers' gender in Bahrain and Lebanon, where students taught by female teachers scored higher than students taught by male teachers.

CHAPTER V

CONCLUSION AND DISCUSSION

The first study focused only on public and private schools in Lebanon. The objective of the first study was to examine the difference between the mathematics performance of students in public and private schools in Lebanon. The second study examined the mathematics performance of students in Bahrain, Egypt, Jordan, Lebanon, Saudi Arabia, Syria, and Tunisia. The objective was to present a deeper examination of the performance of these Arab countries in TIMSS 2007, and to find student and teacher factors that are related to students' mathematics performance in these countries.

Part 1: Lebanon

Before delving into the public and private education in Lebanon, the general performance of Lebanese students was first explored. Because students in Lebanon took the TIMSS 2007 test in either English or French, establishing whether differences between languages existed was important. There was no difference in the achievement of students who took TIMSS in French and students who took the test in English. Even though, in Lebanon, the language of TIMSS was not the students' native language, it is the language in which these students learn mathematics at school. Therefore, having learned the mathematics in the same language as the test might explain why no differences existed between English Educated and French Educated Lebanese students.

Lebanese students performed best in Algebra and Geometry, then in Number, and worst in Data & Chance. Despite the fact that more statistics was added to the new curriculum (Dagher, 1999), the performance of Lebanese students in Data & Chance was not satisfactory. Clearly, there should be more emphasis on Data & Chance in the Lebanese curriculum. One possible explanation for students not performing well in Data & Chance, in TIMSS 2007, in Lebanon, could be the small percentage of the classroom time allotted to Data & Chance. On average, in Lebanon, 12% of the classroom time is allotted to Data & Chance while 21% of the time is allotted to Number, 35% to Geometry, and 27% to Algebra (Mullis et al., 2008). Another explanation might be that teachers of only 77% of the students reported feeling well prepared to teach Data & Chance compared to 91% in Number and 90% in Algebra (Mullis et al., 2008). Moreover, teachers reported only about 49% of the topics tested in Data & Chance in TIMSS 2007 were included in the Lebanese curriculum compared to at least 75% in other content areas (Mullis et al., 2008). Therefore, one suggestion would be for the Ministry of Education in Lebanon to check the TIMSS topics in Data & Chance and see if some of these topics could be included in the Lebanese curriculum. Another suggestion is to hold professional development workshops for teachers in Data & Chance that will help the teachers feel better prepared to teach this topic.

In cognitive domains, Lebanese students scored highest in Knowing, then Applying, and then Reasoning and the difference between all three domains was statistically significant. Although the new Lebanese curriculum was supposed to strengthen students' reasoning skills, Lebanese students did not do well in questions requiring reasoning (Dagher, 1999). Judging by the TIMSS 2007 scores, Lebanese students have some knowledge of the mathematics included; therefore, the lack of reasoning cannot just be attributed to the lack of knowledge of the material. Because one of the goals of the new curriculum was to strengthen the students' mathematics reasoning, perhaps, a revision of the curriculum is needed, with special attention to the parts that are supposed to promote reasoning, to discover what can be changed or added to help students reason at a higher level. As the objectives of the new curriculum were not fully reached, is it not time to reexamine the "new" curriculum after 12 years of implementation?

Public and Private Schools in Lebanon

Any person in Lebanon probably "knows" that private school education in Lebanon is better than public school education. However, this "knowledge" is based solely on reputation and personal experience. There are no published or publicly available studies that support the claim. Furthermore, keeping in mind the literature and the facts about public schools in Lebanon, private schools were expected to perform better than public schools. The results of the current study confirmed that private school education in Lebanon is better on average than public school education in Lebanon in 3 areas: TIMSS Benchmarks, content and cognitive domains, and overall TIMSS average.

More students in private schools were able to reach higher TIMSS benchmarks than students in public schools. Only 47% of the students in private schools were *unable* to surpass TIMSS Low International Benchmark (475) while 85% of the students in public schools were *unable* to surpass the TIMSS Low International Benchmark. Meaning 47% of the students in private schools and 85% of the students in public schools cannot "apply basic mathematical knowledge in straightforward situations"

(Mullis et al., 2008, p. 69); these students barely have basic mathematics knowledge. At the other end of the spectrum, about 16% of the students in private schools scored at or above the TIMSS High International Benchmark while only 1% of the students in public schools scored at or above the High International Benchmark. At the High International Benchmark, students should be able to "apply their understanding and knowledge in a variety of relatively complex situations" (Mullis et al., 2008, p. 69). The discrepancy might be because private school students are exposed to more complex problems, whereas the focus in public schools is more on solving routine problems and drilling.

Students in public schools scored consistently lower in each content and cognitive domain than students in private schools. Interestingly, the relationship between domains within public and private schools is similar: students in both public and private schools were stronger in the same areas (Algebra and Geometry) and weaker in the same areas (Number and Data & Chance). The achievement of students in both public and private schools was the lowest in Data & Chance. However, private schools' worst performance area (Data & Chance) matches public schools' best performance areas (Geometry and Algebra). Similarly in cognitive domains, students in both public and private schools scored highest in Knowing, then in Applying and lowest in Reasoning. Even though Reasoning was the private schools students' worst domain, still students in private schools scored better in Reasoning than students in public schools scored in Knowing, their best domain.

The overall average of students in public schools was lower than the overall average of students in private schools. On average, students in private schools scored 45 points higher than students in public schools. However, the overall average of private school students in Lebanon was still below the TIMSS 2007 scale average of 500. Even though students in private school had higher scores on average than students in public school, private schools students' performance was still not satisfactory. As a result, policy makers in Lebanon should not only find ways to improve public schools scores but improve private schools' scores as well.

Because public schools in Lebanon usually have more socio-economically disadvantaged students than private schools, the next question examined whether public and private schools' achievement would still be different after controlling for SES. Results indicated that although the relationship between SES and students' achievement was positive, SES was not a major contributor (4 points) to the difference in performance between public and private school students. The achievement in public and private schools in Lebanon remained different even after controlling for SES. Therefore, saying that public schools perform lower than private schools because more economically disadvantaged students attend public schools is not entirely correct. Other factors may exist that explain the disparity in scores.

The next research question examined whether students' dispositions toward mathematics are related to students' achievement in public and private schools and whether the relationship is different in public and private schools. Student dispositions were divided into three variables: positive affect towards mathematics, valuing mathematics, and self-confidence in learning mathematics. The relationship of each of the dispositions to mathematics achievement was examined alone and then all three together. Alone positive affect towards mathematics explained 5.2%, valuing mathematics explained 2.86%, and self-confidence explained 13.4% of the within school variance. Self-confidence had the strongest relationship with mathematics achievement, the relationship was a bit weaker for positive affect towards mathematics, and valuing mathematics had the weakest relationship with mathematics achievement. The relationship between positive affect toward mathematics and valuing mathematics did not vary across public and private schools. However, self-confidence had a stronger relationship with mathematics achievement in private schools than in public schools. Together, positive affect towards mathematics, valuing mathematics, and self-confidence in learning mathematics decreased the score gap between public and private schools from 45 points to 27 points. Despite the decrease in score gap the difference in achievement between public and private schools remained statistically significant. One of the objectives of the new curriculum in Lebanon was to make sure students value mathematics more (Dagher, 1999). However, when self-confidence and positive affect were added along with valuing mathematics, valuing mathematics did not contribute much to the students' mathematics achievement neither in public nor in private schools. New objectives which relate to developing students' positive affect toward mathematics and self-confidence in learning mathematics should be added to the Lebanese curriculum because both positive affect towards mathematics and self-confidence in learning mathematics have meaningful contributions to students' mathematics outcomes.

The next research question addressed whether some of the teacher characteristics like age, gender, years of experience, degree, and certification were related to students' mathematics achievement in public and private schools. Certification and teacher's degree had very little or almost no contribution to students' mathematics achievement in either public or in private schools. The fact that teacher certification had no effect on students' mathematics achievement raises the question of what is being taught in certification programs in Lebanon. Surprisingly, whether a teacher only had a high school certificate, a bachelor's degree, or a masters' degree did not matter either. In Lebanon, some teachers with only a high school certificate were allowed to teach in schools, especially during the war when schools had a need to hire teachers that lived close by. At the end of the war, these teachers remained at the schools. Between 25% and 32% of the students in Lebanon who tested for TIMSs were taught by teachers who only had only completed high school (see Appendix B). One suggestion would be to look at teachers' major concentration instead of the degree level and examine whether the concentration is related to the students' mathematics achievement. Students with female teachers scored on average higher than students with male teachers. Both age and experience had a positive relationship with mathematics achievement. Public school teachers are usually older and usually have more experience than private school teachers (Dagher, 1999). Therefore, having older and more experienced teachers is a plus for public schools. In general though, teacher characteristics did not explain the difference in achievement between public and private school students. Public and private school students' achievement was still different even after controlling for teacher characteristics. Future research should examine whether teaching styles or teaching practices in public and private schools are related to the students' outcomes in these schools.

Limitations

Most of the teacher data were reported by teachers themselves. However, the reliability and objectivity of the reporting can be questioned. For example, in TIMSS 2003, teachers reported that less than 50% of the TIMSS topics were included in the Lebanese curriculum. In TIMSS 2007, teachers reported that 74% of the TIMSS topics were include in the Lebanese curriculum. However, the Lebanese curriculum did not change between 2003 and 2007 (Skaff & Habib, 2008), neither did the TIMSS topics.

The TIMSS 2007 test did not contain all of the material included in the Lebanese curriculum at eighth grade. The results in the present study only examined the mathematics content that was tested in TIMSS 2007. If data were available, examining the Lebanese national tests at the ninth grade level could give more insight about the differences in public and private school achievements in Lebanon and cover more content areas that interest Lebanese policy makers than TIMSS would.

Recommendations

We need to develop all Lebanese students, specifically public school students, from having only basic mathematics knowledge to being able to apply their knowledge in simple and straightforward situations; more importantly to being able to apply their knowledge in more complicated situations. Declaring that one objective of the new Lebanese curriculum was to help students with problem solving is not enough. Teachers in the classrooms need to not only rely on drilling but also add problem solving to their lessons.

Because both positive affect towards mathematics and self-confidence in learning mathematics have a positive relationship to mathematics achievement, measures should be taken to insure students enjoy mathematics and are confident in their mathematics skills. These measures may include adding more engaging activities in the mathematics classrooms especially at the elementary level to help the students enjoy the math while learning the concepts. Some of these activities may already take place in private schools in Lebanon as private schools have the resources and some funding to provide the materials needed to the teachers. However, public schools lack both the funding and materials.

Part 2: Arab Countries

All the countries included in this study need some improvement in their education system because all of the countries scored below the TIMSS 2007 scale average. Arab countries cannot really assess their education system by relying on hearsay and subjective opinions, without tangible studies and results. Policy makers need some kind of evidence to base their decisions on. However, empirical studies in the Arab countries are rare. The current study provides some empirical and scientific information about the mathematics education in several Arab countries. Another advantage of this study is it compares the mathematics achievement of Arab countries to each other and looks at strengths and weaknesses that are unique to a country or common to several countries. The results of the analyses in Arab countries are discussed below.

Content and Cognitive Domains

In the content domains, most of the Arab countries had weaknesses in either Data & Chance or Number or both. In 4 out of the 7 countries, students scored the lowest on Data & Chance; in the remaining 3 countries students scored the lowest on Number. In all the countries except Bahrain, students scored highest in either Algebra or Geometry. In Bahrain, students scored the highest in Data & Chance. Accordingly, the present study's findings indicate that most countries need to revise their curriculum in Data & Chance and/or Number, especially Number which is the basis for all the other content areas.

