MATHEMATICS LEARNING STRATEGY AND MATHEMATICS ACHIVEMENT AMONG MIDDLE SCHOOL STUDENTS IN THE NORTH OF JORDAN

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Abstrak

Kajian *Trends in International Mathematics and Science Study* (TIMSS) pada tahun 1999, 2003, 2007 dan 2011 menunjukkan pelajar gred 8 dari Jordan memperoleh pencapaian yang rendah dalam matematik. Hal ini adalah berkaitan dengan banyak faktor termasuk faktor Strategi Pembelajaran Matematik (MLS). Sehingga kini tidak banyak kajian yang dijalankan berkaitan dengan MLS dan pencapaian matematik dalam kalangan gred 8 dari Jordan. Kajian ini bertujuan untuk mengenal pasti perbezaan jantina berdasarkan nombor, algebra, geometri, pencapaian matematik dan visualisasi ruang, dan sejauhmana faktor MLS pelajar iaitu sikap, motivasi, regulasi kendiri, konsep kendiri dan kebimbangan matematik menyumbang kepada pencapaian matematik. Kajian ini juga menentukan sama ada visualisasi ruang menjadi perantara antara MLS dan pencapaian matematik. Responden kajian ini, yang terdiri daripada 360 pelajar gred 8 lapan sekolah menengah harian daerah Alkoura di Utara Jordan, dipilih secara pensampelan rawak berstrata. Kajian ini menggunakan 65 item untuk mengakses MLS. Ujian matematik mengandungi 30 item manakala ujian visualisasi ruang mengandungi 32 item. Dapatan kajian menunjukkan pelajar perempuan memperoleh skor yang lebih tinggi dalam nombor, algebra dan ujian matematik tetapi tidak terdapat perbezaan jantina dalam skor geometri. Pelajar lelaki menunjukkan pencapaian yang lebih baik berbanding dengan pelajar perempuan dalam visualisasi ruang. Keputusan kajian juga menunjukkan bahawa sikap matematik, motivasi, regulasi kendiri dan keberkesanan kendiri menyumbang kepada pencapaian matematik kecuali kebimbangan matematik. Visualisasi ruang menjadi perantara pencapaian matematik dengan sikap, motivasi dan kebimbangan matematik. Kajian ini menyumbang kepada pengetahuan dan teori kognitif sosial berkaitan dengan domain afektif pelajar berdasarkan faktor MLS dan visualisasi ruang yang penting sebagai pengetahuan asas bagi pembelajaran matematik. Pendidik matematik di Jordan perlu mengambil kira faktor MLS apabila mengajar matematik kepada pelajar gred 8 bagi membantu meningkatkan pencapaian matematik mereka.

Kata kunci: Nombor, Algebra, Geometri, visualisasi *spatial*, Strategi Pembelajaran Matematik.

Abstract

The results of 1999, 2003, 2007 and 2011 Trends in International Mathematics and Science Study (TIMSS) showed that Jordanian 8th grade students' achievement in mathematics is low. Mathematics Learning Strategy (MLS) has been identified as one of the attributing factors. To date, there is little study on MLS and mathematics achievement among Jordanian 8th grade students. The study aimed to identify the level of differences between genders based on number, algebra, geometry, mathematics achievement and spatial visualization, and to what extent would the student's MLS factors such as attitude, motivation, self-regulation, self-efficacy and mathematics anxiety contribute to mathematics achievement. Additionally, the study aimed to determine whether spatial visualization mediates between the MLS factors and mathematics achievement. The respondents in this study, who comprised of 360 students, were selected through stratified random sampling, from eight public middle schools in Alkoura District in the North of Jordan. The study used 65 items to assess the MLS. The mathematics test contains 30 items (number, algebra & geometry) while the spatial visualization test contains 32 items. The findings showed that female students scored higher than male students in numbers, algebra, and mathematics test but there are no gender differences in geometry scores. Male students performed better than their female counterparts in spatial visualization. The results also showed that mathematics attitude, motivation, self-regulation and self-efficacy contributed to mathematics achievement except mathematics anxiety. Spatial visualization plays a mediating effect between mathematics achievement and attitude, motivation, and mathematics anxiety. This study contributes to knowledge and social cognitive theory about the students' affective domain base on MLS factors and spatial visualization which is important as prerequisite knowledge for learning mathematics. Mathematics educators in Jordan need to consider the MLS factors when teaching mathematics to 8th grade students to help improve their mathematics achievement.

Keywords: Numbers, Algebra, Geometry, Spatial visualization, Mathematics Learning Strategy.

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List of Abbreviations

MoE	Ministry of Education
NCTM	National Council of Teacher of Mathematics
TIMSS	Trends in International Mathematics and Science Study
UNRWA	United Nation Relief and Work Agency
CTT	Classical Test Theory
SPSS	Statistical Package for the Social Sciences

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

The educational system is primarily viewed as a significant factor forming the basis of an individual's development and progress, which forms the core of countries' development. As such, more and more focus is being emphasized on the educational systems promotion on a global scale. In the context of Jordan, the government has made considerable efforts in developing its educational system. Such system has experienced tremendous development and increasing progress that date back to the 1920s (Al-Jaraideh, 2009). In addition, Jordan undertook the responsibility of the development of an extensive and high-quality system for its citizens' development. As a result, citizens residing in poor and remote areas have had access to schools and education (Al-Jaraideh, 2009). The country's position in favoring basic education over higher education has improved the literacy levels and facilitated the achievement of higher degrees of enrollment. Primary education in Jordan, while freely provided, is not compulsory and it comprises of ten classes from first to tenth class.

Study curricula all over the world, including Jordan, have witnessed a radical change – changes in curricula and courses of all education levels. Specifically, in the last two decades, mathematics curriculum has undergone a lot of development on both the international and local level. On the international arena, more developed countries have begun a comprehensive review of the mathematical teaching program to develop and make them up-to-date to keep abreast of the needs of the 21st century.

These developments are evident in the mathematical curricula and the way they are taught on a local level.

Owing to the significance of mathematics in the knowledge economy, Jordan's Ministry of Education (MoE) has concentrated on improving students' knowledge, skills and achievement in mathematics (Sabah & Hammouri, 2010). Just recently, an interest has sparked in a method of learning and teaching mathematics that assists students in realizing the process of learning mathematics. This interest is evident throughout the approach to teaching the subject. Prior to the said development, the teachers aimed to teach information solely to enable students to solve mathematical problems. On the other hand, in the current times, teaching is centered on the development of students' capability of tackling mathematical problems through questions whose solutions lie in the use of specific data and mathematical diagrams to bring about the organization, analysis and delivery of mathematical ideas, to develop the right surrounding that encourages thinking, and to help students recall prior experience and incorporate them in learning skills. These learning skills assist them in reasoning, perceiving and connecting the links between the problem elements and their past experience while solving mathematical problems.

The importance of mathematics has been hailed by many studies in literature. According to Drew (1996), mathematics is the most important factor that relates to an individual's success. He proceeded to describe mathematics as a subject that is required for entry into many professions and it is important for existing as well as emerging occupations in a global economy that is based on information and technology (Drew, 1996). Saffer (1999) also stated that mathematics is not just useful in the day to day skills such as managing money but also in the most popular occupations and countless of jobs that call for some mathematical skill or another. In addition, mathematical concepts like normal distribution and exponential growth are typical terms used in various fields such as business and social sciences etc. (Tobias, 1990). This is the reason why mathematics is hailed at a higher rate compared to other subjects and it has been called as the queen of all sciences and servant to all disciplines (Ajayi, Lawani, & Adeyanju, 2013). The National Council of Teachers of Mathematics (NCTM, 2000) categorized the curriculum of mathematics into two based on criteria; content criteria and process criteria. The present study concentrates on the process criteria of spatial visualization. This stresses on the importance of students to have their basic understanding of mathematics and its principles applications to their day to day lives and work.

A student's proficiency in mathematics in schools is reflective of the related other variables or a combination of variables comprising academic and non-academic variables including individual characteristics, mathematics attitude , motivation, self-concept, self-confidence, self-regulation, equipment and instructional materials for effectively teaching the subject (Ma & Xu, 2004; Tella, 2007).

Prior studies in literature are of the contention that mathematics achievement can be known by exploring the student's characteristics. This is compounded by other studies (Abakpa & Agbo-Egwu, 2008; Else-Quest, Hyde & Linn, 2010; Ifamuywa & Ajilogba, 2012) who claimed that the significant aspect of school education is revealed through its effect upon student's variables including gender. Also, there are some differences with regard to mathematics achievement based on demographic characteristics like gender with the former being most visible as male students outperform female students in mathematics ability (Wai, Cacchio, Putallaz, & Makel, 2010). There has also been a report confirming the differences between male and female in light of their level of achievement in mathematics. In a related study, Megdadi and Al-Kateeb (2006) examined the gender differences in mathematics achievement in the context of Jordanian school students and they revealed that females are better performers than their male counterparts. Meanwhile, Paterson et al., (2003) stated that males obtain higher mean scores on mathematics in light of content and attitude. Also, Arslan, Carli and Sabo (2012) revealed significant difference between the two genders in mathematics achievement. It is however unfortunate that a gap exists in literature concerning this field of research, especially the examination of demographic variables related to student's achievement in mathematics at school level (Gupta, 2011; Khatoon & Mahmood, 2010).

Studies dedicated to the educational field imply that student attitudes toward a subject influence academic success (Popham, 2005; Royster, Harris, & Schoeps, 1999). Additionally, attitude is among the variables that are gaining more focus from scholars as well as educators. In other words, students' attitudes toward the subject of mathematics in terms of the subject itself and in learning the subject, along with their implications for mathematics instructions have long been examined by the mathematics education community. More importantly, studies have highlighted the relationship between attitudes towards mathematics and achievement in the subject (Bramlett & Herron, 2009) as a reciprocal influence where attitudes impact achievement and vice versa. In addition, Hammoury (2004), in her study involving

8th grade Jordanian school students, revealed that attitude directly impacts mathematics achievement. Moreover, Ajayi, Lawani and Adeyanju (2013) claimed that a direct relation exists between student's attitude toward mathematics and student outcome. Also, in Eleftherios and Theodosios (2007) study, attitude is revealed to impact mathematics achievement and mathematics abilities including spatial visualization to memorize formula and procedures. Researchers have reached the consensus that positive attitude towards the subject results in students' success in mathematics and impacts mathematics achievement at middle school level (Ma & Xu, 2004). Hence, encouraging the students' positive attitude towards the subject is highly acknowledged as a significant component in developing their mathematics ability.

Another variable that can influence and determine the student's success in school is motivation. Learner's motivation is viewed as a crucial aspect of effective learning. Even psychologists are convinced that motivation is a necessary element for learning and that satisfactory school learning may not take place without enough learning motivation (Tella, 2007). Hall (1989) is also of the opinion that the need to motivate students exist to encourage and maintain their interest in learning mathematics. In another study, successful students were revealed to possess significantly higher motivation for achievement compared to their unsuccessful counterparts (Skaalvik & Skaalvik, 2004). Additionally, Hammoury (2004) claimed that motivation significantly and positively impacts mathematics achievement among 8th grade students while Cassidy (2002) revealed that motivation is important in problem solving skills. Moreover, Okoye (1983) claimed that motivation plays a key role in understanding human behavior. He proceeded to explain why one individual steers clear of work while another works in a normal manner to reach a certain level of achievement while some others turn to illegal and unconventional methods to achieve social, academic, economic and political acknowledgement. He stressed on the importance of the careful manipulation of motivation whether in careers or education so that students are not over or under motivated but suitably motivated in order for them to be useful to themselves, their society and to the world. Therefore, in drawing up instructions in learning mathematics, it is important to make use of methods and strategies of material and media, which will facilitate the students' learning, make them active, investigative and adventurous.

Another variable that influences learning is self-regulation as evidenced by many studies demonstrating its relevance for school students and academic achievement (Zimmerman, 2001). Self regulated learning is described as the knowledge and skills acquisition through cognitive and meta-cognitive process and actual behavior (Zimmerman, 2000). Researchers claimed that self-regulation is crucial to the learning process (Jarvela & Jarvenoja, 2011; Zimmerman, 2008) as it assists students in creating better learning habits, strengthening study skills (Wolters, 2011), applying learning strategies to improve academic outcomes and monitoring their achievement (Harris, Friedlander, Sadler, Frizzelle, & Graham, 2005) and evaluating their academic progress (De Bruin, Thiede, & Camp, 2001). On the whole, studies revealed that attitudes and beliefs of learning mathematics and impact mathematics learning and achievement (Chouinard, Karsenti & Roy, 2007).

It is also notable that in the past three decades, educational research has stressed on self-efficacy (Joo, Bong & Choi, 2000; Melhem, 2004). Bandura (1997) described self-efficacy as the belief in one's capabilities to organize and execute the courses of action needed to achieve. Therefore, it can be stated that beliefs of self-efficacy can influence student's behavior through its impact upon the decisions of the tasks to engage in, the level of effort expended, and the time duration of persevering in difficult conditions. A study has also revealed that self-efficacy is a major predictor of general academic achievement and in mathematics achievement in particular (Zimmerman, 2000).

According to several studies, highly efficacious students possess many positive learning behaviors including the engagement in difficult tasks, expansion of great efforts, persistence, less anxiety, and self-regulation compared to their low efficacious counterparts (Bandura, 1997; Pajares & Miller, 1994). Melhem (2004) stressed that those students reporting high scores in self-efficacy also reveal high scores in mathematics achievement while Al-Kateeb (2006) highlighted the difference between middle school students' mathematics attitude through the use of problem solving strategies of two groups – experimental and control groups. The above studies confirm that self-efficacy is the major personal variable that impacts mathematics achievement (Al-Shbool, 2004; Zimmerman, 2000).