In 5 out of the 7 countries, students scored lower on Knowing than on Reasoning or Applying cognitive domains. The two other countries where Knowing did not have the lowest average were Jordan and Lebanon, the two highest scoring Arab countries. These results suggest that increasing the content knowledge of the students might actually improve the scores of these students. In Bahrain, Egypt, Jordan, and Tunisia, students scored higher in Reasoning than other content domains. Usually, we expect students to score higher in Knowing than in Reasoning, because we expect students to know the content and then use their knowledge to reason. Therefore, maybe with more content knowledge or with more practice on how to apply the knowledge (Jordan), these countries might perform better. In Egypt, Jordan, and Syria teachers reported that 10% of classroom time was spent on material that was not Algebra, Geometry, Number, or Data & Chance (See Figure 3). In Bahrain and Tunisia the percentage of classroom time not spent on TIMSS content was 9% and 7%, respectively (Mullis et al., 2008).

Therefore, one explanation for students scoring higher in Reasoning than Knowing could be the mathematics content that is taught to students in these countries is different than the TIMSS 2007 content; therefore, these students have some reasoning skills but were exposed to a somewhat different content. In addition, these findings contradict the fact that education in Arab countries relies on memorization (AHDR, 2003); otherwise, students would have scored higher in Knowing than in Reasoning.

In terms of how the countries compare to one another, Saudi Arabia had the lowest performance, Lebanon had the highest performance, and Egypt and Syria had a similar performance. Not only did Saudi Arabia have the lowest mathematics average than all countries included in this study, but also the performance of Saudi Arabia was lower than all countries in each content and cognitive domain. Students in Saudi Arabia scored highest in Geometry. However, the performance of Saudi Arabian students in Geometry was lower than any other country's performance in any content domain. If Saudi Arabians want to improve the mathematics education in their schools, they should critically examine their mathematics curriculum and add more rigor to their curriculum. Syria and Egypt's performances in mathematics was pretty similar in all content domains except in Geometry, where Syrian students performed better than Egyptian students. This performance resulted Syria's overall mathematics average being higher than Egypt's overall mathematics average. Actually, the distribution of class time between content domains was almost identical in Syria and Egypt (see Figure 3). Lebanon performed higher than all countries in all content domains except Data &

Chance; therefore, again the importance of including more Data & Chance in the Lebanese curriculum in eighth grade is stressed.

Student Factors

In Saudi Arabia and Tunisia, the between school variance was 18% and 16% respectively. Most of the variation in scores was within the same school rather than between the schools. For Saudi Arabia, the small between school variance can be explained by the fact that the ministry controls all aspects of education in Saudi Arabia (Alshumrani, 2007); therefore, we do not expect to find many differences among schools. It would be interesting to control for gender in Saudi Arabia and then examine how much of the variance is within schools, because the education of females and males in Saudi Arabia are dictated by separate entities (Alshumrani, 2007). In Tunisia, around 95% of the students attend public schools which may explain the lack of variation between schools in Tunisia.

Next, we examined whether students' positive affect toward mathematics, valuing mathematics, and self-confidence in learning mathematics were related to student mathematics outcomes in Arab countries. Students with high positive affect towards mathematics scored, in general, higher than students with low positive affect towards mathematics in all the Arab countries included in the study. Similar to other studies (Fenema & Sherman, 1977; Nicolaidou & Philippou, 2003), positive attitude towards mathematics had a positive relationship with mathematics achievement in all Arab countries. Students who valued mathematics more, on average, scored higher in mathematics in all countries except for students in Bahrain. When valuing mathematics was included with self-confidence and positive affect towards mathematics, the effects of valuing mathematics were confounded by the other two variables, for most countries, and valuing mathematics only had a noteworthy relationship to students' performance in Egypt and in Jordan.

Self-confidence had the strongest relationship with student outcomes in all countries. In previous research, self-confidence had a higher correlation to mathematics achievement than positive attitude or valuing mathematics (Fenema & Sherman, 1977). In this study, too, self-confidence had the highest coefficient and explained more of the within school variance than valuing mathematics and positive affect towards mathematics, in all countries. When positive affect towards mathematics, valuing mathematics, and self-confidence were all included together, the coefficients of positive affect towards mathematics were reduced by at least 10 points in all of the countries and were still noteworthy only for Bahrain, Jordan, and Syria and the coefficients of valuing mathematics were reduced by more than half except in Egypt. However, the coefficients of self-confidence were still noteworthy for all countries. Therefore, increasing students' self-confidence in learning mathematics might help all the countries improve their students' performance.

Overall, students' dispositions towards mathematics had a noteworthy relationship with students' performance in mathematics. The strongest relationship between students' dispositions and mathematics achievement was in Jordan where students dispositions towards mathematics explained about 21% of the within school variance. Jordan also had the highest average score difference between high and low positive affect towards mathematics, valuing mathematics, and self-confidence in learning mathematics. In addition, in Jordan, when all the variables (PATM, VALUE, SELFCONF) were added to the unconditional model, students with high self-confidence in learning mathematics still scored on average more than 100 points higher than students who had low self confidence in learning mathematics. The percentage of within school variance explained by students' attitudes and beliefs was slightly lower than the 25% to 32% that was explained by students' attitudes in previous studies (Lipnevich et al., 2011). A previous study using the same TIMSS data set also found students' attitudes towards mathematics increased the mathematics achievement of students in Jordan (Sabah & Hammouri, 2010). However, the previous study in Jordan used the Rasch scores and not the plausible values that were used in this study; therefore, the amount of contribution of attitudes to mathematics was measured in a different scale not allowing for comparison across the two studies. The plausible values were used in this study to enable comparisons across countries. In the Arab Gulf Countries, students' attitude towards science was related to a better performance in science (Areepattamannil, 2012) which is in line with the findings of the present study.

Teacher Characteristics

The relationship between teacher characteristics (age, gender, certification, degree level, and years of experience) and students' achievement in Arab countries were examined. First, the between and within teacher variance were calculated. Between teacher variance was less than 20% for three countries (Bahrain, Saudi Arabia, and Tunisia) meaning that students' achievement in these countries did not vary much between teachers but rather within a classroom. This is contrary to the finding in the U.S. that the variation occurs mostly between teachers (Rivkin et al., 2005). Less variation between teachers might be because in the Arab countries all students take the same classes and there is no option of taking advanced classes or less advanced classes which are usually taught by different teachers in the U.S. In Arab countries, all students in the same grade level use the same books and follow the same lesson and curriculum.

In Arab countries, male teachers usually get higher salaries than female teachers. However, judging by the results of this study, there was no statistically significant difference between the mathematics achievement of students taught by female teachers compared to the achievement of students taught by male teachers in 5 out of the 7 countries. Furthermore, in the other two countries, namely Bahrain and Lebanon, students taught by female teachers performed on average better than students taught by male teachers. The results in Bahrain may be due to the fact that education is segregated in Bahrain and female students performed better than male students in Bahrain and females are usually taught by female teachers. Therefore, according to the results of this study, at the eighth grade, male teachers should not have a higher salary than female teachers in Egypt, Jordan, Saudi Arabia, Syria, and Tunisia. While in Bahrain and Lebanon female teachers should, perhaps, have higher salaries if salaries are judged by the performance of students.

In most Arab countries, salaries are based on teachers' years of experience and the degree the teacher has obtained (Ayyash-Abdo, 2000). However, neither teacher experience nor teacher degree level was related to students' mathematics achievement in any of the countries in eighth grade. Having a certification also had no effect on students' mathematics achievement in any of the countries in the eighth grade; this seems to be in line with studies in elementary schools (Palardy & Rumberger, 2008) and high school (Goldhaber, 1998; Larson, 2000). Other researchers have also found no relation between years of experience and mathematics achievement in elementary, middle, and high school (Goldhaber, 1998; Palardy & Rumberger, 2008; Winters et al., 2012). However, in studies where teachers were divided as beginners and more experienced, more experience was associated with better achievement (Rivkin et al., 2005). One suggestion is to divide teachers into two categories (beginners and more experienced) only and then to run the analysis instead of using the exact years of experience.

Similar to what Rivkin and her associates (2005) suggested, most of the teacher characteristics were not meaningful in predicting students' mathematics performance in 8th grade. Maybe we should be looking at teacher practices instead. Actually Palardy and Rumberger (2008) suggested teachers' instructional practices might be better in predicting students' performance than teacher chracteristics.

Limitations

One limitation is that TIMSS' 2007 content might not exactly match the content areas or objectives of the eighth grade curriculum in each of the countries, and therefore, TIMSS results might not explicitly portray the level of mathematics education in each country. However, TIMSS' results allowed comparison of achievement across countries in specific content areas. Even though using the TIMSS data set does limit the study to content that is tested by TIMSS, for some countries TIMSS is the only data available about students' mathematics achievement.

Another limitation is for some countries the study had to rely on teachers' answers to the TIMSS questionnaires to identify what content is taught in the classrooms and how classroom time was divided between contents because an explicit curriculum for eighth grade mathematics could not be located. Teachers' reporting might not be very reliable and might differ even within between teachers within the same school teaching the same class. However, the teachers' answers did provide some insight to what is being taught in each country.

Recommendations for Arab Countries

Because all the countries had weaknesses in Data & Chance or Number, Arab countries need to revise their curriculum paying special attention to these content areas. Arab countries could perhaps examine the curricula in high achieving countries and identify where discrepancies exist then decide whether including some of the material might benefit their students.

Self-confidence was related to mathematics achievement in all of the countries. Perhaps methods of increasing students' self-confidence in learning mathematics should be sought. Several studies have showed that allowing students to discover the material on their own through discovery, inquiry, or project based learning develops more confidence in their mathematics ability. These teaching methods could replace the traditional lecture style in Arab countries.

One last recommendation would be for these countries to participate at the 4th grade level, which will allow for more insights and earlier discoveries of problem areas. In addition, these countries can also participate at the 12th grade level to assess the mathematical knowledge of their students when these students finish high school and compare this knowledge to other countries.

Suggestions for Future Research

As Lebanon was one of the worst performing Arab countries in science in TIMSS 20007, it would be interesting to examine the factors affecting Lebanon's performance in science and come up with recommendations to improve science education in Lebanon as well. Another option would be to use results from national tests to complement this study. Also, national tests could be used as a means of assessing specific content like Data & Chance, or Reasoning.

All of the countries in this study also participated in TIMSS 2011. With all 7 countries participating in 2003, 2007, and 2011, an examination of trends in each country is now possible. Examining the trends can help identify whether the same strengths and weaknesses were maintained throughout the years.

Let us see what the 2011 TIMSS scores will reveal!

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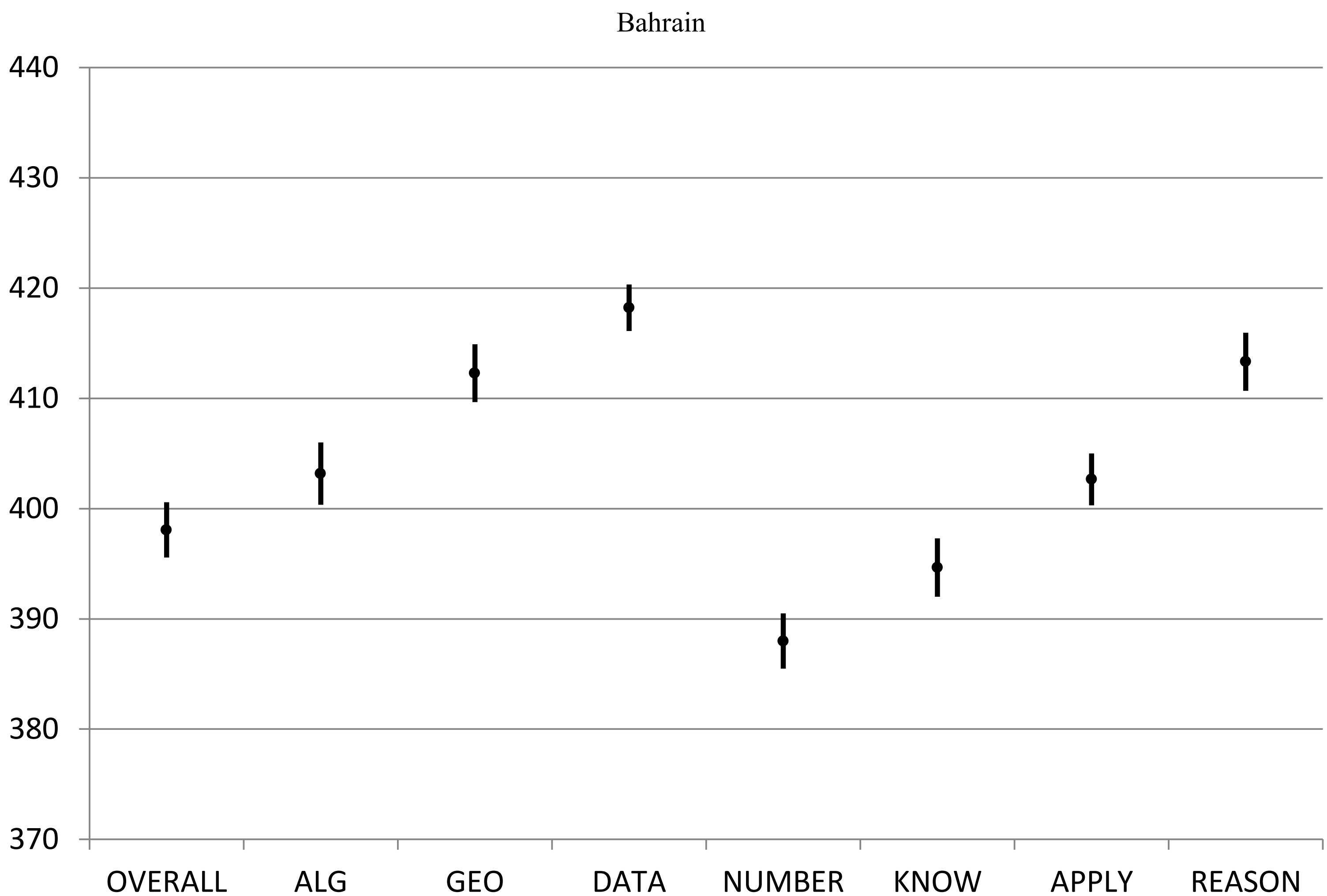
APPENDIX A



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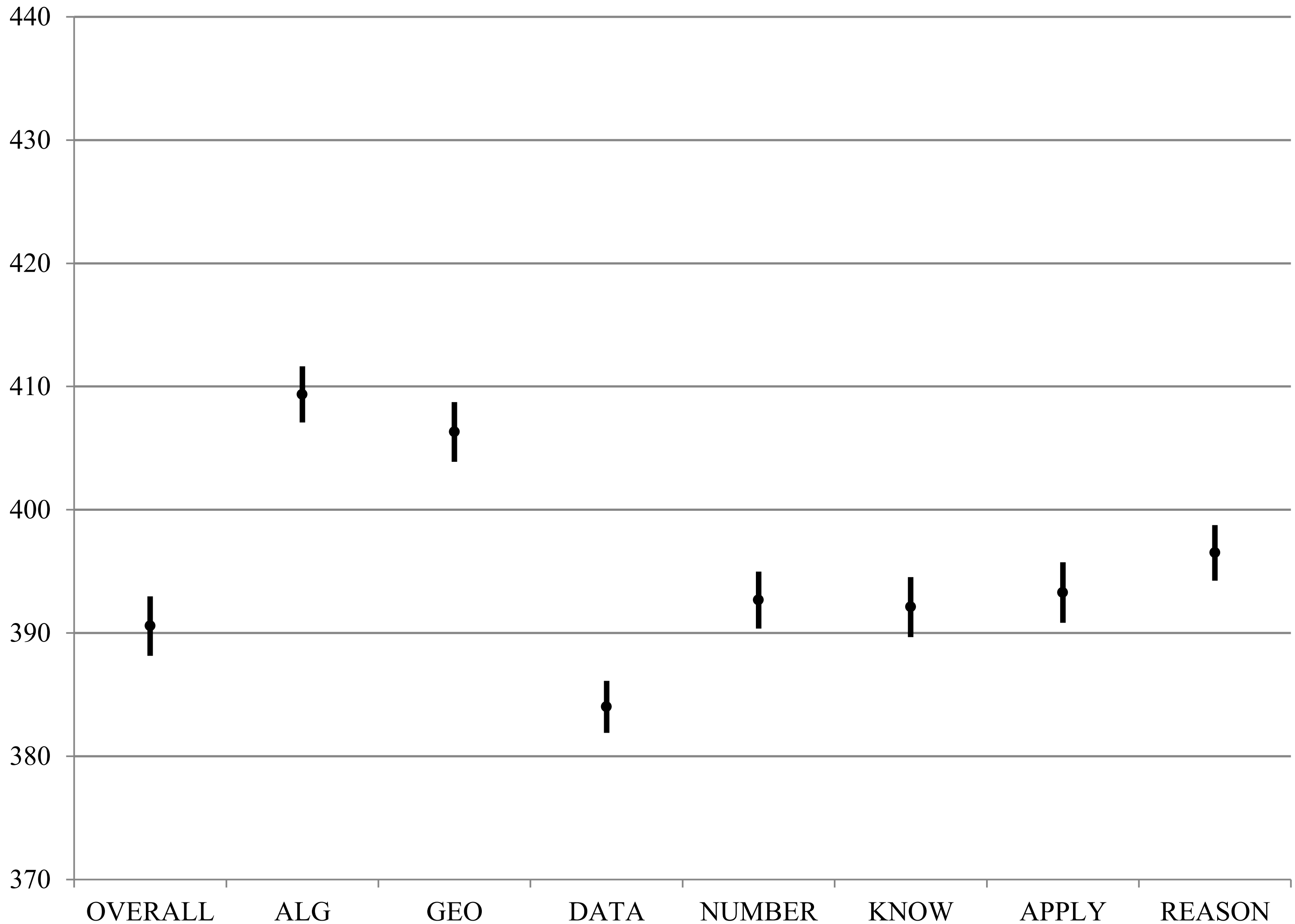
Egypt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