In addition, feelings concerning mathematics as an irrelevant field may negatively impact motivation as well feelings of anxiety. Sometimes, mathematics may bring on feelings of dread, fear and panic that may offset concentration and recollection (McLeod, 1992) as described by a phenomenon known as mathematics anxiety. It is a psychological and physiological barrier that leads to feelings of tension and anxiety that inhibits the manipulation of numbers and solving mathematical problems in everyday life and academic situations (McLeod, 1992). The condition also explains poor mathematics achievement. According to Kesici and Erdogan (2010), one of the major reasons for preventing mathematics achievement is mathematics anxiety while Tawalbeh (2003) found anxiety along with self esteem to relate to mathematics achievement. In study of meta-analysis, Ma (1999) revealed that mathematics anxiety is inversely related to mathematics achievement. Other studies (Kesici & Erdogan, 2010; Ikegulu, 2000) stated that mathematics anxiety may hinder the developmental achievement of mathematics learners. Moreover, Karimi and Venkatesh (2009) claimed that mathematics anxiety is a factor that leads students to stop trying when they encounter mathematics problems. Mathematics anxiety may lead to higher withdrawal and/or failure rates among students who take developmental mathematics courses.

1.2 Problem Statement

The importance of acquiring mathematics knowledge in the world is quite evident owing to its usefulness in everyday life and in several disciplines. The students' low achievement in mathematics in all education levels is the most crucial issue that researchers and educators are concerned about (Abo-lebdeh, 2008). Studies concerning the topic have revealed low level of mathematics achievement of school students, particularly 8^{th} graders (Chouinard, et al., 2007; Ikegulu, 2000; Megdadi & Al-Kateeb, 2006). This called for several studies to examine the low mathematics achievement of eight graders in schools in general and in Jordanian schools students in particular (Abo-lebdeh, 2008; Hammouri, 2004).

Despite the different factors of mathematics achievement that have been investigated (Capraro, Young, Lewis, Yetkiner, & Woods, 2009; Hammoury, 2004), they are still insufficient and they paid minimal attention to schools (Abo-lebdeh, 2008; Abedi, Coutney, Leon, Kao & Azzam, 2006; Capraro, et al., 2009). As such, researchers over the past two decades have examined the low level of mathematics achievement school-going students.

According to some researchers, low achievement in mathematics among Jordanian school students is attributed to many factors including MLS factors (Alkhateeb & Ababneh, 2011; Megdadi & Al-Kateeb, 2006; Melhem, 2004; Saihi, 2012). Additionally, concerns were also stressed on the Jordanian students' poor mathematics achievement (Megdadi & Alkateeb, 2006). On the basis of Megdadi and Alkateeb (2006) study, female students exhibit higher achievement compared to male students.

According to Mullis, Martin, Foy and Arora (2012), Jordanian 8th graders students revealed low achievement in mathematics through four periods of Trends in International Mathematics and Science Study (TIMSS) in 1999, 2003, 2007 and 2011 (Figure 1.1). In addition, the report exposed that Jordanian female students were better than their male counterparts through all periods (Figure 1.2).

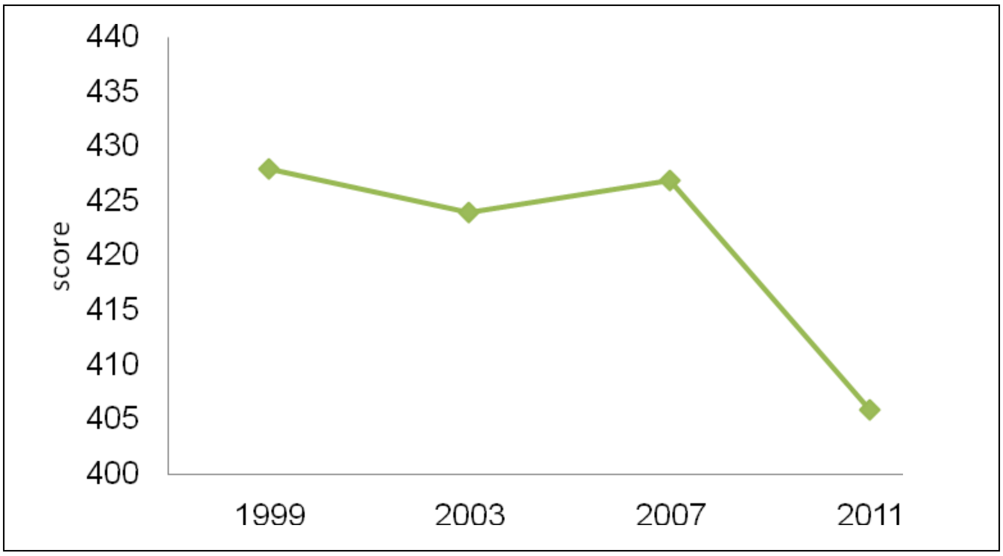

Figure 1.1. Average of Mathematics Achievement Score of Jordanian Student Eight Graders

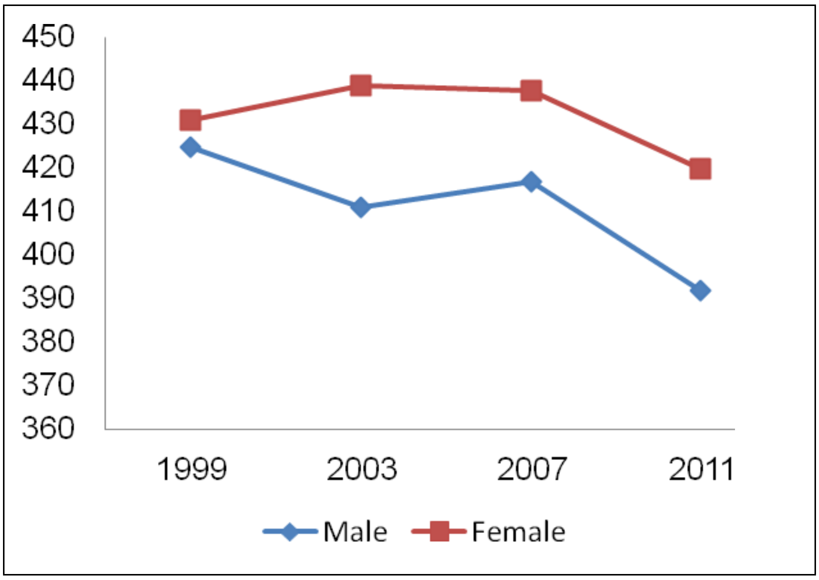

Figure 1.2. Differences between average mathematics score of Jordanian male and female students among 8^{th} graders in TIMSS study.

As mentioned, student's attitude is considered among the factors that relate to mathematics achievement. Students generally have an inclination to give up when faced with a challenging task (Bembenutty & Zimmerman, 2003). Based on the study of Hammoury (2004), attitudinal factors are predictors of student's achievement in mathematics while Jarwan (2002) revealed that a positive mathematics attitude is a significant factor in the determination of the mathematics achievement of Jordanian 8^{th} graders. Other studies (Chouinard et al., 2007; Ikegulu, 2000; Moenikia & Zahed-Babelan, 2010) hypothesized that mathematics attitude impact mathematics achievement.

Issues surrounding student motivation in education and the influence of these issues upon academic achievement are viewed as crucial aspects of effective learning where the learner's reaction to education pinpoints the level to which he/she will continue education. Hence, the effect of motivation on mathematics education cannot be ignored. It is believed that motivation provides the primary impetus to initiate learning and later the driving force to sustain the learning (Guilloteaux & Dornyei, 2008; Wang, 2008).

Students who are self-regulated learners are also able to persevere throughout the process of learning (Zimmerman, 2001) as they are more capable of controlling their cognitive, meta-cognitive and behavioral aspects of learning (Pintrich, 1995; Zimmerman, 2001).

Research has shown that self-efficacy is a strong predictor of academic achievement in general and mathematics achievement in particular (Suarez, Femandez & Muniz, 2014). Studies revealed that highly efficacious students have many positive learning behaviors, such as difficult tasks engagement, expanding greater efforts, persisting longer, less anxiety, and they self-regulate more than low efficacious students (Bandura, 1997; Sartawi, Alsawaie, Dodeen, Tii, & Alghazo, 2012). These reviews lend further support that self-efficacy is the key personal factor affecting mathematics achievement (Zimmerman, 2000).

Mathematics anxiety has also been brought forward as the reason for poor mathematics achievement. Moreover, Hopko et al. (2003) observed that persons with mathematics anxiety make more mistakes in dealing with mathematics problems. These mistakes can cause students to have low achievement in mathematics and in turn, experience increased mathematics anxiety.

Moreover, although spatial visualization has been considered to be significantly related to mathematics achievement, findings are inconclusive. Some researchers revealed a positive link between spatial visualization and mathematics achievement (Clifford, 2008; Meyer et al., 2010; Rohde, 2007) and others revealed minimal to no correlation between the two (Gould, 1996; Lee et al., 2004; Pandisco, 1994).

Hence, based on the above evidence, researchers (Beswick, 2007; Ghanbarzadeh, 2001; Hodges, 2005; Kabiri, 2003) called for further examination of MLS factors as antecedents of mathematics achievement. The present study therefore attempts to study whether MLS factors including mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation and mathematics anxiety are antecedents to mathematics achievement and spatial visualization in a framework. The findings confirm whether the above five influence mathematics achievement with special focus on Jordanian students.

Studies claimed that MLS factors are all significant in improving students' mathematical achievement (Areepattamannil, 2014; Capraro, et al., 2009; Ifamuyiwa

& Ajilogba, 2012; Sartawi, et al., 2012). However, regardless of their comprehensive findings, there is still the need to investigate the factors on a global scale and in the context of Jordan as there is still a gap in literature (Hammoury, 2004; Roviro & Sancho-Vinuesa, 2012).

More importantly, prior literature examining the above MLS factors relationship with mathematics achievement found inconsistent results. Some studies revealed a positive relation between the MLS factors and mathematics achievement (Areepattamannil, 2014; Ajayi, Lawani & Adeyanju, 2013; Sartawi et al., 2012; Suarez, Femandez & Muniz, 2014), others found the MLS factors to be related to mathematics achievement and some others indicated no significant results (Furinghetti & Pekhonen, 2002; Pajares & Graham, 1999; Vancouver, Thompson & Tischner, 2001). Hence, inconsistent results abound literature concerning the relationship between the MLS factors and mathematics achievement. It is also notable that prior studies highlighted the need for studies to examine the impact of these factors in school settings in Jordan and other countries while other studies called for more work to investigate the relationship between the MLS factors and mathematics achievement (Beswick, 2007; Capraro, et al., 2009; Hodges, 2005; Ifamuyiwa & Ajilogba, 2012). Hence, the present study is an attempt to study the relationship between these factors and mathematics achievement based on topics (Numbers, algebra and geometry) and spatial visualization in the context of Jordanian students.

Some prior studies that examined the relationship between gender and mathematics achievement (Kabiri, 2003; Mullis, Martin, Foy & Arora, 2012; Pajares, 1996) revealed that gender affects achievement in mathematics while others (Abakpa & Agbo-Egwu, 2008; Else-Quest, Hyde, Linn, 2010; Ifamuyiwa & Ajilogba, 2012) revealed no effect of gender upon mathematics achievement. Furthermore, the findings of the above studies are inconsistent – in other words, some (Halpern et al., 2007) revealed that males outperform females on mathematical achievement while others found different levels of differences between the two genders according to their ability to solve different types of mathematical tasks (Hyde, 2005; Voyer, Voyer, & Bryden, 1995). Thus, studies call for in-depth investigation on the impact of gender and students' mathematics achievement (Abo-lebdeh, 2008; Mullis, 2012; Gupta, 2011).

On the basis of the above evidence, research dedicated to mathematics achievement should be an ongoing process until evidence is found concerning how to improve the interest and achievement of learners in mathematics, particularly students in middle school level.

1.3 Objectives of the Study

This study aims to address the following objectives:-

i. To identify t he level of difficulty of Numbers, Algebra and Geometry as indicator of mathematics achievement.
ii. To identify the differences in gender base on Numbers, Algebra, Geometry, mathematics achievement and spatial visualization.

iii. To identify the most contributive factor in Mathematics Learning Strategy factors such as mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation, mathematics anxiety that would predict mathematics achievement.

iv. To determine whether spatial visualization mediate the relationship between Mathematics Learning Strategy factors and mathematics achievement?

1.4 Research Questions

On the basis of the enumerated objectives, the following questions are addressed in this research:

i. Identify the level of difficulty of Numbers, Algebra and Geometry as indicator of mathematics achievement.

ii. Is there a significant differences between genders based on Numbers, Algebra, Geometry, mathematics achievement and spatial visualization?

iii. To what extent would the students' Mathematics Learning Strategy factors such as mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation, and mathematics anxiety predict mathematics achievement?

iv. Does spatial visualization mediate the relationship between Mathematics Learning Strategy factors and mathematics achievement?

1.5 Hypotheses of the Study

The following hypotheses are addressed in this research:

H_A (1): There is a significant difference between gender and Numbers among Jordanian 8th grade school students.

H_A (2): There is a significant difference between gender and Algebra among Jordanian 8th grade school students.

H_A (3): There is a significant difference between gender and Geometry among Jordanian 8th grade school students.

H_A (4): There is a significant difference between gender and mathematics achievement among Jordanian 8th grade school students.

H_A (5): There is a significant difference between gender and spatial visualization among Jordanian 8th grade school students.

H_A (6): Spatial visualization mediates the relationship between mathematics attitude and mathematics achievement.

H_A (7): Spatial visualization mediates the relationship between mathematics motivation and mathematics achievement.

H_A (8): Spatial visualization mediates the relationship between mathematics self-regulation and mathematics achievement.

H_A (9): Spatial visualization mediates the relationship between mathematics self-efficacy and mathematics achievement.

H_A (10): Spatial visualization mediates the relationship between mathematics anxiety and mathematics achievement.

1.6 Significance of the Study

Currently, students are facing new demands upon their learning abilities owing to the increasing knowledge and the eventual need for lifelong learning. Hence, it becomes necessary for students to acquire new as well as existing knowledge. It is imperative for students to be qualified to play the role of active learners for the preparation to meet the societal demands. The mathematics achievement of students is a crucial factor in the mathematics field because it reflects the success in this field of education. Although the Ministry of Education of Jordan has exerted efforts in enhancing the student's general achievement and mathematics achievement, prior studies have stressed on the poor achievement in mathematics among middle school students in the country (Abo-lebdeh, 2008; Mullis et al. 2012). According to Shatnawi (2005), Jordanian students' achievement of mathematics is minimal.

The Curriculum and Evaluation Standards for School Mathematics published by National Council of Teacher of Mathematics (NCTM) in 1989 states "equally important is the continued development of students' skills in visualization, pictorial representation, and application of geometric ideas to describe and answer questions about natural, physical, and social phenomena" (p 160). The geometric content consists of many visual components. Experiences with visualization and making representations at middle school level form the foundation of higher study of Euclidean and non-Euclidean geometries and calculus. Gualin (1985) stressed the need of re-establishing the development of spatial intuition as one of the major goal of teaching mathematics.

The general notion is that human beings are cognitive individuals in addition to being social persons possessing beliefs, emotions and views influencing their learning development. Several researchers have examined the factors impacting students' mathematics achievement and spatial visualization in the previous decades. Moreover, in the recent times, many interlinked concepts have been examined including mathematics attitude, motivation, self-efficacy, self-regulation and anxiety towards mathematics in relation to achievement in mathematics (Capraro, et al., 2009; Beswick, 2007; Ifamuyiwa & Ajilogba, 2012).

Previous studies reveals mathematics attitude influence on mathematics achievement. Nevertheless, the findings regarding the relationship are inconsistent (Abu-Hilal, 2000; Paparastasiou, 2000; Schreiber, 2002). Moreover, a universal need for more research concerning the effect of mathematics attitude for student's mathematics achievement exists (Chouinard et al., 2007; Beswick, 2007; Hannula, 2002; Schweinle, Meyer & Turner, 2006). Hence, it is imperative to assist students to overcome their negative attitude and their behaviors through different ways. Singh, Granville and Dika (2002) claimed that the relationship between attitudes and achievement in mathematics has not been investigated enough.

In addition, motivation has been emphasized time and again owing to its significance in learning motivation. Motivation is believed to provide the initial impetus for learning and the engine of sustainable learning (Guilloteaux & Dornyei, 2008; Wang, 2008). In the field of mathematics education, motivation has also been viewed as one of the top significant issues (Walker & Guzdial, 1999). To this end Hannula (2006) further stressed that the understanding of students' behavior towards mathematics entails the maximization of understanding of motivation and its regulation.

Researchers also suggested self-regulation in prominent academic contexts and achievement levels to ascertain whether it predicts academic success (Ley & Young, 1998; Pintrich, 2000; Ruban, McCoach, & Reis, 2002). The theory underlying self-regulated learning explains the way students engage in the learning process and offers some reasons as to why students possessing the same cognitive levels (enrolled in developmental mathematics) exhibit varying patterns of academic achievement (Zimmermann, 2001).

Mathematics anxiety is very prevalent and has considerable influence on students' math achievement. Math, more than any other subject, engenders anxiety and avoidance in students (Shores, 2005). This is why one needs to know if students possess mathematics anxiety. Moreover, Miller (2000) called for further investigation into mathematics anxiety and perceived relevance of mathematics among developmental students.

Among the many factors influencing school achievement, motivation is considered the most influential. It is defined as the cognitive, emotional, and behavioral indicators of student's investment in and attachment to education (Tucker, Zayco, & Herman, 2002). It is evident that students who lack the motivation to succeed do not work hard although not much research has been done to investigate the linkage between motivation and students' achievement (Brannigan, 2004).

Extant literature shows a significant lack of theoretically derived models underlying the explanation of the mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation and anxiety towards mathematics achievement (Beswick, 2007; Brannigan, 2004; Capraro et al., 2009; Chouinard et al., 2007).

The present study therefore contributes by examining other research proposals concerning the effect of these factors upon mathematics achievement with topics (Numbers, Algebra and Geometry) and spatial visualization as evidently, only a few studies have studied them, particularly in the context of gender (Ifamuyiwa & Ajilogba, 2012) .

1.7 Study Limitations

The present study possesses some limitations, with the first one being the confined samples. The sample consists of 8^{th} graders and not all middle school students. The second limitation is the limitation in light of area of study; although there are many cities in Jordan, the study is confined to North Jordan. In addition, the sample may not represent a bigger population because it is taken from only one city in Northern Jordan excluding others. In other words, generalization across geographical as well as demographical areas may not be confirmed. Thirdly, study data is based on the students' personal reports. Due to the fact that quantitative data are taken through self-report measures, there is ample chance that participants may manipulate their answers for several reasons. They may get bored with the test battery and choose answers randomly to get it over with quickly and to satisfy the researcher; therefore, they may choose answers voluntary or involuntary which may not represent their true experience. Fourthly, the sample size of the study is 360 8^{th} grade students. Fifthly, Jordanian researchers have been noted to be more inclined to utilize instruments that comprise of only a few items in their researches; however, some of the present research's measurement contained multi items and dimensions.

1.8 Operational Definitions

Mathematics Achievement

Mathematics achievement is used to measure the ability of 8^{th} grade students in Jordan in numbers, algebra and geometry.

Numbers achievement

Numbers achievement refers to the achievement in whole numbers, fractions and decimals, integers and root.

Algebra achievement

Algebra achievement refers to achievement in patterns, algebraic expressions, equations and formulas, and relationship.

Geometry

Geometry achievement refers to achievement in line and angles, two-three dimensional shapes and locations.

Spatial Visualization

Spatial visualization refers to two and three dimension views of the building and mat plan including the description of the building base by square and numbers.

Item Difficulty

Item difficulty is the percentage of students who answered the item correctly to the total number of students answering the item.

Mathematics Attitude

Mathematics attitude is defined as a general emotional nature toward the school subject of mathematics. In this study, mathematic attitude refers to value and enjoyment.

Mathematics Motivation

Mathematics motivation is defined as the cognitive, emotional and behavioral indicators of student investment in and attachment to education. In this study, mathematics motivation refers to intrinsic and extrinsic motivation.

Mathematics Self-regulation

Mathematics self-regulation refers to assessment students ability to direct and maintain their attention on academic tasks (concentration), it helps out also to assess students use of reviewing and monitoring techniques to determine their level of understanding of information (self testing), moreover, it assess their use of techniques or resources to help them learn (study aids), furthermore, it assess their use of time management principles for academic tasks (time management).

Mathematics Self-efficacy

Self-efficacy refers to students' judgments about their ability to successfully accomplish a task, as well as to a student's confidence in his/her skills to perform that task.

Mathematics anxiety

Mathematics anxiety in this study refers to what extent the students feel helpless and under emotional stress when dealing with mathematics.

Summary

Mathematics is one of the major subject areas tested in school. Majority of research has also depicted mathematics to be one of the most important school subjects indicating the requirement for students to be proficient in the subject. It is also critical to stress on the subject achievement's role in schooling, career choices and professional development. A thorough review of literature indicated that some factors are crucial to the achievement of mathematics in schools. Hence, it becomes imperative to determine the factors influencing mathematics achievement through topics (Numbers, Algebra & geometry) and spatial visualization. However, the relationship between self-regulation and attitudinal factors is an area that has not received sufficient attention. The importance of the area lies in the fact that self-directed learning and attitude towards learning may impact the academic achievement. In light of this notion, researchers have suggested that individual differences including self-efficacy, motivation and gender factors impact mathematics achievement base on (numbers, algebra and geometry) and spatial visualization and therefore, the factors influencing mathematics achievement and spatial visualization should be determined. The next chapter presented the review of literalure relevant to the topic under study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The goal of the present study is to identify the top contributive factors in MLS factors. This chapter presents a brief overview of the studies conducted in the past by giving an introduction to the education system in Jordan, their mathematics curriculum of Eigth grade and its importance. It also covers Difficulty index, social cognitive theory, gender and mathematics achievement that includes number achievement, algebra achievement, geometry achievement, and spatial visualization. Moreover, it highlights Mathematics learning that covers attitude, motivation, self-regulation, self-efficacy and anxiety towards mathematics achievement based on numbers, algebra and geometry. At the end this chapter sums up with a brief summary of the chapter.

2.2 Education System in Jordan

Jordan is known for its young population as indicated by Minestry of Education report that 42.2% of students are below 14 and 31.4% are from ages 15-29. It is notable that in Jordan, education is provided for free in the primary and secondary level and has been made compulsory for students through the age of fifteen (Al-Jaraideh, 2009) with one-third of the population enrolled in educational institutions including 95% of which comprise of school going children - a great improvement from 47% back in 1960 (Al-Jaraideh, 2009).

Based on the Ministry of Education Report for the years 2007-2008, there were 3,053 schools providing basic education, 2,137 of them under the Ministry of Education while 16 are controlled by other governmental authorities like the Ministry of Defense, 176 owned by United Nation Relief and Work Agency (UNRWA) and 724 are run by the private sector. Of the total schools, 1, 904 are coeducational, 782 exclusively for boys and 367 for girls with a total enrolment of 1,297,905 students (664,174 boys and 633,731 girls). A total of 914, 937 students are enrolled in schools under the Ministry of Education in Jordan (MoE), 246,545 are in private schools and 122,068 in schools run by UNRWA while the remaining number of students are enrolled in schools run by governmental authorities (MoE, 2008).

In Jordan, basic education constitutes ten years of compulsory schooling from the age of 5 years and 8 months. Students are provided with a basic, well-balanced education in the several aspects; social, emotion, intellectual, physical and spiritual elements of their growth to create the basis for learning at higher education and for lifelong learning. The aim of basic education is to prepare the students in achieving Jordanian system objectives including dealing with numerical systems, basic mathematical processes and geometrical figures and their usage in daily life (United Nation Educational, Scientific and Cultural Organization, 2010).

2.3 Mathematics Curriculum of 8th Grade in Jordan

Among the many crucial aspects of the education system that has the potential to include an effective component of business education is the incorporation of a wide variety of useful knowledge, life skills and attitudes for the reinforcement of the wide-based and comprehensive experience. Basic compulsory education is the driver for such a technique as it is general, non-specific, universal and generic. From the point of view of quantity and structure, the study plan for Jordanian basic education spans grades 1-10 within the age group of 6-16 years. It offers all the required disciplines including mathematics, paving the way to obtain the needed life skills.

In Jordan's field of teaching and learning mathematics, significant developments and changes have been witnessed that are related to the way mathematics curriculum is taught. Among the most important aspect in the field is to highlight the standards of Mathematical content and the processes. Mathematical standards are considered as descriptions of the way mathematics should be taught in a manner that allows students to understand the subject and apply it. These standards confirm the knowledge and the skills of the student gained in various levels of education (Abo-Zenah & Ababnah, 2007).

A group of visions pertaining to mathematics teachers has been set up by the U.S. National Council to determine the mathematical content that the student should learn and the way of teaching them. These standards were adopted in the development of the Jordanian mathematics curriculum. The outcome resulted in the division of standards into two – the first includes the standards of content, setting the mathematical content for the educational levels including counting and mathematical operations, algebra, geometry, measurement, analyzing data, and probability for grades 1-12. The second one determines the standards of operation concerned with the thinking processes encapsulating problem solving, thinking, proof to mathematical equation, communication, linkage and mathematical representation.

Some of the standards upheld by the U.S. National Council for teachers of mathematics are the standards for mathematical representation and for problem solving. Among the crucial aims of the standards laid down for students from 6^{th}-8^{th} is to allow the students to develop and use mathematical representations of organizing, registering and delivering mathematical ideas and their ability to tackle mathematical problems (NCTM, 2000).

In Jordan, the 8^{th} grade mathematics textbooks are divided into three namely numbers, algebra and geometry. The first domain contains numbers, ways of representing them, relationships among numbers and the number systems. Grade 8^{th} students are expected to develop the number sense and computational fluency, to understand the meanings behind the operations and the relationship between them, and to use numbers and operations in problem solving. This domain contains understandings and skills that relate to whole numbers, fractions and decimals, integers and roots with the emphasis on fractions and decimals computation as opposed to whole numbers. The emphasis within fractions and decimals is on representing and translating between forms, comprehending the quantities and symbols, computing and problem solving. 8^{th} graders are expected to handle equivalent fractions, decimals, and percents by employing various strategies and they are expected to have expanded their understanding of mathematics from whole numbers to integers in terms of order and magnitude. Lastly, the third domain contains the recognition and extension of patterns with the help of algebraic symbols to represent mathematical situations, and the development of fluency in generating expressions and providing solutions to linear equations. Algebra covers the following major topics; patterns, algebraic expressions, equations, formulas and functions. Additionally, algebraic concepts are formalized by the 8^{th} grade and students are expected to have developed an understanding of linear relationships and the variable concept. 8^{th} graders should be able to employ and solve linear equations, inequalities, pairs of simultaneous equations that entail two variables, and employ various functions. They should also be able to determine solutions to real-world problems through algebraic models and explain associations that entail concepts of algebra (Abo-lebdeh, 2008).