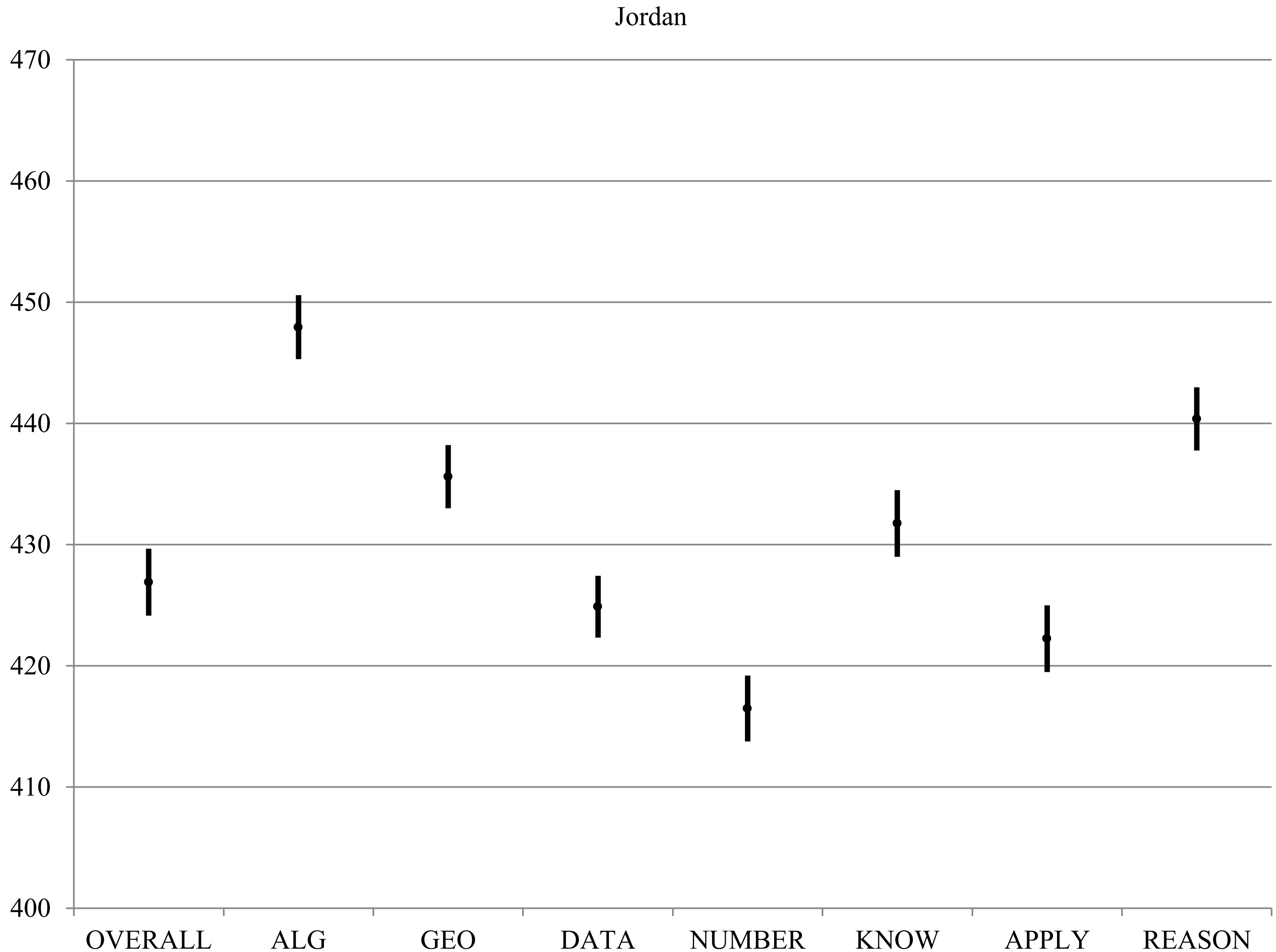
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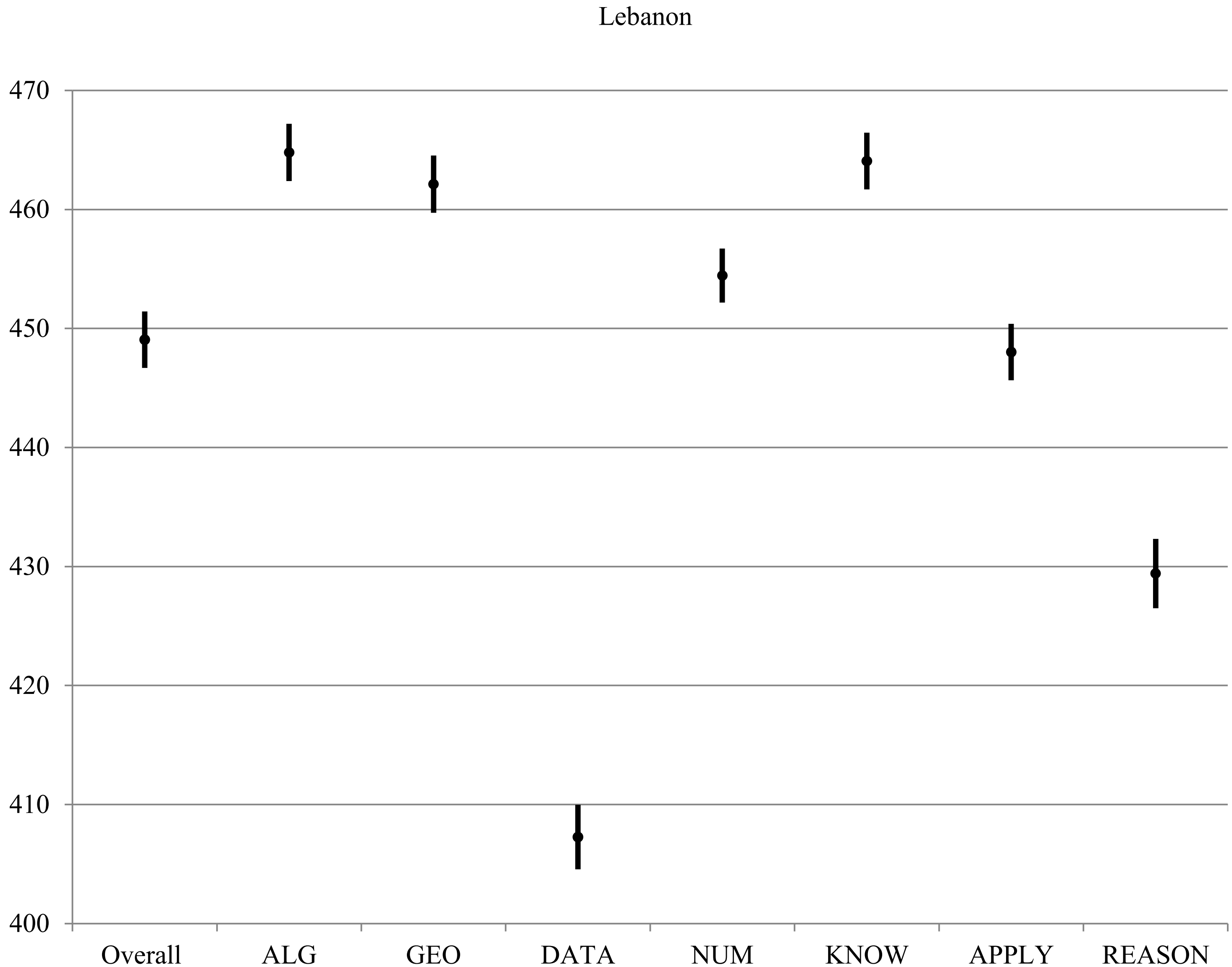
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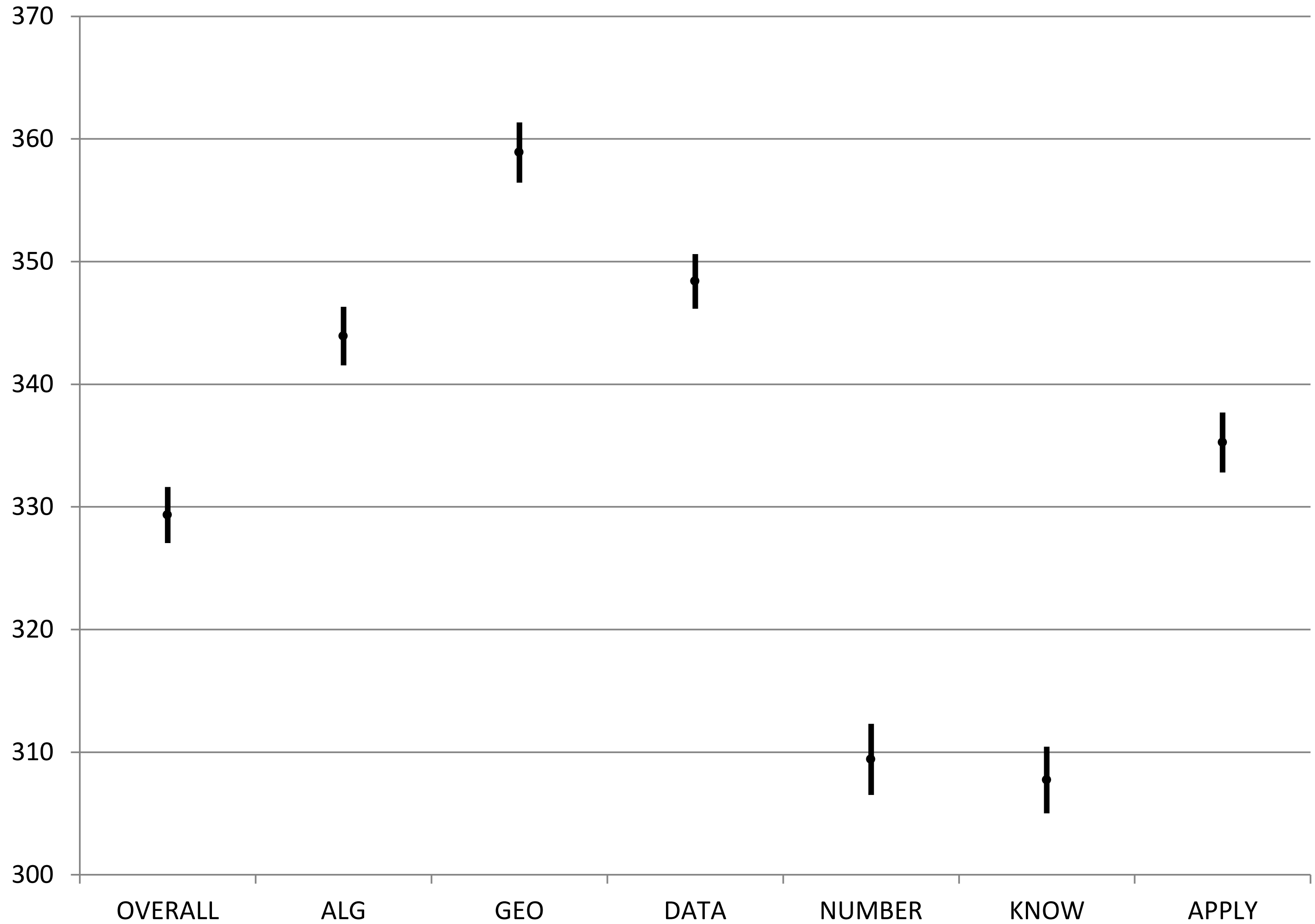