With regards to the final domain, 8^{th} graders are expected to analyze the properties and characteristics of various two and three-dimensional geometric figures, such as lengths of sides, and size of angles, and to furnish an explanation on the basis of geometric relationships. This domain is focused on using geometric properties and the relationships they entail. Students are expected to be competent in measuring with the help of geometric instruments, estimating and choosing the correct formula to use for perimeters, areas and volumes. This domain also includes comprehending the coordinate representations and employing spatial visualization skills to move between two-three dimensional shapes and their representations. Moreover, students are expected to use symmetry and employ transformation in analyzing mathematical situations. Geometry covers five areas namely, lines, angles, two dimensional shapes, three dimensional shapes and locations (Abo-lebdeh, 2008).

2.3.1 The Importance of Mathematics in 8^{th} Grade

The importance of mathematics in everyday life is evident in many forms of employment, science and technology, medicine, economy, the environment and progress, and in public decision-making. In the past decades, a growing interest on mathematics in various educational experiences, success and educational outcomes have been occurring. According to researchers, mathematics is a “critical filter for future academic and occupational options” (Crombie, et al., 2005). It is a subject that a student has to be proficient in to enter into many careers and it is crucial for existing and emerging occupations in global, information and technology based economy (Drew, 1996). The subject’s importance goes beyond everyday money management and covers employment in the most money making occupations (Saffer, 1999). Almost all occupations need some mathematical skills (Saffer, 1999). Mathematical concepts including normal distribution and exponential growth are normal vocabulary in various fields such as business and social sciences (Tobias, 1990). In the field of education, mathematics is considered as a significant learning tool where students identify relationships between mathematical concepts and daily situations and link the subject to other subjects being studied to develop the use of mathematics and to employ their knowledge in other areas of curriculum such as science, music and language. It is thus imperative that students obtain a basic understanding of mathematics and are capable of applying the principles of mathematics to their everyday lives and work. The core reason behind the importance of mathematics achievement is that it assists the student in deciding his/her later schooling, career selection and professional development. Next section brifly describe the item difficulty index associated theory.

2.4 Difficulty Index

Classical Test Theory (CTT) item analysis is considered among the most extensively utilized method to examine the test item reliability. The first item characteristics determined is such a theory is item difficulty index. This is commonly done because tests are often deemed as an unreliable measure of the performance of the student owing to the inconsistency of item difficulty and the students' ability.

Item analysis refers to the collection, summarization and employment of information obtained from the responses of students for the assessment of the test items quality. Difficulty index is considered as a parameter that is used for the evaluation of the standard of multiple choice questions employed in the examination, having abnormal values that indicate negative quality.

The item difficulty index is computed as percentage of the entire number of correct responses to the test item (Sim & Rasiah, 2006), through the formula P = R / T, with P representing the item difficulty, R representing the number of correct responses and lastly, T representing the total number of responses (both correct & wrong). The higher the percentage of answering the item right, the easier the item and the higher the difficulty index, the easier the item is deemed to be (Wood, 1960). It can differ between 0.0 and 1.0, where the greater value shows that a significant proportion of the total examinees answered the item correctly and thus it is an easier item (Crocker & Algina, 1986).

The item difficulty is used to determine the level of items difficulty for numbers, algebra and geometry. This study uses a mathematical test where it includes of 30 multiple choice consist of three groups namely numbers, algebra and geometry. Test items for numbers, algebra and geometry were selected based on modified and constructed version provided by the Ministry of Education in Jordan. Items that have a difficulty index below 0.30 are classified as having a high level of difficulty and those above 0.70 is considered to be low-level of difficulty. Items that have difficulty index between the two values (0.30 - 0.70) are considered to have a moderate level of difficulty (Kaplan & Saccuzzo, 2001). Classical Test Theory is used to evaluate the item difficulty index.

2.5 Social Cognitive Theory

Social-Cognitive Theory was presented by Bandura (1986) who came up with the theory and established variables in the learning psychology field which illustrated several learning techniques. Social cognitive theory is assigned to a model of growing interactive agency. It suggestes that a person is not autonomous factor or mechanical conveyers of animating environmental influences rather they develop causal contribution to their own motivation and action encapsulated in a system of triadic reciprocal causation (p. 175). This provides base for the Bandura's (1986) conception of reciprocal determinism which is the fundamental concept on which this model of triadic reciprocal causation is based on. The social cognitive theory put forward by him in 1989 discusses that a person can be a good judge of his own experience and thought processes by self-reflecting that the self-reflection leads to evaluate and modify his environments and social systems. Therefore, social cognitive theory has been used to several fields of psychosocial function such as attitude, anxiety, self-concept, self-regulation and motivation (Pajares & Graham, 1999; Landry, 2003). These evaluations contain understanding of self-efficacy.

Self-efficacy theory explains the level and strength of self-efficacy deduce some points like, no matter if a behavior is initiated or not, the amount of resulting effort is essetntial, and the degree of sustenance of effort through challenges. Self-efficacy allows individuals to impact their course of action and change their situation where an individual's activity choice, persistence, and effort are all depending on his beliefs of self-efficacy (Bandura, 1997). For example, people with a lower sense of efficacy for completing a specific task may tend to ignore but the individuals with a high sense of efficacy is likely to readily take part in its completion. Furthermore, efficacious people are better persistent and more industrious when faced with challenges as compared to those who underestimate themselves (Schunk & Pajares, 2002). Moreover, according to Bandura (1986) that self-efficacy can be an indicator to analyse prospective achievements like confidence in learning mathematics better than global indicators. Most commonly, the Instruments that is used to measure attitude toward mathematics like self-confidence or self-efficacy as in theory, a person's mathematics self-efficacy can be an indicator of his/her reaction to mathematics which can be positive or negative. Therefore, it can be believed that self-efficacy is restricted and definite as compared to general attitudes of a student toward mathematics.

Additionally, anxiety towards mathematics can stem from low mathematics self-efficacy based on social learning theory (Bandura, 1997). In other words, an individual who experiences anxiousness towards mathematics may not feel capable of handling a mathematical task. Hence, mathematics anxiety could indicate mathematics self-efficacy even though the two concepts are different. According to

Bandura (1997), when an individual works in a field, he develops high self-efficacy towards the field and creates an internal motivation towards the related task. Positive mathematics attitude has also been reported to be determined and predicted by beliefs of self-efficacy.

With regards to motivation, it has always been viewed as related to the way behavior is initiated and maintained (Bandura, 1977). According to Bandura (1977), sometimes motivation is obtained through the avoidance of aversive external stimuli, including hunger, thirst and pain. A major portion of human motivation is initiated and maintained over a great duration of time even with lack of external stimulation. The ability to represent future outcome in thought serves as a cognitive based source of motivation. Bandura (1977) stated that when individuals are committed to particular goals, their perception of discrepancies between what they do and what they hope to achieve, creates dissatisfactions that offer as motivational inducements for change (p. 161).

As for self-regulated learning, Zimmerman and Schunk (1989) defined it as learning in light of self generated thoughts, feelings, and actions oriented towards the achievements of goals in a systematic way. Learners who are self-regulators engage in their academic tasks to fulfill their personal interest and satisfaction. They are also actively participating in their learning in a meta-cognitive and behavioral way (Ablard & Lipschultz, 1998). Learners characterized as self-regulated possess a great amount of cognitive and meta-cognitive strategies that they use when required for academic tasks completion. They are reported to be persistent in their efforts to fulfill their goals (Wolters, 1998).

In sum, mathematics anxiety is revealed to generate debilitating impacts on mathematics achievement and owing to the importance of mathematics, mathematics anxiety has been the subject of countless of studies (Miller, 1991). The relationship between attitude and mathematics achievement has also been examined in prior literature. Schreiber (2000) revealed that students who are better performers in mathematics are more inclined to have a positive attitude towards the subject.

According to current research concerning mathematics achievement, the MLS domains are crucial elements where gender differences are noted and this may have a significant bearing on the search to determine the differences in the students' MLS domains in light of gender differences. For the effective and efficient determination of these differences, knowledge regarding the relation between MLS factors and mathematics achievement and the changes in this relation in light of gender would be an invaluable study for educators of mathematics.

2.6 Gender and Mathematics Achievement

Gender is an important factor in the examination of academic achievement in general and of mathematics achievement in particular. Gender differences in mathematics stem from visual spatial abilities (Casey, Nuttall & Pezaris, 1997). This contention was supported by Geary (1994) who stated that the difference between gender achievements in mathematics is partly due to biological, spatial visualization. The question of gender differences in mathematics achievement has been tackled by a huge portion of research with various contradictory findings.

According to Levine et al. (1999), the core reason behind the gender gap in mathematics lies in the differences in the spatial abilities of both genders with boys' superiority over girls. Boys are reported to utilize a different method to process spatial visualization information from girls. This is supported by Kimura (1999) who claimed that boys outperform girls on spatial orientation and visualization tasks while girls outperform them on verbal skills and tests that entail memory and perpetual speed.

In a related study, Geary et al. (2000) stated that a male advantage in computational fluency adds to the male advantage in mathematical achievement. Boys often exhibit early signs of interest in and ability with number and quantitative relation more than girls. Geary et al. (2000) claimed that males possess advantages over females particularly in arithmetic reasoning as they have higher computational fluency and spatial cognition. They revealed that male advantages in spatial cognition added to their advantage in mathematical problem solving.

Moreover, Cheng and Seng (2001) conducted a comparison between genders among 7^{th} seventh and 8^{th} grade in four Asian countries; Singapore, Japan, Korea and Hong Kong. They revealed high gender differences in Hong Kong and Korea but less in Japan and the least in Singapore. Singaporean girls were revealed to perform better compared to their counterparts. In the other three countries, male advantage was noted in mathematical achievement in seventh and 8^{th} graders compared to no gender differences in grades prior to seventh grade.

In another related study, Geary and Desoto (2001) examined the sex differences in light of spatial abilities of 104 students in the U.S. and China. The findings of the two samples revealed that males do have an advantage over females in mental retention and rotate representations of geometry.

Martin, Mullis and Foy (2008) stated that sixty four countries were involved in TIMSS (2003) study in an attempt to measure students' achievement in mathematics. The findings revealed that eight grade females in sixteen countries overcame their counterparts and Jordan is included as one of these sixteen countries. In addition, mathematics results in the TIMSS study in 1999 to 2007 in Jordan also supported this result (National Center for Human Resources Development in Jordan, 2008). The differences between average mathematics score of Jordanian male and female students among eight grades in a TIMSS 4 years study is shown in *Figure 1.1*.

Additionally, Alkhateeb (2001) examined gender differences in mathematics achievement of students in their last year of high schools and the changes in the differences over a time span of 10 years in U.A.E. The study involved a sample of 200 students- 100 males and 100 females for each of the academic years. The sample was obtained from the records of the Ministry of Education along with the achievement of males and females, which were later compared. The findings revealed that high school females outperformed their male counterparts in mathematics achievement.

Moreover, Arslan, Carli and Sabo (2012) tested the impact of gender on mathematics achievement among a sample of 584 students from 6^{th}, 7^{th}, and 8^{th} grades in Turkey with the number of participants comprising of 89 female and 108 male students in 6^{th} grade, 73 female and 98 male students in 7^{th} grade, and finally, 108 female and 77 male students in 8^{th} grade. The total sample comprised of 270 (49%) female students and 283 (51%) male students. The findings showed a significant difference between female and male students in light of their achievements in mathematics with the female students outperforming their male counterparts.

Furthermore, Brunner, Krauss and Kunter’s (2007) study investigated the mathematics achievement of German students and conducted a comparison between the gender in light of their overall mathematics ability and specific mathematics ability (their ability to influence achievement on mathematics over and above general cognitive ability) (p. 405). The findings revealed that girls outperform boys in a slight margin on reasoning ability but on specific mathematics ability, boys outperformed girls on a high margin.

Some studies’ findings are inconsistent with the existence of the difference between the two genders in mathematics achievement (Else-Quest, Hyde & Linn, 2010; Lloyd, Walsh, & Yailagh, 2005; Pajares & Graham, 1999; Ross, Bruce, & Scott, 2012; Silver, Strutchens & Zaowjewski, 1996; Stringer & Heath, 2008).

Specifically, Ross, Bruce and Scott (2012) sample involved 996 Canadian students from grades 7-10 and they revealed that gender differences in achievement was quite minimal; in fact it was nearly zero.

On a similer line of study, in Abiam and Odat (2006) study, they tested the factors in students’ achievement in various branches of secondary school mathematics and found no significant relation between gender and mathematics achievement in light of number and numeration, algebraic process and statistics. However, they revealed minimal significant relation in Geometry and Trigonometry in eight graders.

Similarly, Awofala (2011) study in the context of Southeastern part of Nigeria revealed no gender differences in mathematics achievement of 8^{th} graders in co-educational school. In addition, Isiksal and Askar (2005) investigation of the impact of dynamic geometry software upon mathematics achievement of Turkish seventh graders revealed no gender differences. The findings presented in the TIMSS report indicated that the achievements of eight graders, both male and female, on the mathematics test did not show significant difference in the context of Turkey (Mullis, Martin, Fierros, Goldberg, & Stemler, 2000).

Moreover, Sprigler and Alsup (2004) detection of difference between elementary boys and girls in light of their mathematical reasoning ability and sub-skills of analysis-synthesis, involving 120 male students and 119 female students (from grades 1-5) enrolled in a moderate sized rural South Dakota community, indicated no gender difference.

In another related study, Battista (1990) involved 145 high school students in his quest to examine the impact of spatial visualization on gender differences in geometry. He made use of the Purdue spatial visualization test to measure the students' level of spatial visualization and paper and pencil tests to gauge their logical reasoning, geometry knowledge and geometrical problem solving strategies. He concluded no sexual difference between high school students' spatial visualization in terms of their geometry achievement (Battista, 1990).

To conclude, gender is among the core variables that have been, time and again, researched in history in light of its impact on mathematics achievement. The differences in gender garner significant attention as they highlight the causes which may help in the identification of policies to narrow the gender gap. While some studies revealed significant differences between the genders in mathematics achievement, with males outperforming females, most researchers who examined the various reasons for the differences also touched upon the variable of gender and they failed to show any significant difference (Mason & Scrivani, 2004).

Hence, the issue of gender differences in mathematics achievement is still unresolved at present as there remains no clear consensus concerning mathematics achievement differences between the genders. The present study determines whether gender differences in mathematics achievement level exist among 8th graders in Jordan.

2.6.1 Gender and Number achievement

Several scholars have examined gender differences in mathematics learning and included the importance of gender in learning numbers. The NCTM Standards stated that "children must understand numbers if they are to make sense of the ways numbers are used in their everyday world" (NCTM, 1989). Some studies showed that males and femals possess identical primary numerical abilities (Dehaene, 1997; Nunes & Bryant, 1996). Carr and Jessup (1997) in their report discussing males and females in their first school year, stated that they may use different strategies for solving mathematical problems, but there is no difference in the level of performance. Recent studies also have indicated that there is no difference between male and female in achievement of numbers (Hyde & Linn, 2006; Isiksal & Cakiroglu, 2008) whereas various studies have indicated that males tend to outperform their female counterpart in standardized tests of mathematics (Cleary, 1992; Gallagher & Kaufman, 2005).

Awang and Ismail (2007) studied gender differences with respect to overall mathematics average achievement along with the main content of mathematics topics, such as fraction and number sense; data representation, analysis and probability; geometry and algebra. The results of the literature described that overall average of achievement for female is greater than male. Though, the average achievement for female is greater than male in all five content areas, the differences are observed in three topics that are, algebra, data and numbers were negligible.

Singh (2009) carried out a study for the assessment of students' achievement in the number sense among 1756 students from ages 13-16 years in Malaysia. The findings indicated that students exhibited a low percentage of success rates from 37.3% to 47.7% throughout the levels. In light of the difference between genders, the male students outscored the female students with the difference only significant on the secondary 1 level.

Aunio et al. (2006) looked into the influences of nationality, age and gender on Chinese (N=130) and Finnish (N=203) pre-schoolers' number sense. The result showed a significant age related gain in both aspects of number sense, whereas no gender differences were found.

Because gender differences in numbers skills have attracted little attention (Torbeyns et al., 2002; Van de Rijt et al., 2003), the present study aims to determine whether there is a gender differences in numbers achievement among eight grade students in Jordan.

2.6.2 Gender and Algebra achievement

Russell (2009) refers to Algebra as one of the branches of mathematics which is concerned with finding the unknown or employing equations to solve real life problems. There has been significant concern on a global level concerning gender differences in the students' algebra achievement. While some researchers revealed significant differences, others revealed none at all in terms of male-female algebra achievement.

Atovigba, Vershima, O'kwu, and Ijenkeli (2012) looked into the difference between genders in algebra achievement among a total of 100 secondary school students in the Stat of Benue, Nigeria. They revealed the existence of gender differences and showed that male students outperformed their female counterparts at a significant level. Similarly, Lee, Grigg, and Doin (2007) reviewed the United States of America's National Centre for Education Statistics' reports 2004 concerning specific proficiencies in mathematics and the percentage of students who have reached proficiency in those areas by gender. He noted that boys and girls are similarly successful at each level of basic levels but boys outperform girls in complex levels including Algebra.

In the context of U.A.E., Alkhateeb (2001) observed high school students and revealed that female students outscore males in algebra. Shafiq (2013) examined the effects of gender on algebra, geometry, and trigonometry performance in public New York State high school in grades 9- 12. The results revealed no differences in algebra, geometry, and trigonometry unit examination scores by gender. McCoy (2005), on the other hand, examined the impact of demographic and personal variables upon achievement of eight grade algebra. The study involved 107 urban and suburban students of Algebra. The students in this sample did not show gender differences in Algebra achievement.

The studies failed to reach a consensus on the existence of differences of algebra achievement level between the genders and thus, the present study determines whether gender differences exist in algebra achievement among 8^{th} graders in Jordan.

2.6.3 Gender and Geometry achievement

Several scholars have looked into the gender-mathematics learning relationship. Moreover, the significance of gender in learning geometry has been touched upon. Empirical studies (Becker, 1981) revealed that boys are better than girls when it comes to geometry measurement. In a related study, Hanna (1986) examined the gender related differences in geometry achievement among 8^{th} graders in the context of Ontario, Canada. The finding revealed that the mean percentage of correct responses in geometry and measurement is slightly greater for boys compared to girls.

The National Assessment of Education Progress (2007) conducted the Nations Report Card where assessments have been carried out since 1969 among a nationally representative sample in many fields including math. The assessment involved around 197,700 students from 4^{th} grade, 153,000 from 8^{th} grade in 2007. Male students outperformed female students among 8^{th} graders by 2 points; a gap consistent with the prior years' results. The findings showed that male students scored higher on average than female students with the exception of geometry and data analysis/probability.

Similarly, Battista (1990) studied the role of spatial visualization in achievement and gender differences in geometry. Population of the sample if the study was 145, comprises of high school students admitted in five intact classes, two of which were taught by one teacher while the rest by a different instructor. Battista (1990) took the paper and pencil tests in four different aspects; spatial visualization, knowledge of geometry, geometry problem/strategies and logical reasoning. The findings described that there is a difference between boys and girls in their spatial visualization and achievement in geometry. Besides, no prominent difference was observed in applying geometric problem solving strategies. Particularly, the findings showed that spatial visualization is an important factor for geometry achievement for girls while logical reasoning was for boys.

Bayram (2004) investigated the impact of gender on geometry achievement among a sample of 106 8^{th} grade students in one of the private school in Ankara. The population of the sample used in the study was 51 girls and 55 boys students. The results of the study have not observed any mean variation among female and male in understanding geometry. Similarly, Erbas and Yenmez (2011) explored the effects of using a dynamic geometry environment along with inquiry-based explorations on the sixth grade students' achievements in congruency and polygons and similarity of polygons. The research was unable to show statistically significant gender influence on students' achievement in polygons. Hence, the aim of the research is to find the gender differences in the understanding of geometry among students of 8th standard in Jorden.

2.7 Gender and Spatial Visualization

Gender's importance in light of learning mathematics and in spatial visualization has been addressed by many researchers (Halat 2008; Kaufman, 2007). According to Levine et al. (1999), a gender gap exists in mathematics owing to the distinction between male and female spatial abilities where boys are reported to be superior to girls. This superiority stems from the different techniques utilized by males to process spatial visualization information. Other studies (Allivatos & Petrides, 1997; Richardson, 1994; Capraro, 2001; Moe & Pazzaglia, 2006) contending that differences in gender in spatial visualization attributes it to genetic explanations, educational experiences, social experiences, motivational aspects and the cerebral hemispheres of the brain.

Rayan (2008) study, aimed to investigate the effect of set of indicators mainly gender, age, accumulative average and their related interactions on spatial ability among Al-Quds Open University students studying elementary school education. The study was implemented on a sample that consisted of (132) students (25 males and 107 females). Students were selected by using stratified sample from the fourth year elementary education majors at Al-Quds Open University- Hebron region registered for the first semester of the academic year 2006/2007. Results revealed statistically significant differences in spatial ability that can be attributed to two variables, i.e. gender for the benefit of male students and accumulative average for the benefit of high average group. Results also showed no statistically significant differences that can be attributed to age or to the interaction between these variables.

In a related study Ghbari, Abu Shendi and Abu Sheirah (2008) investigated the development of spatial ability among information technology students at Zarqa Private University in Jordan throughout the years of the study. The sample consisted of (221) students chosen randomly from different sections, who responded to a mental rotation test to measure spatial ability. The results indicated that there were no significant differences in performance on the test of spatial ability due to years of study. Results also show no significant differences in spatial ability test performance due to the academic performance or social status.

Along a similar line, Abu Mustafa (2010) carried out a study to identify the relationship between the spatial ability and the achievement of sixth-grade students in mathematics, to identify the impact of sex variable, and to identify the diversity among students of high and low spatial abilities. The sample of the study consists of 6 classes from the students of the sixth grade with a number of 228 students distributed to three female classes and three male classes. The tool employed in the study was the spatial orientation test - Card Rotation- by Whitley Test. Pearson correlation coefficient was calculated between the students' scores in the spatial ability test and their scores in math. Surprisingly, a positive correlation with statistical significance between achievement in mathematics and spatial ability of the students was found. It was also found that male students possess high spatial abilities than female students when applying the one way analysis of variance between the scores of both males and females, and that high achievers had high spatial abilities compared to their peers of average and low achievement.

Seabra and Santos (2008) investigated the spatial visualization abilities of engineering students to assess the association between spatial abilities with gender and age. The sample involved 605 students in mental rotation test and 587 students in visualization test. The finding showed significant differences between male and female students in light of their score in spatial visualization abilities with the male students outperforming their female counterparts.

Furthermore, Sipus and and Cizmesija (2012) examined the gender differences in spatial ability of students in Croatia using Mental Cutting Test. The study involved a sample of 130 students and the findings revealed that male students perform statistically significantly better than female students.

Tal and Abu-wardih (2013) carried out a study involving eighty students from fourth grade in Ajloun city in Jordan to investigate the effectiveness of a manual training program in the development of mental rotation ability. Results of the study indicated that there were statistical significant differences in reaction time and in the accuracy between the experimental and control groups in favor of the experimental group where the reaction time decreased and the accuracy increased significantly. Results also indicated that there was a significant difference in accuracy in the experimental group in favor of the females.

Also, Ben-Chaim et al. (1988) carried out a study involving students from fifth to eight grades to examine the differences in the spatial visualization abilities and the impact of instruction on spatial visualization in terms of grade, gender and site. About 1,000 students' from three sites, representing a wide range of socioeconomic status, participated in the study. The spatial visualization units engaged students in concrete activities, building and drawing solids made of cubes. The findings revealed a positive correlation between grade level and spatial visualization skills and no significant gender differences despite initial gender differences. In a related study, Robichaux (2000) attempted to explain the development of spatial ability and discovered that this ability could be gradually developed with childhood experiences that are impacted by family income, gender, and family members' occupation.

Other studies of the same caliber include Boulter (1992) who investigated the sexual differences of spatial visualization among 7^{th} and 8^{th} graders, female and male students and revealed no such differences. In another study, Manger and Eikeland (1998) examined the link between gender and spatial visualization ability and mathematics achievement among a total of 725 students in 6^{th} grade. The results showed males to be superior to females in their mathematics achievement although no significant difference was found in light of spatial visualization.

Extant studies however failed to explain the differences of spatial visualization level between the genders and thus, the present study determines whether gender differences in spatial visualization level exist between 8^{th} graders in Jordan.

2.8 MLS and Mathematics Achievement

2.8.1 Mathematics Attitude and Mathematics Achievement

Attitudes are considered as psychological constructs postulated to comprise emotional, cognitive and behavioral components. Attitudes are functions that encapsulate social expressions, value expressions, utilitarian and defensive functions for those who have them (Newbill, 2005). Attitudes are included in Bandura's (1986) social cognitive learning theory as among the personal factors impacting learning (Newbill, 2005).

Attitudes are defined as 'a summary evaluation of an object of thought' (Bohner & Wanke, 2002). Based on the Multicomponent Model of Attitude proposed by Eagly and Chaiken (1993), attitudes are impacted by three components namely cognitive (beliefs, thoughts, attributes), affective (feelings, emotions) and behavioral information (past events, experiences) (Maio, Maio, & Haddock, 2010). It is a crucial concept in learning mathematics as students' attitude towards the subject impacts their level of enjoyment derived from solving mathematical problems. According to Hight (1993), mathematics attitude can be described as the ability of the individual to recognize the usefulness of mathematics and how he/she feels regarding the subject. This has its basis on the way students are taught to view mathematics in their educational processes. Most students studying mathematics exhibit a negative attitude towards it in the form of mathematics anxiety or mathematics avoidance. This challenge is however unrelated to their ability but rather their attitudes regarding mathematics (Yenilmez, Girginer, & Uzun, 2007).

Negative attitudes toward mathematics underlie the way developmental learners lose focus when encountering mathematical challenges or obstacles (Pintrich & Garcia, 1994; Zimmerman, 2001). According to Bembenutty and Zimmerman (2003), the developmental students are inclined to throw in the towel when they are faced with challenging tasks or distractions, which could be due to their lack of ability or their mistaken assumptions concerning mathematics or even their negative attitudes towards it (Drew, 1996; Mealey, 1990). The negative attitude of mathematics' impact upon its learning has been contended by several researchers (Chouinard et al., 2007; Ikegulu, 2000).

Attitudes towards mathematics differ based on the category of subject (fractions, algebra, or geometry etc.) (Ruffell et al., 1998). Negative attitudes towards mathematics stem from several reasons such as drill and practice methods, testing situations, and perceptions of mathematics as rules-based (Ruffell, et al., 1998).

Attitude is a significant concept when it comes to learning mathematics. The students' mathematics attitude impacts their achievement and their level of enjoyment from studying the subject (Moenikia & Zahed-Babelan, 2010). Mathematics attitude is the individual's manner, disposition and feeling concerning the subject (Stramel, 2010). According to Swafford and Brown, developing students' mathematics attitude is among the goals of school mathematics instruction along with achievement-related goals.

Several researchers are convinced that negative attitudes towards the subject impact learning (Chouinard, Karsenti & Roy, 2007; Ikegulu, 2000; Stipek, Salmon, Givvin, & Kazemi, 1998). Similarly, McCleod (1992) stated that mathematics attitude is linked to mathematics achievement in the classroom. Hence, mathematics attitude has a key role in mathematics learning and teaching. In addition, it impacts student's mathematics achievement. According to Shashaani (1995), attitudes toward mathematics are significant in the students' achievement and participation in the subject. The attitude towards math should be considered as a predisposition in either a favorable or an unfavorable way to mathematics (Moenikia & Babelan, 2010).