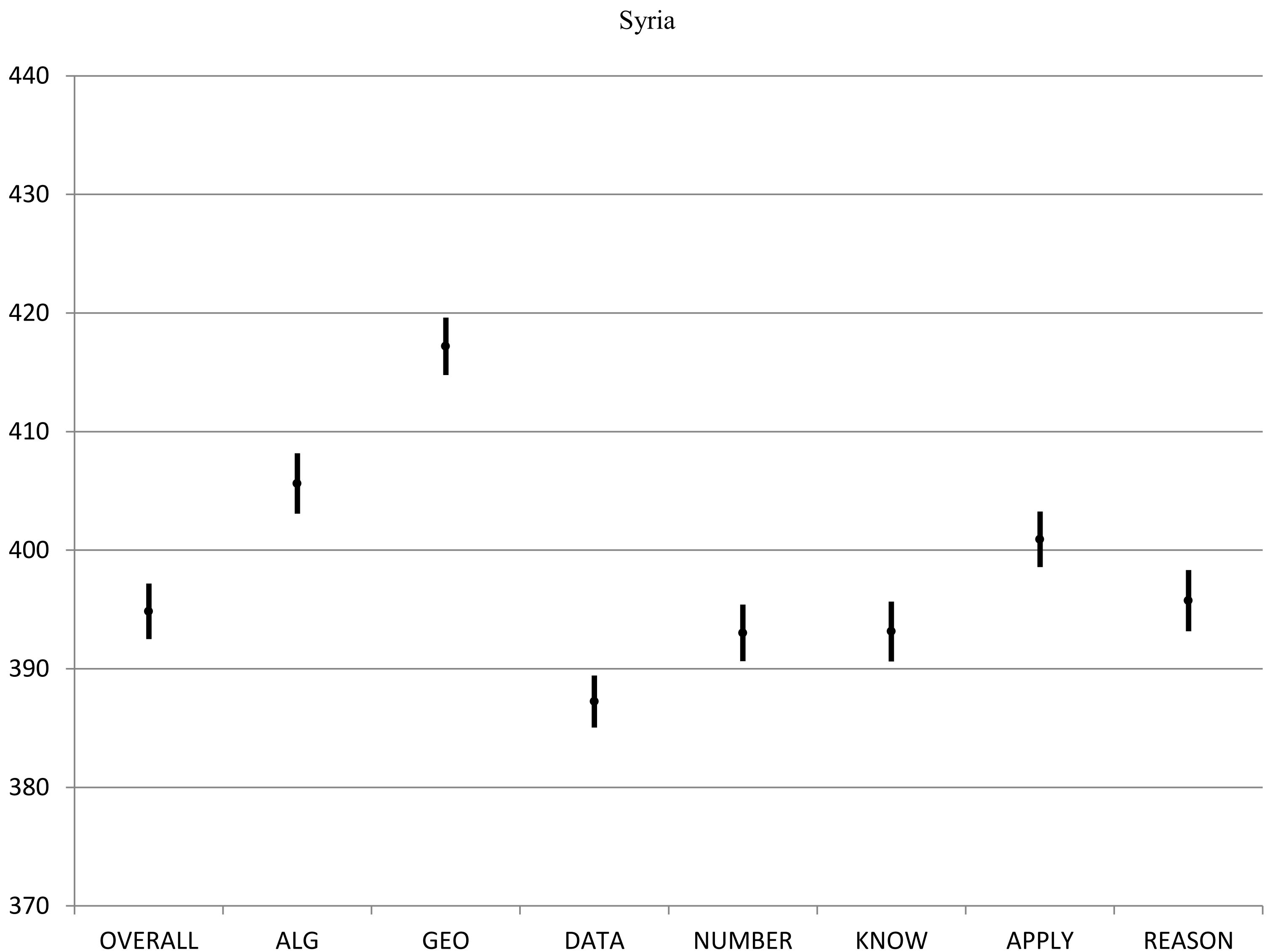
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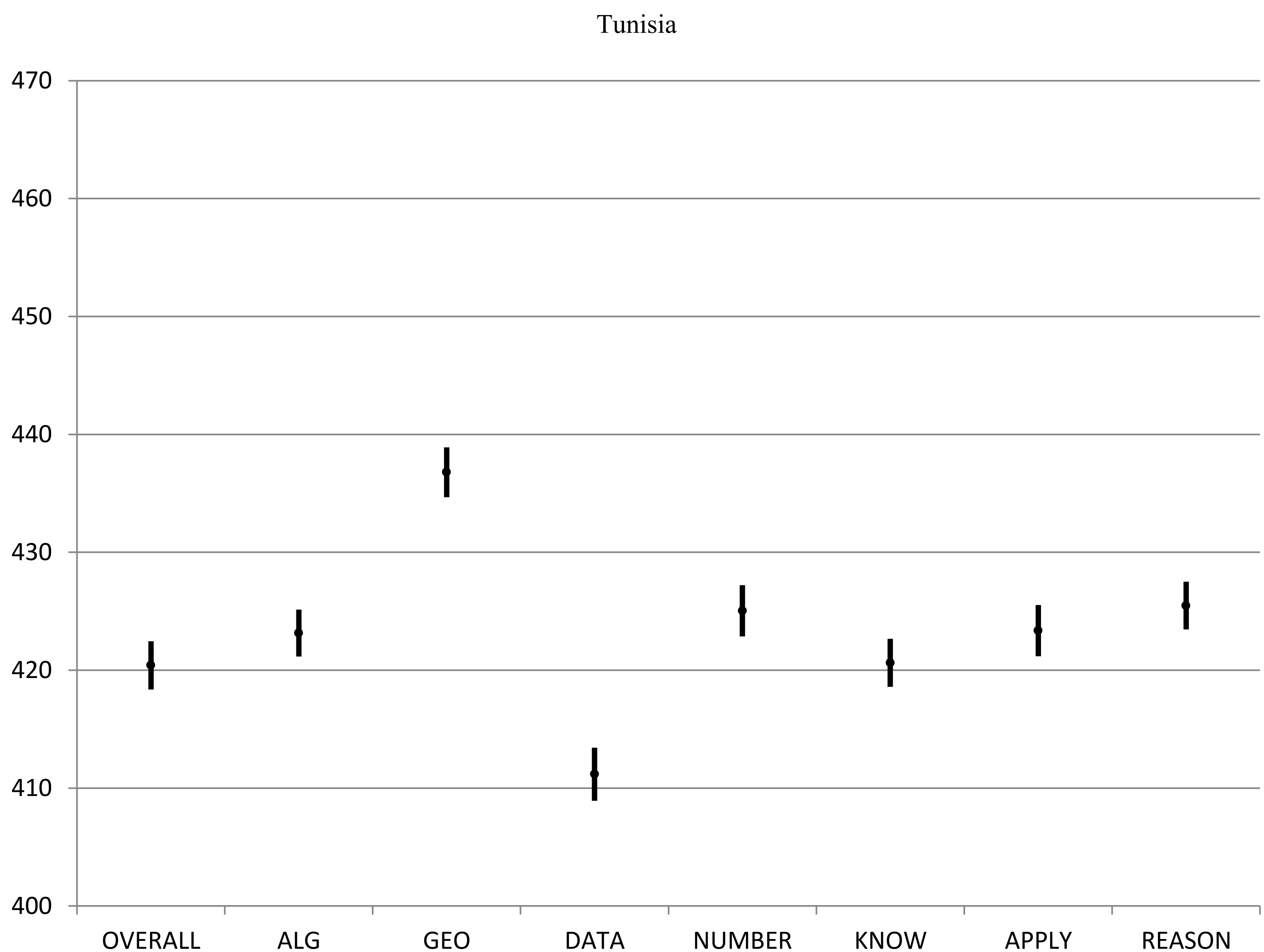
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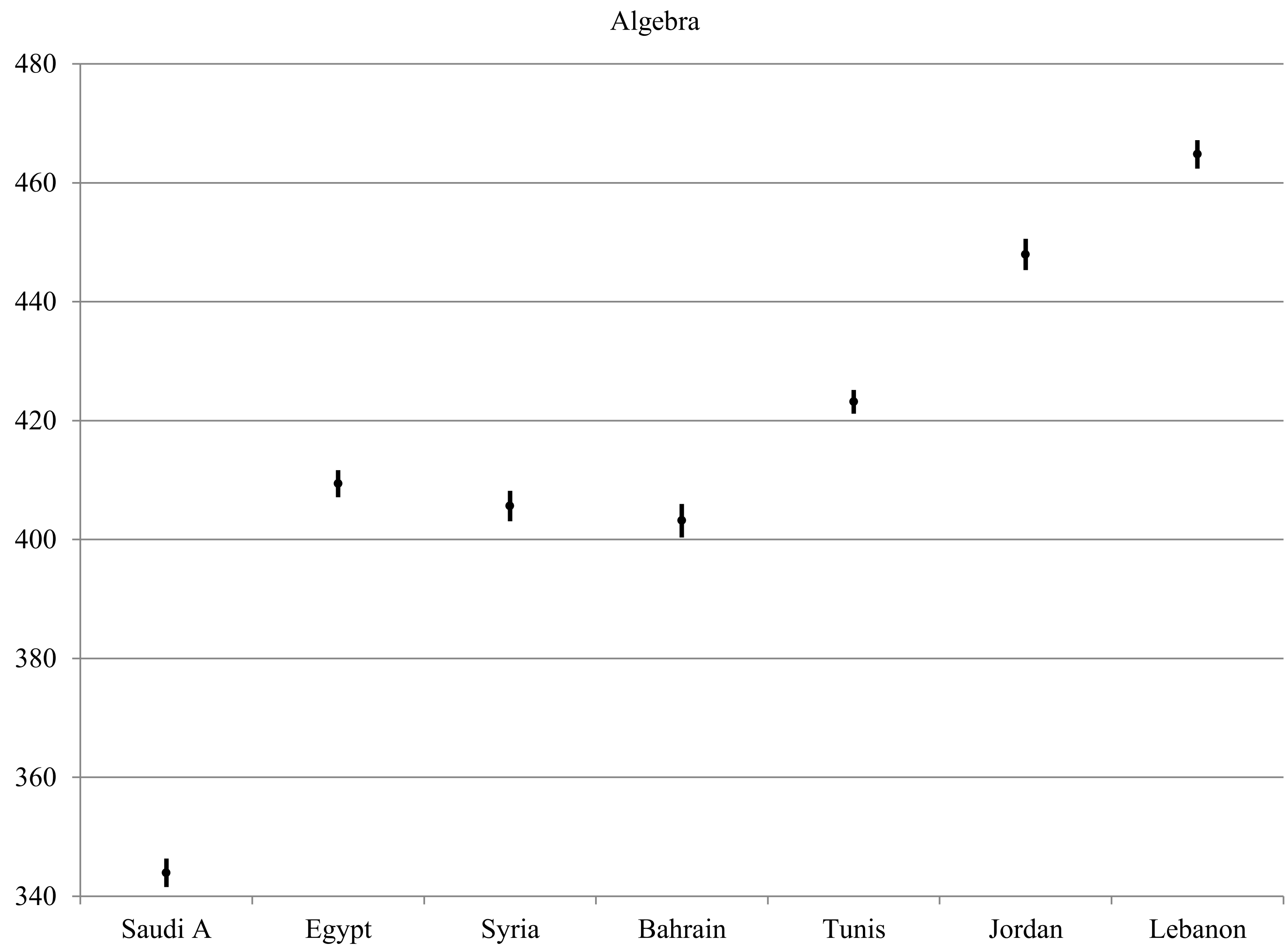
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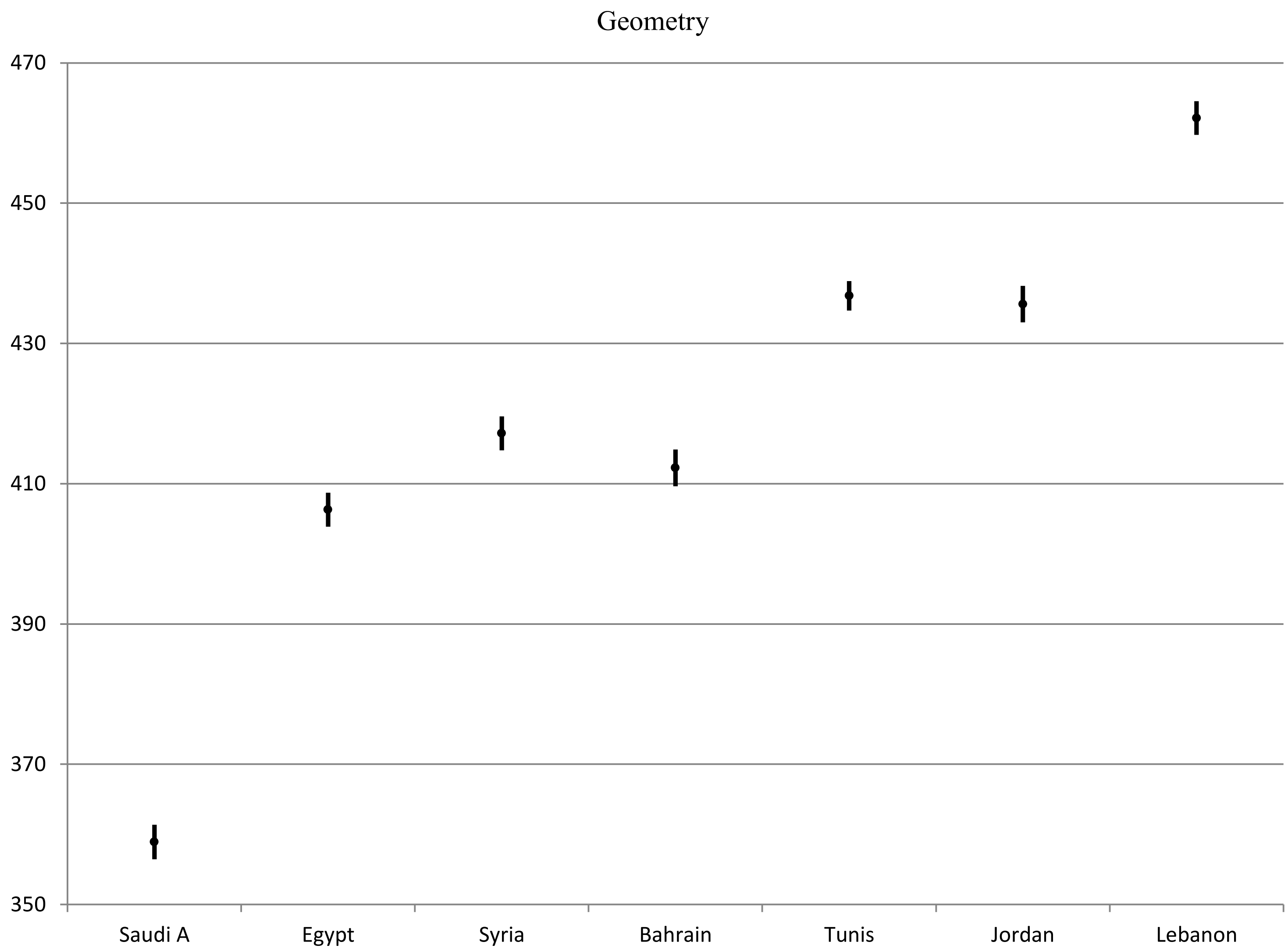
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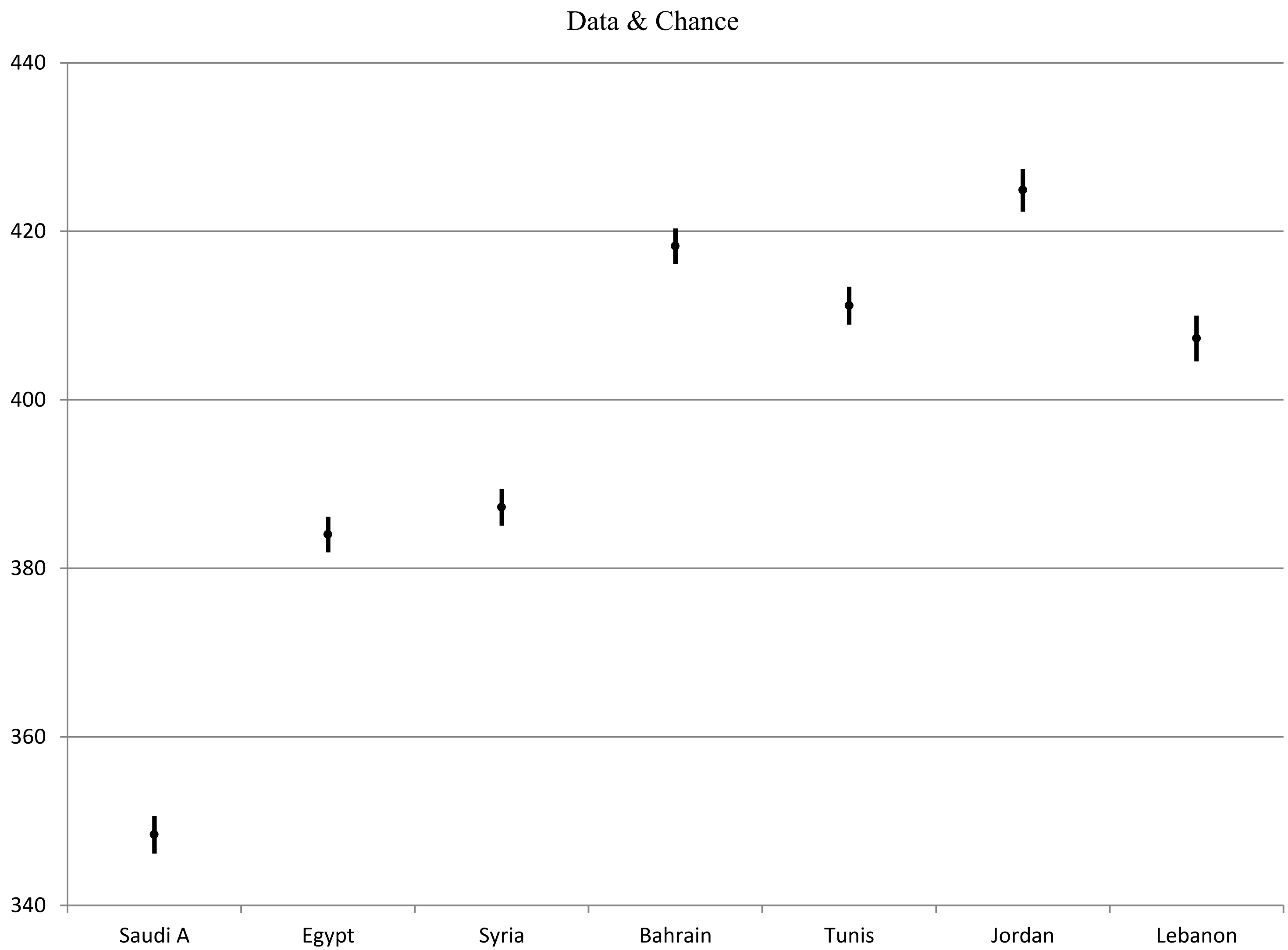
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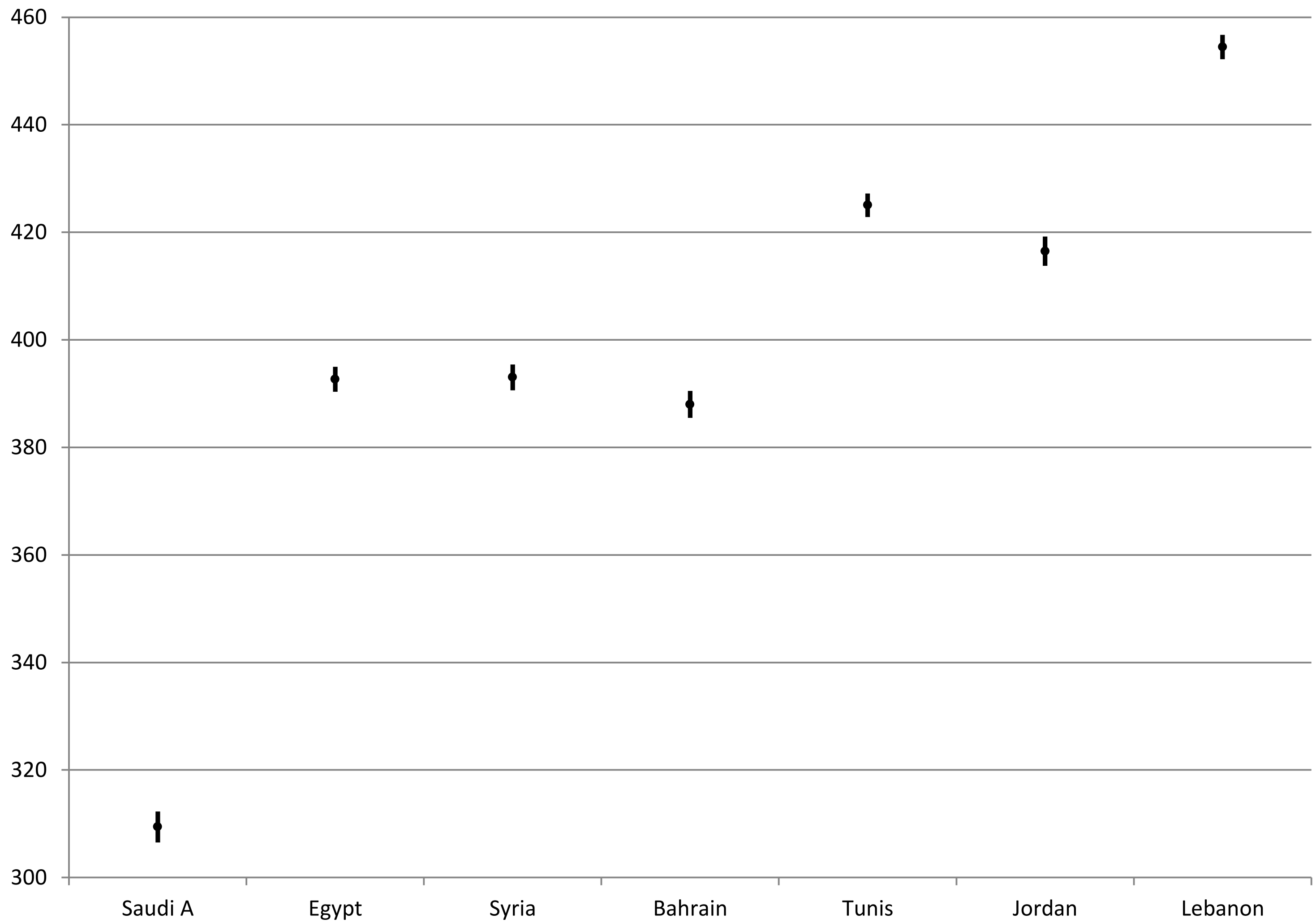
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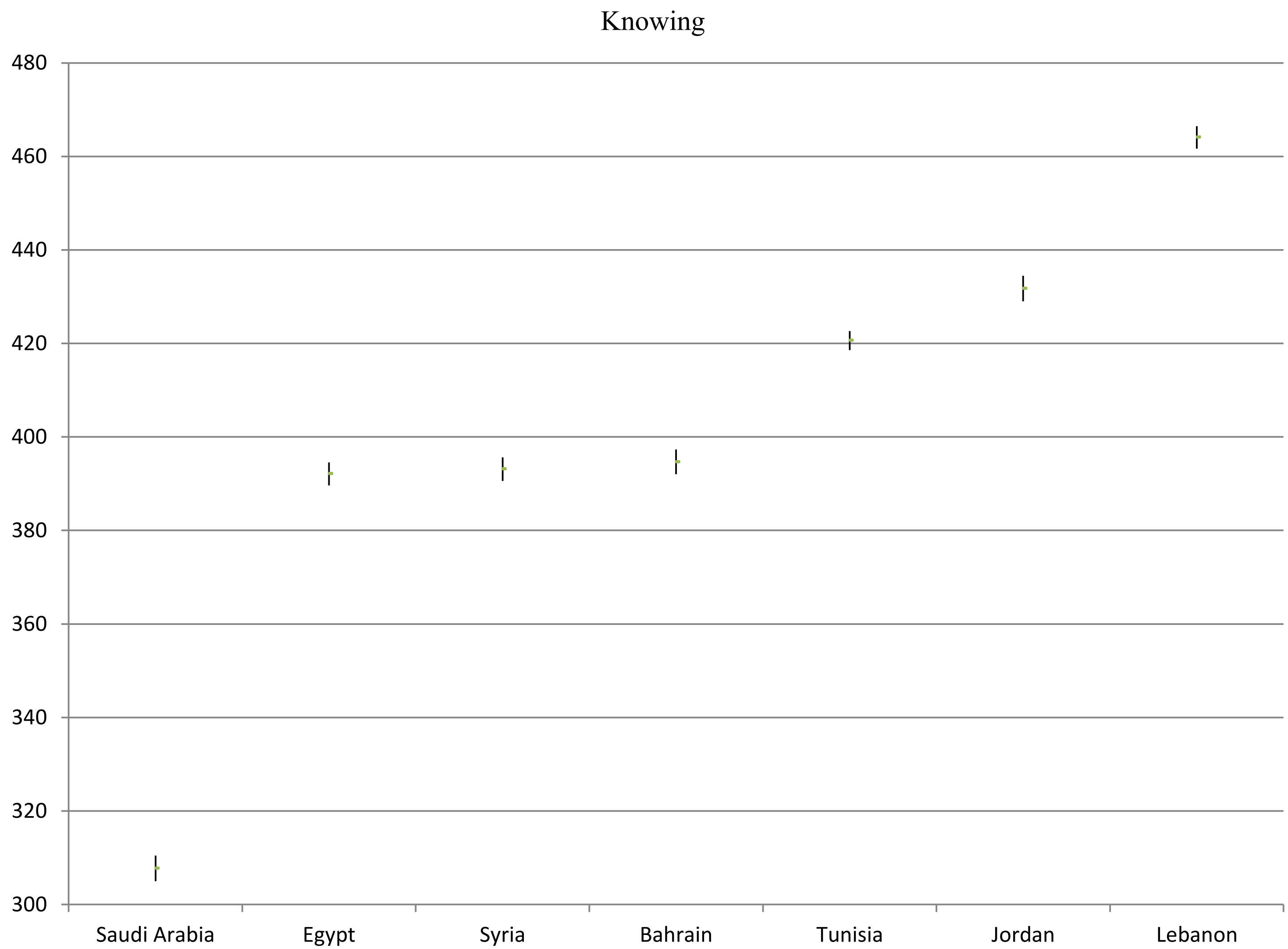
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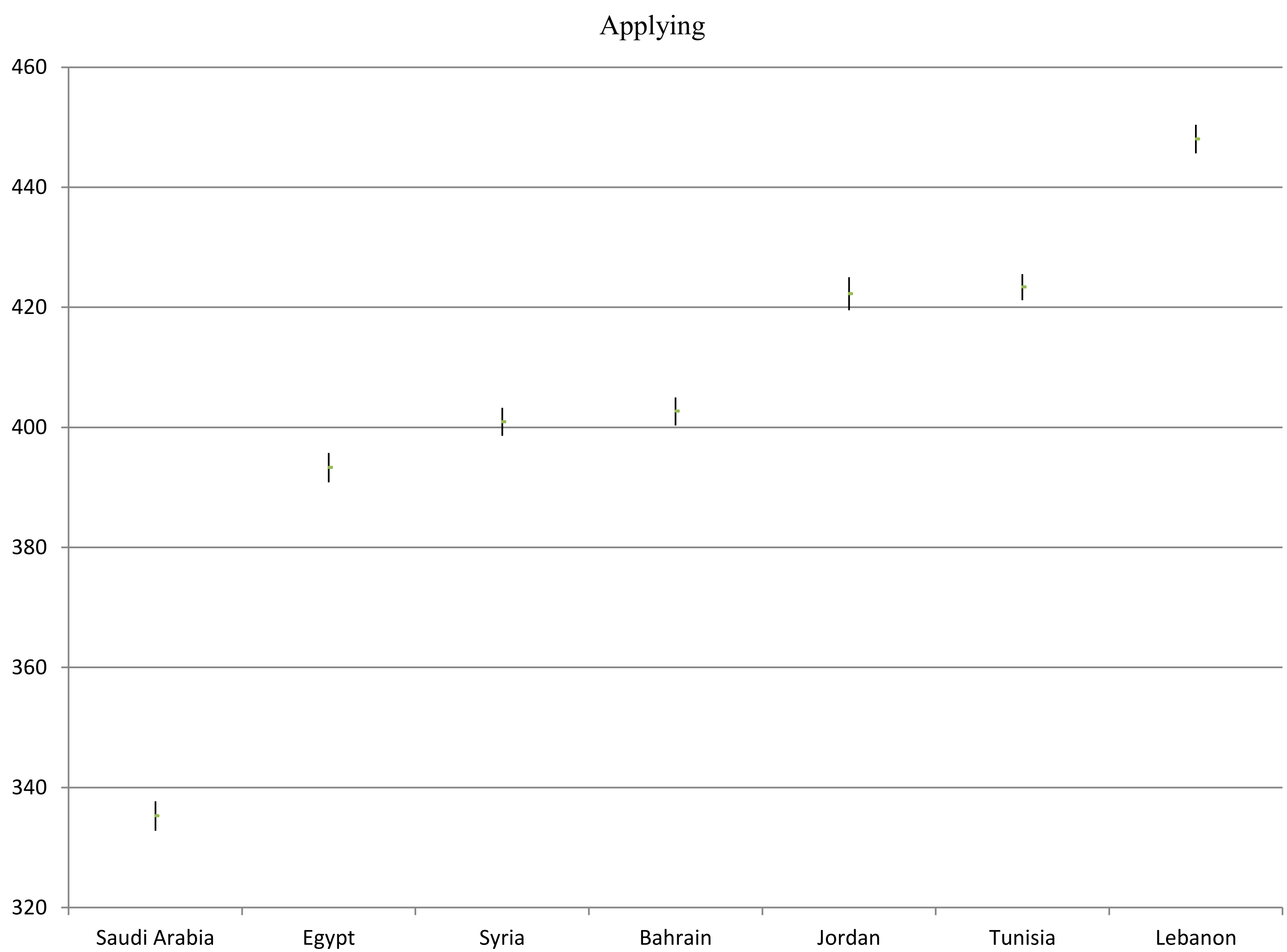
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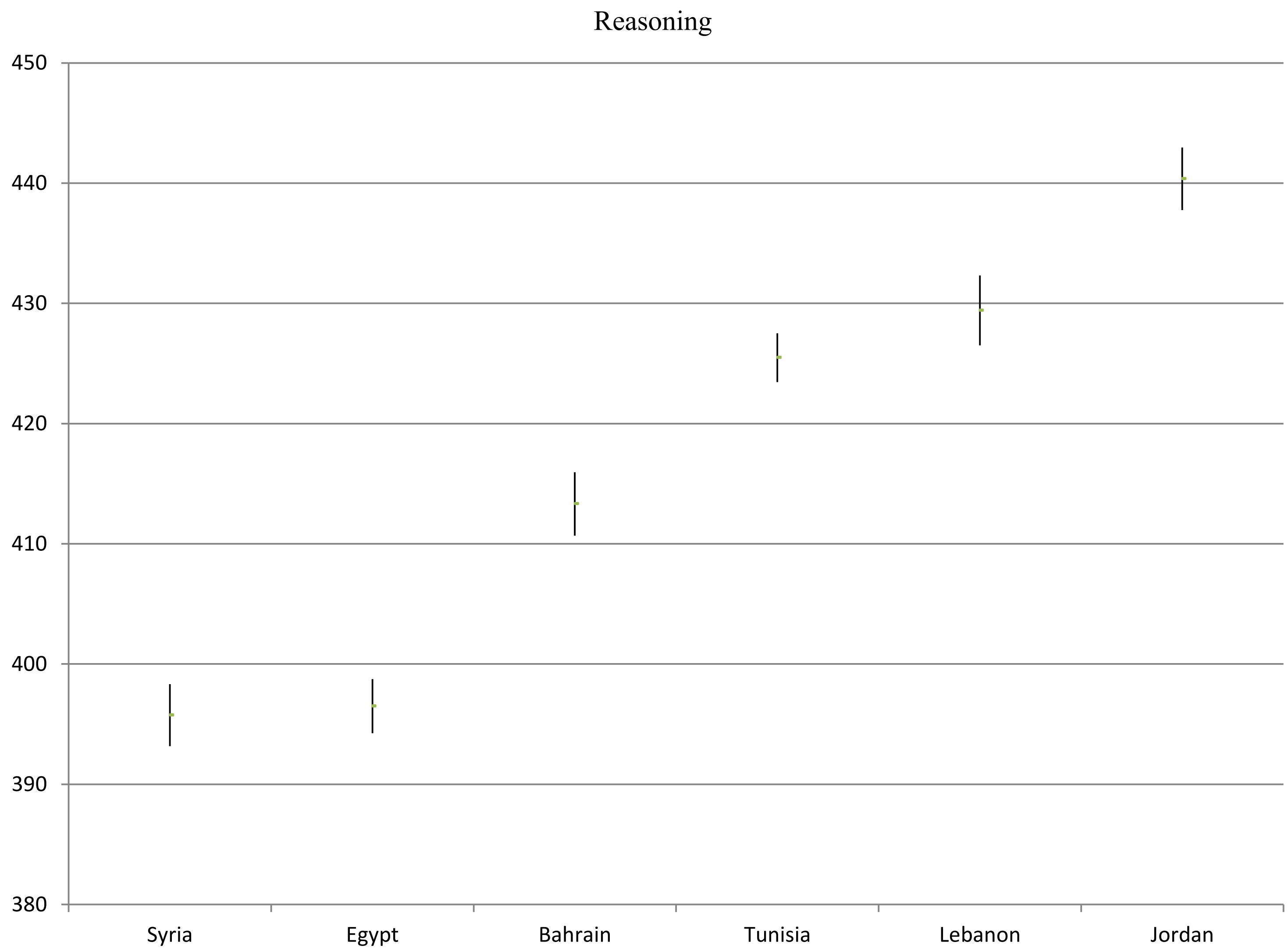
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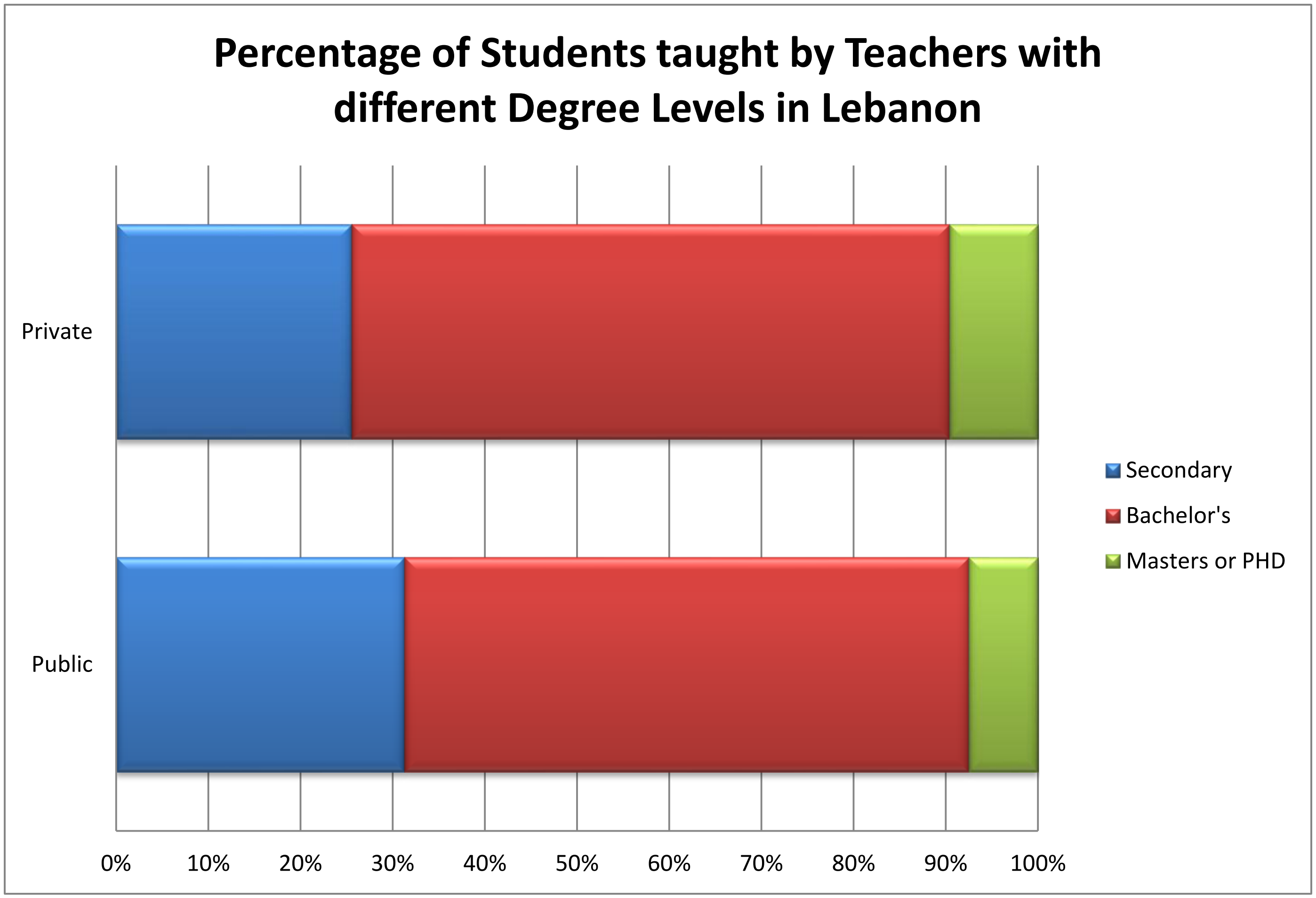