There have been attempts from some studies to enhance mathematics attitude at lower grades to strengthen mathematics in higher studies. Attitude also impacts mathematics achievement in secondary school level (Ma & Xu, 2004). Moreover, attitudes can dramatically change in a short period of time (Hannula, 2002). It is therefore imperative that teachers try to improve students' work and positively change their mathematics attitude (Ma & Xu, 2004).

In a related study Tapia and Marsh (2001) examined the correlation between students' attitude and mathematics success. They encouraged researchers to examine the impact of attitude on students' inclination to engage in math activities and the degree of their mathematics attainment. Additionally, they stressed that students do not completely understand the concepts taught to them but attempt at associating what they learn with their experiences. Therefore, attitude towards math could factor in the determination of students' achievement in the subject.

Several studies have been carried out to determine the relationship between the factors mathematics attitude and students' mathematics achievement with most of them being in a consensus of a positive correlation between the two (Bramlett & Herron, 2009; Mohd, Mahmood & Ismail, 2011).

Also, Kadijevich (2008) requested the participation of thirty three countries in the TIMSS 2003 project involving 8^{th} graders. He revealed that every dimension of mathematics attitude positively link to mathematics achievement in all the participating countries.

In addition, Ajayi, Lawani and Adeyanju (2013) investigated the impact of mathematics attitude and self concept concerning math achievement among a total of 2400 Nigerian school students. They revealed that attitude towards the subject significantly impacts mathematics achievement. In another study, Arslan et al. (2012) revealed that mathematics attitude impacted 6-8th graders' mathematics' achievement.

Moreover, Hammouri (2004) study of attitudinal and motivational variables along with their relationship with mathematics achievement revealed results that are consistent with prior studies. She made use of the Third International Mathematics and Science Study (TIMSS) to examine 8th graders in the context of Jordan. Jordanians have been showing poor achievement in mathematics and hence, for this particular study, Hammouri (2004) attempted to relate it to their attitude. She found significant positive impact of attitude towards math on the students' achievement in mathematics and their self-perception of the importance of the subject. She also found the students' confidence in math ability positively impacts their math achievement, their attitude towards math, educational and self-perception of math's importance. She also revealed that educational aspiration of students have a positive impact upon their math achievement and their attitude towards it. Finally, she revealed that a positive impact of self-perception of maths importance upon maths achievement.

Nasser and Birenbaum (2005), on the other hand, examined the relationship between mathematics achievement and a number of learner-related factors including self-efficacy, beliefs regarding knowledge, and mathematics attitude. They carried out the study in two samples 8^{th} graders Arabs and Jews. They revealed that both groups of students' mathematics achievement are best predicted by their beliefs concerning their achievement capabilities in mathematics. They operationalized attitudes towards mathematics to cover the level of the students' partiality to the subject, the level of their difficulty with it and the level of importance they place in the subject. The relationship between mathematics achievement and attitudes was however unclear. They revealed that attitudes insignificantly impacted mathematics achievement of Jewish students while it significantly impacted the Arab students. In other words, Arab students who exhibited positive attitudes towards the subject gained higher achievement compared with those who have a negative attitude. In another study, Nicolaidou and Philippou (2003) revealed a significant correlation between mathematics attitude and problem solving achievement.

Furthermore, Manoah, Indoshi and Othuon (2011) examined attitudinal influence upon students' mathematics achievement. They conducted the study among 2960 secondary school students enrolled in Kisumu East District in Kenya. Their data collection methods were students' questionnaire and a math test. Through Pearson Correlation, they revealed a relationship between students' attitude and mathematics achievement which is consistent with other studies (Ghanbarzadeh, 2001; Hammouri, 2004; Scott, 2001).

In light of the above studies, the findings presented a strong relationship between mathematics attitude and mathematics achievement as supported by some studies (Ghanbarzadeh, 2001; Hammouri, 2004).

Although the relationship between attitude and achievement is statistically significant, it is far from strong in a practical point of view. According to Scott (2001), the relationship between the two factors should not be considered as definite. Therefore, researchers have been dedicating studies towards examining the mathematics attitude while calling the need for the development of a theoretical concept. Other studies (Di-Martino & Zan, 2001; Hannula, 2003) stated that attitude is an unclear construct and is often utilized sans a universal definition. They call for its theoretical development and the refining of the measures.

In sum, several studies have been conducted to determine the factors impacting students' achievement in mathematics. One of the factors that they have studied is students' mathematics attitude. They often reveal that students' attitude positively impacts students' academic achievement (Mohd., Mahmood, & Ismail, 2011). Therefore, students' mathematics attitude is a main factor that may influence their achievement.

The present study attempts to determine the relationship between mathematics attitude and mathematics achievement in the context of Jordan in order to contribute to literature.

2.8.2 Mathematics Motivation and Mathematics Achievement

Among the many influential factors impacting school achievements is motivation. On the basis of Pintrich and Zusho (2002) study, academic motivation is the internal processes instigating and sustaining activities that are aimed at fulfilling particular goals in academy. In addition, according to self-determination theorists, academic motivation has various dimensions and is categorized into three global types: intrinsic motivation, extrinsic motivation and contextual motivation (Deci & Ryan, 2002).

The above three types were differentiated by Holden (2003). According to her, students' motivation is controlled by rewards. In other words, extrinsically motivated students are often lured by extrinsic rewards like phrase, or positive feedback. On the other hand, the students' intrinsic motivation is controlled by intrinsic rewards that are concerned with the development of understanding, obtaining power, and experiencing task enjoyment. With regards to contextually motivated students, they expect to obtain contextual rewards like peer acknowledgement, working with challenging tasks and obtaining usefulness from the task (Waege, 2007).

On a different take, extrinsic and intrinsic motivation was related by Goodchild (2001) with ego and task orientation, and with performance and learning goals respectively. He explained that an extrinsically motivated student believes that he is doing something that would result to an outcome that is external to the task (gaining approval or proving self-worth). On the other hand, one who is intrinsically motivated when he believes that the task is valuable for its sake – task achievement is brought about to understand.

In this regard, Evans and Wedege (2004) posited that individual's motivation and resistance to mathematics learning is an interrelated phenomena. They demonstrated and discussed various meanings of both terms as utilized in the field of mathematics and adult education. Also, Middleton and Spanias' (1999) conducted a review of literature dedicated to motivation in mathematics education, and found that intrinsic motivation is defined as the student's inclination to take part in learning for its sake while extrinsically motivated students take part in the same to receive rewards like good grades, or approval, or to steer clear of punishment.

On the other hand, Child (1986) defined motivation as the "internal processes which spur on us to satisfy some need (p. 32)". Moreover, both high motivation and learning engagement have been constantly related to decreased dropout rates and heightened level of student achievement (Kushman, Sieber, & Harold, 2000).

Similarly, Pintrich and Schunk (1996) defined motivation as "the process whereby goal-directed activity is instigated and sustained (p.4)", while Dornyei and Otto (1998) described it as "the dynamically changing cumulative arousal in a person that initiates, directs, coordinates, amplifies, terminates and evaluates the cognitive and motor processes whereby initial wishes and desires are selected prioritized, operationalized and (successfully or unsuccessfully) acted out (p. 65).

Moreover, Gardner (2010) described motivation as a construct with an elusive definition although its characteristics can be identified through those exhibited by motivated individuals. He proceeded to state that motivated individuals exhibit effort and persistence in reaching goals and they tackle tasks effectively. They also have a strong desire to reach goals, enjoy activities, encouraged to fulfill their aims and they hold expectancies of their successes and failures. Gardner (2010) is of the opinion that upon achieving some level of success they exhibit self-efficacy and are confident about their achievement. The reasons behind their behavior are their motives.

Hence, it is logical to state that student motivation is a complex process that entails the interaction of MLS factors. Students who are motivated posses the ability to utilize higher cognitive processes to learn, absorbs, and retain more from their subjects (Graham & Golan, 1991). Motivated students exert effort to understand the subject matter, enhance their performance, and look for challenges and exhibit persistence in their tasks even when they are faced with failure (Wookfolk & Hoy, 1990).

Other studies (Tucker, Zayco & Herman, 2002) referred to motivation as an academic engagement that can be defined as "cognitive, emotional and behavior indicators of student investment in and attachment to education". It is evident that unmotivated students do not work hard. Several researchers go as far as stating motivation is the only factor that impacts academic achievement and all the other factors indirectly impact achievement through it (Tucker et al., 2002). It is however not easy to determine what exactly motivates students to succeed in their academic undertaking.

To conclude, motivation has always been an issue of controversy among researchers in the field of mathematics learning. This controversy does not stem from any doubt regarding the importance of motivational factors for mathematics learning but from the differences between intrinsic and extrinsic motivation and the serious criticisms attributed to them (Moenikia & Babelan, 2010). In the previous four centuries or so, a large portion of literature has stressed on the importance of motivation in mathematics learning (Cleary & Chen, 2009).

Middleton and Spanias (1999) claimed that mathematics success is a significant influence upon the motivation to achieve. Similarly, Dickinson and Butt (1989) stated that students will perceive the task more enjoyable when they have a moderately high probability of success than when they have a lower probability of it. Several external and internal factors including feeling valued, perception of cognitive competence, benefits and threats from peers and teachers, and perception of parents, supportive environment, task difficulty, real-live activities, gender, perception of success, fear of punishment all have a major role in motivating students to achieve in mathematics (Alderman, 1997; Gottfried, Fleming, & Gottfried, 2001; Wentzel, 1998). Based on Brophy (1998) study students' motivation to succeed in mathematics is considered as a cognitive reaction that involves attempts to understand mathematics activity, information linked to prior knowledge and to master the skills that it promotes. This indicates that for the development of student motivation in learning and succeeding in mathematics as an enduring disposition, it is imperative that students value mathematics learning for its potential for self-actualization and life-application and hence, to learn mathematics with a personal purpose (Brophy, 1998).

Motivation assists in solving problems. On the basis of several problem solving models, O'Neil and Schacter (1997) created the National Center for Research on Evaluation, Standards, and Student Testing model of problem solving contains four elements namely content understanding, problem solving strategies, metacognition and motivation. Motivation is considered by the model to comprise of three components namely self-efficacy, effort and worry. Some researchers revealed that high worry is linked to low cognitive achievement (Pajares & Urdan, 1996) while others (Stevens, Olivarez, William & Talent-Runnels, 2004) revealed that upon believing in their mathematics skills, the students motivation will heighten and previous mastery experiences assist in improving their self-efficacy and motivation by giving them higher confidence to achieve mathematics.

Hammouri (2004) study involved data from 3,736 thirteen year old Jordanian students enrolled in 8^{th} grade who are participants to the TIMSS study. The students completed a student questionnaire and took the math test provided. Hammouri (2004) aimed to investigate the relationship between attitudinal and motivational student-related variables connected to mathematics achievement. The study's affective factorss were educational aspirations, students' attitude, success attribution, confidence in ability (self-efficacy), and perception of the mathematics importance. She postulated that while mathematics achievement is impacted by these factors, it is not caused by them and that every factor positively impacted mathematics achievement. She revealed that all the factors showed positive impact with the exception of student's attribution of their mathematics to luck, and their friends' perceptions of the mathematics importance. Her findings also revealed that individuals who are closely related to the students have great influence in establishing their beliefs and attitudinal orientations. In addition, maternal perception of the mathematics importance had the highest positive total and the direct impact upon mathematics achievement.

The academic motivation (motivation, extrinsic motivation, intrinsic motivation) – academic achievement was also examined by Areepattamannil (2014). His study's sample comprised 363 Indian adolescents in India and 355 Indian immigrant adolescents in Canada. He conducted the hierarchical multiple regression analysis on the data obtained and revealed that intrinsic motivation, extrinsic motivation and amotivation did not statistically and significantly relate to mathematics achievement among the first group but it did among the second. Specifically, in the second group (immigrants in Canada), intrinsic motivation was found to statistically and significantly predict mathematics achievement in a positive way whereas extrinsic motivation statistically and significantly predicted mathematics achievement in a negative way. Moreover, amotivation did not significantly and statistically relate to mathematics achievement among the same group. Prior research documents that extrinsically motivated students are more likely to have lower academic achievement (Becker et al., 2010).

On the other hand, Shores and Shanon (2007) examined the role of many factors with the inclusion of motivation upon the students' mathematics achievement. The sample consisted of 169 school students in South Florida and the findings revealed that intrinsic motivation factors significantly correlate with mathematics achievement.

In addition, Schweinle, Meyer and Turner (2006) examined the relationship between motivation and affect, and motivation and teachers' instructional practices. Their study sample consisted of 42 students from grades five and six of mixed ability from a White Middle Class Suburban School. The students were requested to report on social affect (their feelings regarding social experiences in the context of classrooms), personal affect (feelings regarding themselves as individuals), efficacy (perceived skills and abilities), and challenge of mathematics learning to them and to their peers. They revealed that affect is crucial to students' mathematical experience and that students' perceived skills in math are correlated with affective factors (their feelings concerning mathematics) and students consider challenges as a threat to their self-efficacy in mathematics learning.

The above findings by Schweinle et al. (2006) is consistent with a prior study by Stevens, Olivarez, Lan and Tallent-Runnels (2004) who examined 258 Latino and Caucasian in grades 9 and 10 in Texas to comprehend how self-efficacy and motivation are linked to mathematics achievement. They revealed that similar motivation systems are present for mathematics achievement prediction throughout ethnicities and that self-efficacy is a predictor of motivational orientation and mathematics achievement. Their findings revealed that student's beliefs and motivation has key role in mathematics achievement indicating that researchers should take these factors in consideration and explore methods to support the development of students in light of these qualities.