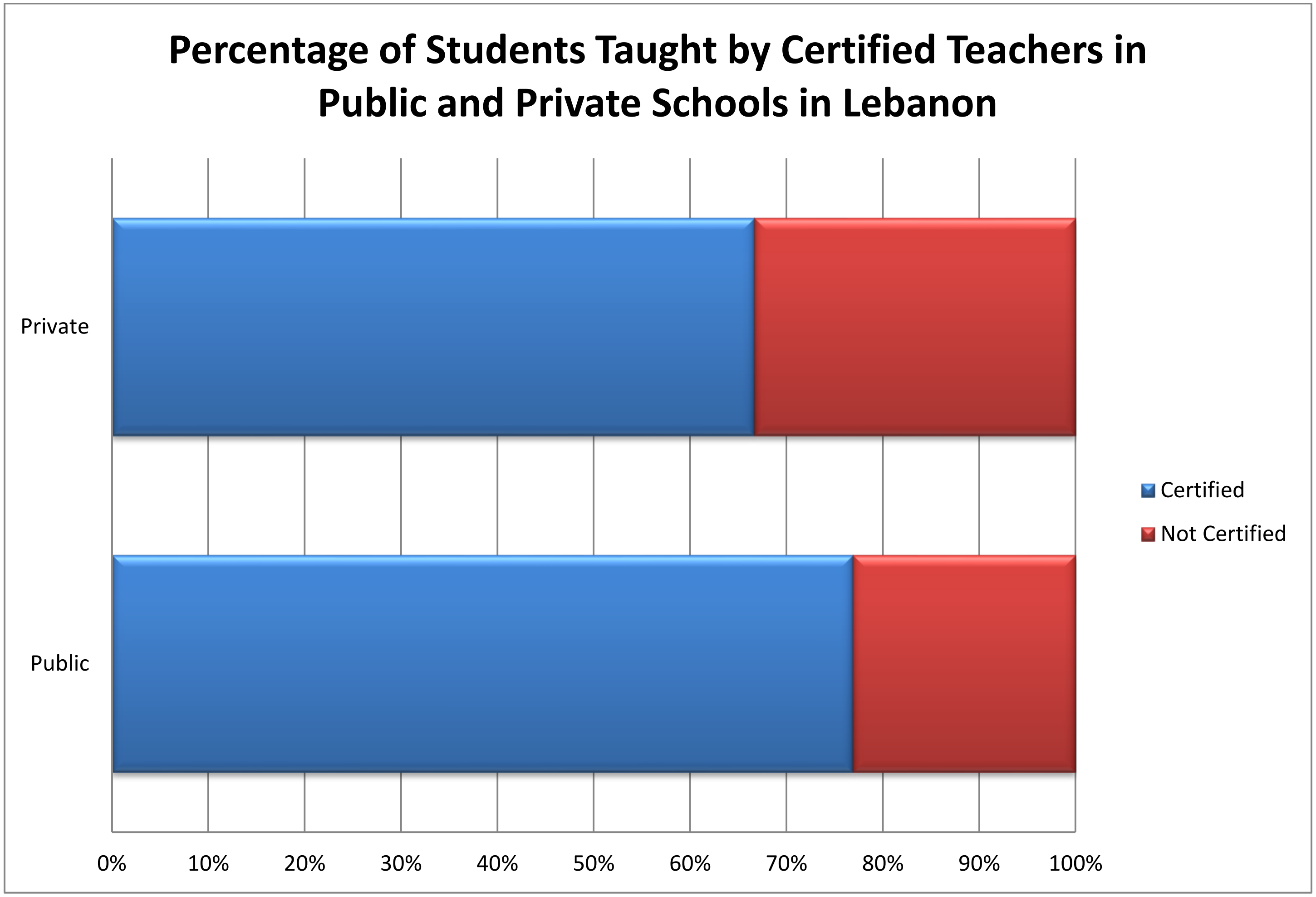
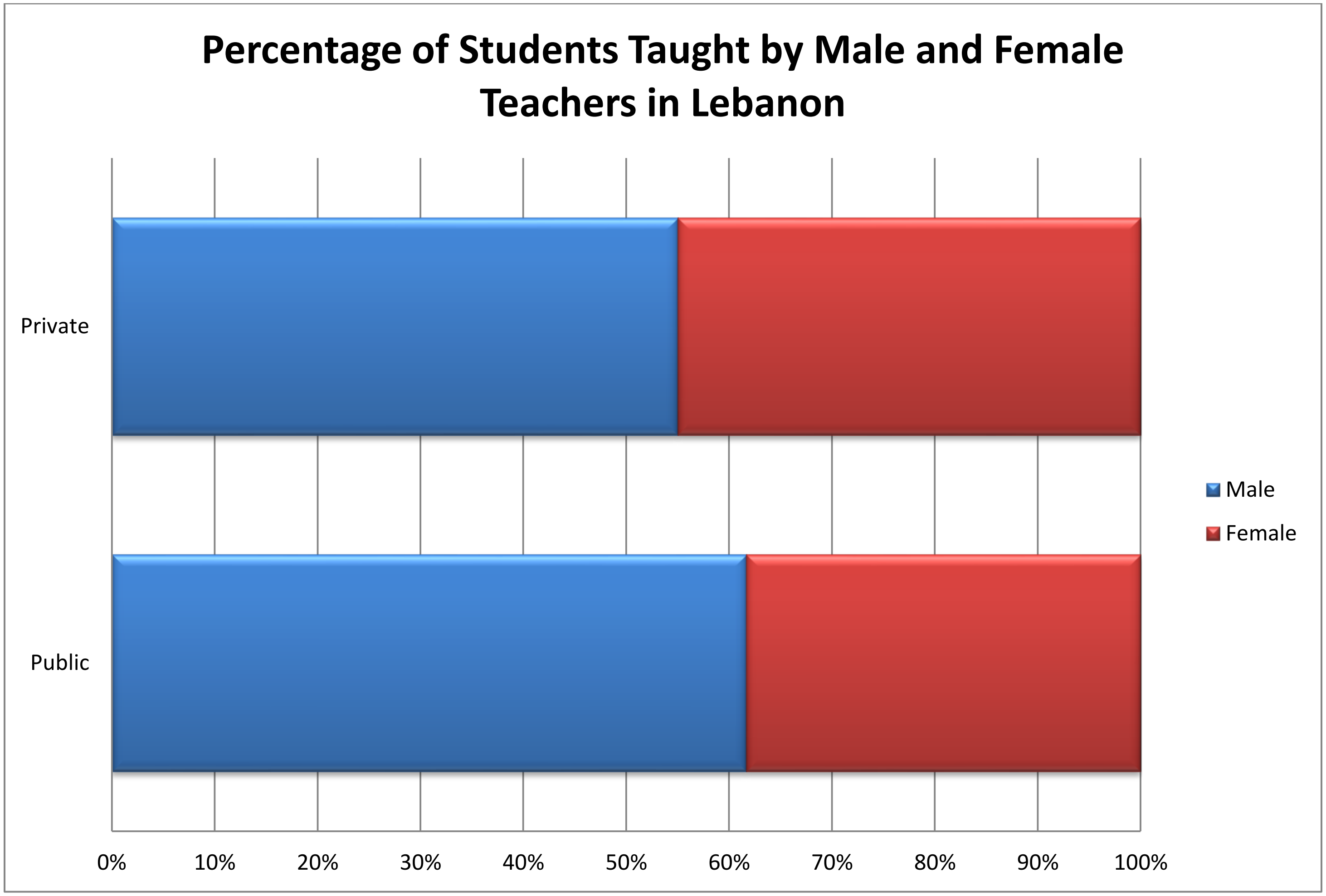
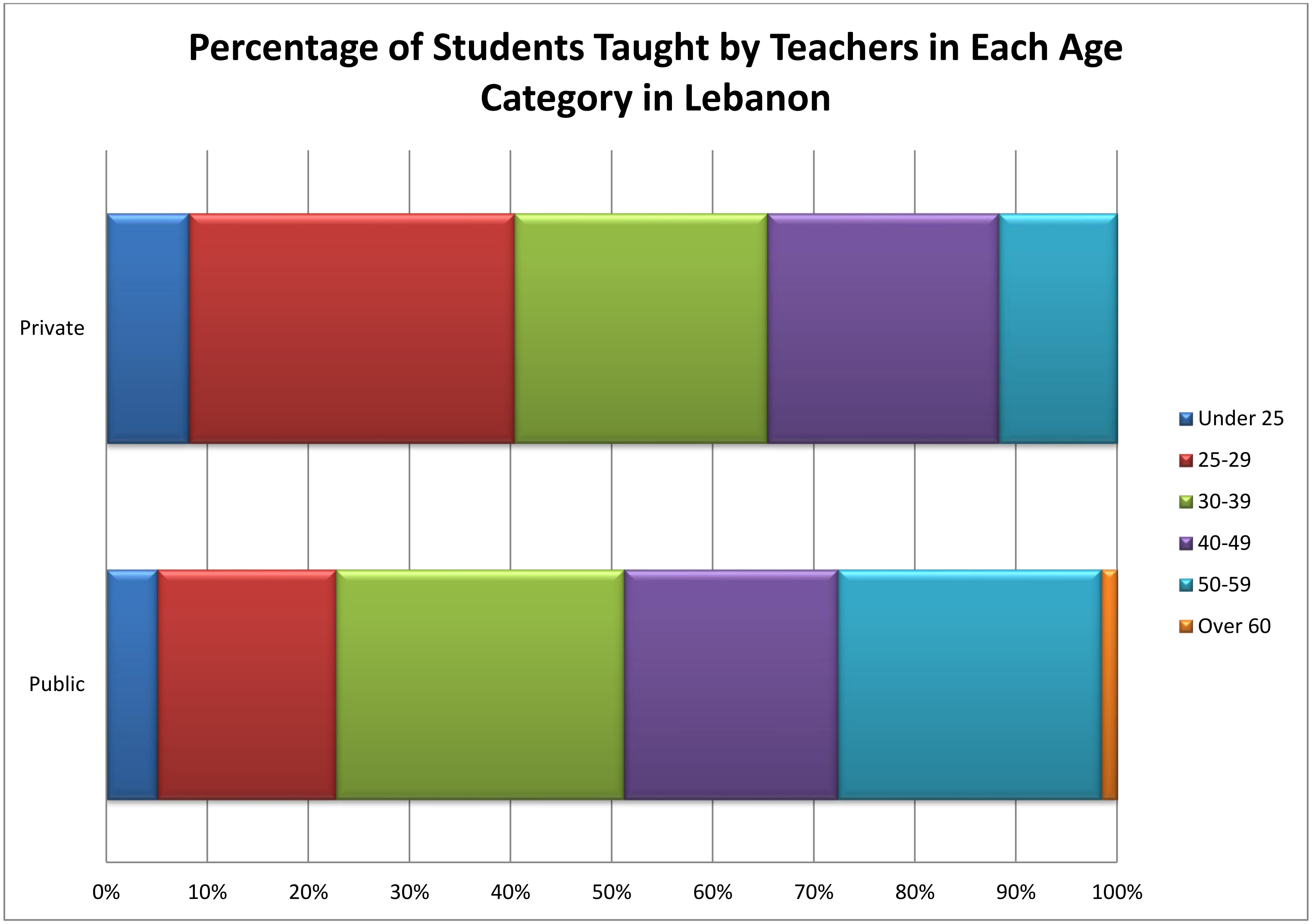
APPENDIX B


Percentage of Students taught by Teachers with different Degree Levels in Lebanon
Private
Public
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Secondary
Bachelor's
Masters or PHD


Percentage of Students Taught by Certified Teachers in Public and Private Schools in Lebanon
Private
Public
Certified
Not Certified
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


Percentage of Students Taught by Male and Female Teachers in Lebanon
Private
Public
Male
Female
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


Percentage of Students Taught by Teachers in Each Age Category in Lebanon
Private
Public
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Under 25
25-29
30-39
40-49
50-59
Over 60