Moreover, Vermeer, Boekaerts and Seegers (2000) conducted an examination of 158 students of whom, 79 are boys and 79 girls. The students studied sixth grade mathematical problem solving behavior of two types namely mathematics tasks and computations and applications. They revealed differences between the gender when it came to mathematical problem-solving behavior, which greatly relied on the contents of the tasks and on gender. They proceeded to add that students' achievement of task appraisal and learning intention were higher for computation problems compared to application problems. Also, Khoush, Bakht and Kayyer (2005) and Yunus, Suraya and Ali (2009) revealed a significant positive link between motivation and students' mathematics achievement.

Suarez et al., (2014) examined the relationship between academic performance (mathematics & science) and three variables namely, self concept, motivation, and academic expectations. A sample of 7,729 students from secondary school in Spain was used. The findings showed that all three variables had a high and statistically significant correlation with academic performance. And the results showed that these variables predict mathematics and science performance.

In relation to the above studies, the motivation effects of Mathematics classrooms help-seeking behavior and the students' feelings concerning such behavior's advantages and disadvantages were examined by Ryan and Pintrich (1997). Their study sample comprised 203 grade 7th and 8th students who were requested to fill the questionnaire that gauged their perceptions of social and cognitive competence, achievement goals, attitudes, and avoidance of adaptive help-seeking behavior. According to Ryan and Pintrich (1997) avoidance of help-seeking is when a student requires help but refuses to ask for it whereas adaptive help-seeking is when a student requests for hints to solve the problem, to obtain examples of such problems, or to make the problems clearer (p.329). A pattern of results were revealed among motivation variables and these included goals achievement, task-focus, extrinsic, relative ability, perception of competence, social and cognitive and help-seeking behaviors (adaptive and avoidance). They also revealed the following findings; a significant negative relationship between the latter type of help-seeking behavior and task-focused goals, cognitive competence and benefits, a significant positive relationship between the former type of help-seeking and task-focused goals, cognitive competence and benefits, a significant positive relationship between avoidance of help-seeking and extrinsic, relative ability goals, threats from peers and teachers, a significant negative relationship between adaptive help-seeking and extrinsic goals, treats from peers and teachers, and finally, a negative math achievement-avoidance of help-seeking relationship (Ryan & Pintrich, 1997).

Majority of research concerning intrinsic and extrinsic motivation revealed that these motivation components are strong factors of motivational beliefs and this element allows students to get involved with the learning tasks and obtain superior mathematics achievement. Several mathematics instructors have examined students' motivation in light of motivational beliefs (Opt, Eynde, De Corte, & Verschaffel, 2002) and interest (Koller, Baumert, & Schnabel, 2001). Similarly, Evans and Wedege (2006) opined that people's motivation and resistance to learning mathematics is interrelated with each other. While a number of studies have tackled people's motivation (Evans & Wedege, 2004; Hannulla, 2006), only a few of them have examined the impact of motivation on mathematics achievement (Holden, 2003) and hence, the present study hopes to contribute to literature through the examination of motivation factors influencing the students' successes in mathematics.

2.8.3 Self-regulation and Mathematics Achievement

Social cognitive researchers define self-regulation as the proactive initiation of thoughts, feelings and behaviors that has been planned and adapted in a cyclical way on the basis of self-generated or performance feedback in the quest to achieving personal goals (Zimmerman, 2000). Researchers claim that self-regulated learning is context specific (Zimmerman, 2001) and hence, students may hold various patterns of strategy use in mathematics compared to any other subjects. It seems that the use of strategy is related to the students' learning goals in mathematics.

Self-regulated learning is an invaluable context for examining the academic success of developmental students. Self-regulated learning is considered as the acquisition of knowledge and skills through cognitive and meta-cognitive processes along with actual behavior (Zimmerman, 2008). It provides the learning process with an active and constructive approach, involving awareness, monitoring and management of cognitive, motivational affective and behavioral elements (Pintrich, 2000b; Zimmerman, 2008). On the other hand, cognitive regulation entails the knowledge of when and how to utilize different learning strategies while regulation of motivation and affect entails the management of motivation and attitudes (Pintrich, 2000b). In addition behavioral regulation entails the management of actions and may encapsulate activities like time management, record keeping and help seeking (Pintrich, 2000b). Therefore, effective self-regulated learners possess the ability to control their motivation, cognition, behavior and environment (Pintrich, 2000).

Many self-regulatory strategies have been proposed. The following strategies were proposed by Zimmerman and Martinez-Pons (1988); tests, notes or texts reviews, seeking information, environmental structuring, seeking help, record keeping and self-monitoring, self consequences, and self-evaluation. Other researchers (Pintrich, Smith, Garcia & McKeachie, 1991) proposed elaboration, meta-cognitive self-regulation, effort regulation and peer learning. Learners who are self-regulated adopt various strategies during learning including organizing and transforming information, elaborating, rehearsing and memorizing, and reviewing tests, notes and texts, which are all considered as cognitive learning strategies (Zimmerman, 2000).

While rehearsal is a more surface method of learning, while strategies like elaboration and organization/transformation are complex tasks requiring in-depth processing (Pintrich, et al., 1991). Along with using various learning strategies, self-regulated learners also make use of meta-cognitive (self-monitoring, self-evaluating) as well as behavioral strategies (time-management, effort regulation) in an attempt to maintain their performance.

Self-regulation has been examined in a number of academic settings in the past two decades. Self-regulated learning is especially important for school students. According to Pintrich and Garcia (1994), self-regulatory strategies are particularly significant for students because they can be learned. Hence, the developing schools students may acquire and employ self-regulatory strategies to improve their academic success. Bembenutty and Zimmerman (2003) revealed a causal relationship between self-regulated learning and academic achievement. Hence, students who are able to self-regulate may have a higher chance of experiencing academic success. However, empirical researches dedicated to the application of self-regulated learning on mathematics achievement are few and far between. Hence, self-regulation acts as a gateway for studies expansion concerning mathematics achievement through the determination whether self-regulation can predict mathematics achievement.

Self-regulation has often been linked time and again to positive outcomes and student achievement (Halloran, 2010). Stoeger and Ziegler (2005) utilized the training program developed by Zimmerman, Bonner and Kovach (1996) to examine a self-regulated training program for exceptional students that are weak in mathematics. The study was carried out in the context of a regular classroom instruction on the subject of mathematics over six weeks. The findings revealed that training was effective to increase mathematics achievement indicating that students may have different patterns of strategy in mathematics compared to other subjects which is linked with their learning goals in the subject.

In a related study, Pintrich (2000) examined the correlation between achievement goals comprising of mastery and achievement, a number of motivation variables including self-efficacy and task value, affect and adaptive and maladaptive self-regulated learning strategies including cognitive and meta-cognitive ways among 150 middle school American students. He made use of a series of scales to be administered at the onset and the end of 8^{th} grade. At the onset of the following grade, it was revealed that students assuming more mastery goal orientations had the greatest probability of making use of adaptive self-regulated learning strategies and they exhibited higher levels of self-efficacy compared to those students who are achievement oriented.

In addition, Nicolaidou and Philippou (2005) examined the relationship between self-regulation strategies use, motivation and mathematics achievement in Cyprus. Data was gathered from 194 pre-service instructors through the modified version of MSLQ and mathematics achievement. The findings revealed self-efficacy to be a strong predictor of mathematics and self-regulation use has a negative impact on mathematics achievement owing to the participant's lack of using these strategies.

Moreover, Zimmerman and Martinez-Pons (1990) carried out a study in their attempt to provide a description of the use of 14 self-regulation learning strategies and to estimate verbal and mathematical efficacy. The study sample consisted of 90 students who are from fifth, 8^{th} and eleventh grade of different ethnicities. The findings showed that the perceptions of verbal and mathematical efficacy were significantly and positively related with the stated use of self-regulatory strategies (self-evaluation, record keeping and monitoring).

Also, Kimer (2009) study examined the impact of training of self-regulation learning strategies upon mathematics anxiety and math achievement. The participants to the study comprised of 60 freshman students enrolled in the Urban University in the Northern U.S. The findings revealed that self-regulation learning strategies are correlated with enhanced mathematics and science problem solving.

In the context of Germany, Perels et al. (2009) conducted an evaluation of the effectiveness of self-regulatory strategies to enhance mathematical achievement of students in sixth grade. The study sample comprised of 53 German students who were participants to a pre-test/post-test control group design model studied over three years. The former group was instructed self-regulated learning strategies emphasizing on positive mathematics attitude and learning, motivation, goal-setting, planning and dealing with distractions (Perels, et al., 2009). The strategies were coupled with the same mathematical content presented to the latter group. The findings showed a significant improvement of mathematics achievement among the former experimental group.

In a related study of middle grade students, Otts (2010) studied the relationship between students' self-regulation strategies and their attitude towards math and the course outcomes in mathematics development. The study sample comprised of 376 students who studied developmental math course in a college community. Students were more inclined to regulate their effort and structure their learning environment among the other self-regulated learning scales (meta-cognitive self-regulation, effort regulation, environmental management, peer help, and study strategies). In addition, the regression test showed that self regulated learning and attitude towards math are significant factors and predictors of students achievement in mathematics.

Loong (2012), on the other hand, examined self-regulation learning between low, average and high achievers among pre university students in Malaysia of local and international origins. The study sample comprised of 156 students and self regulated learning was measured by LASSI and math achievement was measured by the final scores of the students in their mathematical subject. The findings revealed that attitude and self-testing subscales were significant predictors of home students math performance, while attitude and test strategy subscales were significant predictors of international students math performance.

Meanwhile, Pintrich (2000) study involved 194 American students who are 8th and 9thgraders and the findings indicated that strategy usage comprising of planning, monitoring, and regulating cognition in math classes decreased from the students while their handicapping behaviors comprising of procrastinating and withdrawing increased over the same period. This shows the necessity for instructors to motivate their students to make use of self-regulatory strategies in math and to teach them how to employ such strategies. Moreover, students having mastery orientations were not as likely to engage in self-handicapping and withdrawing of effort in the face of difficulty as their peers (Pintrich, 2000). These findings are inconsistent with those of Zimmerman and Martinez Pons (1990) who stated that self-regulatory strategy use increased from 5th to 8th and to 11th grades. The inconsistent findings are attributed to different research methods, analysis and academic contexts.

Several studies have shown that self-regulation variables significantly correlate with mathematics achievement. Studies such as those conducted by Montague (2008), Perels, Dignath and Schmitz (2009) outlined positive correlations in the mathematical achievement-self-regulation relationship. The findings revealed that self-regulatory strategies including self-monitoring and organizing and transforming are advantageous for developmental students. While Um, Corter and Tatsuoka (2005) examined the effects of motivational resources and autonomy support on math performance. There sample comprised 9,072 eight grade students from 150 sampled school in U.S. the result of their study stated that intrinsic motivation positively influence math performance, while external regulation negatively influences math performance. Therefore, this study seeks to add to the literature by examining self-regulation factor that influence achievement of mathematics among 8^{th} graders in Jordan.

2.8.4 Self-efficacy and Mathematics Achievement

Perceived self-efficacy is considered as a core factor that impacts human functioning in the context of social cognitive theory. It is referred to as the "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). In the context of academic settings, self-efficacy is the students' beliefs in their learning capabilities to complete a task or to succeed in an activity. Beliefs of efficacy exhibit future-oriented judgments instead of the actual degree of competence (Woolfolk & Hoy, 1990).

These beliefs are either task-specific or situation-specific judgments of an individual's competence and are utilized in reference to specific goals. Therefore, an individual's self-efficacy may differ based on various factors like the nature of tasks, required skills, preparation, and environmental conditions. For example, a student's efficacy for solving a mathematical problem that calls for the application of a concept may be lower than his efficacy for solving a problem that calls for basic skills.

Self-efficacy is a concept introduced by Bandura (1977) in his paper entitled, "Self-efficacy: Toward a Unifying Theory of Behavioral Change". Bandura assumed that psychological procedure, like cognitive appraisals of observation or other stimuli work as a method to form more self-efficacy. He proposed that self-efficacy stems from achievement accomplishments, vicarious experience, verbal persuasion and physiological states. He assumed two expectations namely efficacy expectations and outcome expectations. The latter is described as the individual's expectation that a particular outcome will result from a specific behavior while the former is the expectation that the required behaviors can be carried out successfully in order to result to a desired outcome.

Diverging from his behaviorist training, Bandura stressed that social learning theory "emphasizes the informative function of physiological arousal" (Bandura, 1977, p. 199) and that the cognitive evaluation of arousal ascertains the level and direction of an individual's motivation to act. Following his introduction of the theory, Bandura (1982) conducted a review of self-efficacy research and came to the conclusion that it has extensive explanatory power in different fields including health rehabilitation, phobias, physical stamina, addiction, achievement strivings and career choice. He proceeded to study self-efficacy and consequently contributed his ideas to social cognitive theory (Bandura, 1986). The theory posits that a person's cognitive factors, behavior and environment are inter-correlated through a model consisting of reciprocal dynamism. The model assumes that individuals are not directed by inner forces and they are not molded by external stimuli but explained through a model of triadic reciprocality whereby behavior, cognitive and other personal factors and environmental events all interact with each other. Each component's impact differs in Bandura's triadic reciprocality in varying situations. For instance, a person having low level of self-efficacy in one situation would have low potential to control the environment compared to when the same person is in a situation where he experiences a high level of efficacy. Several studies have reinforced this contention;

research in the field of meta-analyses of self-efficacy research in the domains of academic achievement (Multon, Brown, & Lent, 1991), group functioning (Gully, Incalcaterra, Joshi & Beauien, 2002), sports performance (Moritz, Feltz, Fahrbach & Mack, 2000) that support the self-efficacy beliefs and significantly contribute to both motivation and achievement.

Current researches (Vancouver, Thompson, Tischner & Putka, 2002; Vancouver, Thompson & Williams, 2001) go against the causal link between self-efficacy and achievement claiming that they found a negative relation between the two factors. Summarily, the conclusions indicated that as an individual's self-efficacy towards a task heightens, he exerts less effort for its achievement (Vancouver et al., 2002). Vancouver et al. (2001) did not consider their findings as new but they claimed that their methods of analysis highlight the aspect of self-efficacy and they called for more research to support their contention.

In response, Bandura and Locke (2003) examined Power's control theory and the results of Vancouver et al. (2002), and Vancouver et al., (2001) and dismissed them. In a strict analysis of control theory, Bandura and Locke described it as psychologically barren, identifying little in terms of new processes aside from those that are already identified (p. 93). As for findings of Vancouver et al. (2002) and Vancouver et al. (2001), Bandura and Locke mentioned nine extensive meta-analyses to prove that self-efficacy positively impacts achievement. They also tackled conceptual, methodological and interpretive issues with it. Bandura (1997) also examined Vancouver et al.'s (2001, 2002) contention that high self-efficacy results in adverse achievement. He stated that many individuals turn complacent as they consider themselves to be highly efficacious in achieving the task and therefore become too content to exert minimal effort. In addition, based on folk wisdom, overconfidence has deceived many. Hence, motivation is best maintained by high efficacy in order to veer away from failure along with uncertainty attributed to the challenge faced in task completion as opposed to basic doubts of one's abilities to exert the required effort for the challenges (p. 130).

According to some researchers, self-efficacy is a significant predictor of students' future mathematics achievement (Parker et al., 2014). Researchers who evidenced the positive impact of self-efficacy on achievement claimed that educational approaches improve students' mathematical knowledge as well as heighten their mathematics self-efficacy (Jackson, 2002; Ponton, 2002). They also showed that mathematics self-efficacy or students' belief of their ability to tackle mathematical problems encourage them to achieve superior results and they end up becoming masters in problem solving. While solving mathematics problems, students having heightened self-efficacy are more inclined to show higher interest in and pay more attention to how to solve the problems, to show higher perseverance when met with challenges, and to present high optimism of success. Contrarily, students who are struggling in many academic areas stemming from motivation, education or physiological reasons, often have self-efficacy problems (Brewer, 2009).

In a related study, Lopez and Lent (1992) examined self-efficacy in mathematics in order to understand its origin in high school students. They revealed that self-efficacy in mathematics correlate significantly and positively with students' grades. They showed that students' beliefs of their self-efficacy in mathematics stem from their previous experiences and emotional arousal information. As a result, inferior achievement and lack of mathematics self-efficacy lead to lack of motivation to engage in math courses in the future.

Pajares and Kranzler (1995) reached the same conclusion and stated that as self-efficacy beliefs strongly predict achievement and mathematics anxiety, it is important for educators to take students' perception of competence and actual competence into consideration. Current researches also continue to show self-efficacy's significant impact upon mathematics achievement (Pietsch, Walker, & Chapman, 2003; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004).

Researchers are convinced of self-efficacy's importance as a predictor of math achievement. Pajares and Graham (1999) examined self-efficacy and motivation and mathematics achievement of Middle school students. The study sample comprised of a total of 273 sixth graders from a public middle school in a suburban area of which 190 of them are White, 47 are African American, 12 Hispanic American and 24 Asian American. They statistically controlled for additional motivational factors (anxiety, self-concept, self-regulation, value and engagement). They revealed that despite the correlation between self-efficacy in mathematics with the other measured motivational factors, self-efficacy on its own was revealed to be a predictor of achievement in mathematics at the start of the school year and at the end.

Similarly, Watts (2011) studied the predictor factors of mathematics success of individuals in the context of Western Area of South Atlantic State. The study involved the participation of 107 students among whom 72 were Caucasian, 14 were African American, 8 Latino, 4 Asian while 9 were others. He utilized the multiple variables analysis and the findings showed that age, mathematics anxiety, and mathematics self-efficacy while related, self-efficacy in mathematics is the only predictor of achievement.

According to Shores and Shanon (2007), self-efficacy variable significantly correlates with mathematics achievement. They reached this conclusion from studying the role of multi factors including self-efficacy of students on mathematics achievement. Their study involved a total of 169 students in South Florida. Similarly, Pajares and Kranszler (1995) stated that the self-efficacy of American students in the 9th, 10th, 11th, and 12th grade directly affected their mathematics anxiety and achievement. Additionally, self-efficacy in math of exceptional students in grade 8 in the U.S. is a predictor of their achievement in mathematics (Pajares, 1996). This finding was supported by Yildirim (2010) findings. He examined the self-efficacy, motivation and anxiety's prediction of mathematics achievement through PISA 2003 which involved Turkey, Finland and Japan. All three countries showed self-efficacy's positive prediction of mathematics achievement.

In a similar study, Sartawi, Alsawaie, Dodeen, Tii, and Alghazo (2012) examined self-efficacy and motivation as predictors of mathematics achievement in light of gender and achievement levels in the context of U.A.E. The study sample comprises of 287 students in fifth grade. Self-efficacy measurement was made through two sub-scales which varied in levels of specificity namely category specific and task specific. On the other hand, motivation was measured with the help of four sub-constructs of motivation – motivation, external regulation, introjections regulation and intrinsic motivation. The study utilized multiple regressions analysis which revealed that six factors were predictors with a high percentage (32%) of the variance of mathematics achievement. Moreover, the top three predictors were self-efficacy, external regulation and intrinsic regulation. In the context of Australia, Nielsen and Moore (2003) revealed that Australian students in the ninth grade had mathematics self-efficacy scores which significantly and positively related with their mathematics scores from the prior year. Also, Nasser and Birenbaum (2005) stated that self-efficacy of Palestinian and Jewish 8th graders positively affected their scores in the National Assessment Test in Mathematics.

In related study, Parker, Marsh, Ciarrochi, Marshall, and Abduljabbar (2014) examined self-efficacy and self-concept as predictors of of long-term achievement outcomes. They used the longitudinal study of Australian youth which uses the 2003 Australian Programme of International Student Assessment over eight years. The findings showed a strong relationship between achievement, self-efficacy and self-concept in mathematics at age 15. Also, the findings showed mathematics self-efficacy was a significant predictor of university entry but math self-concept was not, math self-concept was a significant predictor of undertaking post-school studies in science, technology, math, but math self-efficacy was not.

In sum, many studies were conducted to examine the relationship between self-efficacy and achievement. Additionally, the widespread use of self-efficacy in the field of education, particularly in mathematics education has led to the increasing number of studies in the field. Self-efficacy in mathematics is revealed to strongly predict the outcomes and its impact in math achievement influences general mental ability (Pajares & Graham, 1999). Some studies who examined the above relationship confirmed strong relationship (Pajares & Miller, 1994). Among them, Pietsch, Walker and Chapman (2003) indicated that self-efficacy is a more suitable measure for predicting future math achievement.

2.8.5 Mathematics anxiety and Mathematics Achievement

Mathematics anxiety often originates from negative experiences, stressful situations or personal issues that students face during their academic experience. Many definitions of mathematics anxiety have been developed by researchers over the years. The most widely used definition come from Richardson and Suinn (1972). They defined it as, “involving feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations” (p. 551). May (1977) followed with her definition which states that mathematical anxiety is “the apprehension cued off by a threat to some value that the individual holds essential to his existence as a personality” (p. 205).

It has also been defined as an, “inconceivable dread of mathematics that can interfere with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations” (Buckley & Ribordy, 1982).

On the other hand, Fiore (1999) defined it as the panic, helplessness, paralysis, and mental disorganization that is felt by some people upon being asked to solve a mathematical problem (p. 403). Similarly, Arem (2003) opined that mathematics anxiety can be linked directly to test anxiety resulting from poor test-taking skills, poor test preparation and psychological tension felt by the individual. Also, Richardson and Suinn (1972) claimed that mathematics anxiety entails both feelings of tension and anxiety that hinders the number manipulation and providing solution to mathematical problems in various walks of daily and academic life (p.551).

According to Preis and Biggs (2001), mathematics anxiety is a cycle beginning with negative experiences in mathematics. Consequently, a student performs poorly in mathematics test resulting in another adverse experience. This cycle can urge mathematics anxious students to believe that they cannot be successful in mathematics. In order to ascertain the impact of mathematics anxiety upon educational system, the concept has to be understood. Arem (2003) anxiety/achievement curve revolves around the belief that certain degrees of anxiety may motivate and hence are necessary for higher degrees of achievement. On the other hand, students suffering from low levels of anxiety are unmotivated and hence perform poorly. With the increase in the anxiety level, the student’s motivation increases changing their perceptions of mathematics and increasing their performance. With greater increase of anxiety, the feelings of panic sets in along with forgetfulness and self-doubt which impact the student’s ability to perform good in mathematics as the level of achievement takes a dip. When the curve is plotted on a graph, it seems like an inverted U.

Mathematics anxiety impacts many students in different levels of academia and when the overall level of anxiety begins to take a dip, more students are inclined to pursue educational paths to prepare them for their professions as mathematicians, statisticians, engineers, scientists and educators (Scarpello, 2007). Educators should be aware of their responsibility to comprehend mathematics anxiety in order to ascertain if an individual is suffering from it and the degree to which it is experienced. This is then supplemented by lessons to help individuals overcome their anxiety. Despite the number of researchers who have brought forward unique explanations of mathematics anxiety, literature reveals that mathematics anxiety does exist and it impacts the student's ability to achieve in mathematics. Norwood (1994) claimed that mathematics anxiety does not stem from just one cause but different factors like the inability to handle frustration, excessive school absences, poor self-concept, parental and teacher attitudes towards mathematics and stress in learning mathematics through drilling as opposed to understanding. In order to decrease the degree of anxiety, educators should determine which individuals are suffering from it and the level of their anxiety. This can be followed by remediation through the provision of instructional strategies for anxiety alleviation. After alleviating anxiety, the students can proceed to understand mathematical concepts.

According to Kesici and Erdogan (2010), "One of the most significant reasons preventing mathematics achievement is mathematics anxiety" (p. 54). Mathematics anxiety ranges from simple forms of test anxiety to the stronger forms of entire incapacitation when beholding mathematics problems. Researchers stated that mathematics anxiety impacts the individual's memory - an aspect required to handle math tasks in a successful way.

There are various causes of mathematics anxiety but researchers are of the consensus that students' mathematics anxiety stems to a degree, from negative past experience with the subject. This type of experience include poor instruction, self doubt, unrealistic academic expectations of both teachers and parents, gaps in knowledge, and attitudes of teachers, among others (Cavanagh, 2007; Furner & Berman, 2003). Several studies indicated that students begin experiencing mathematics anxiety when they first handle Algebra in late middle school or early high school.

Literature is full of studies dedicated to examining the relationship between students' anxiety and their mathematics achievement. According to Green (1990), while mathematics anxiety significantly relates to math achievement of developmental math students, other factors such as test anxiety, math placement test scores and feedback from teachers are also significant predictors of math outcome. On the other hand, to determine whether eight grade students consisting of 86 males and 70 females differed in their mathematics anxiety based on low and high achievement motivation, Kesici and Erdogan (2010) compared their motivation and their self-esteem. They revealed that students exhibiting high achievement motivation had higher anxiety of math compared to their counterparts with low achievement motivation. The findings revealed that low self-esteemed students had higher mathematics anxiety compared to higher self-esteemed students. They also showed that students tend to compare between themselves and their peers as opposed to just understanding their own deficiencies and mistakes.

Moreover, Cates and Rhymer (2003) studied the mathematics anxiety -mathematics achievement relationship and showed correlation between the two factors. Also, Karimi and Venkatesh's (2009) study examined 10^{th} graders (144 males and 140 females) from Karnataka, India. They attempted to study the level of mathematics anxiety-mathematics achievement and academic hardiness relationship and the impact of gender on the three variables. Their findings revealed a significant negative relation between mathematics anxiety and achievement. In other words, as the students' anxiety increased, their achievement takes a dip. Similarly, Khatoon and Mahmood (2010) attempted to examine the relationship between mathematics anxiety and math achievement among 1652 Indian students in various academic settings through the mathematics anxiety scale (MAS) and mathematics achievement test (MAT). They revealed a significant negative link in the relationship.

A similar result was revealed by Ovez (2012) study when he examined the relationship among 244 5^{th}-8^{th} graders in Sindirgi District, Balikesir Province, Turkey. Ma (1999) findings were also along the same lines. His study was a meta-analysis involving the examination of 26 studies concerning the relationship between mathematics anxiety and mathematics achievement among elementary and secondary students. The results showed a negative relationship between mathematics anxiety and mathematics achievement. The meta-analysis also involved studies in various countries, so results further revealed that mathematics anxiety was prevalent worldwide.

Additionally, Birgin, Baloglu, Catlioglu, and Gurbuz (2010) investigated mathematics anxiety among 220 Turkish students of 6^{th}-8^{th} grades in light of their achievement levels in Math, perceived enjoyment of math teaching method and perceived help from parents. According to their findings, mathematics anxiety increased with the students move from one grade to the next. They revealed that mathematics anxiety is at its lowest among students in grade 6 where M=28.32 and SD=8.24 and it is at its highest among 8^{th} graders with M=33.49 and SD=7.57.

In a related study, Joseph (2012) studied the students' five psych-academic variables and their role as predictors of students' mathematics achievement. The study sample consisted of 854 9^{th} graders from secondary school in Ibom State in Nigeria. The findings revealed anxiety not to be a significant predictor of students' mathematics achievement.

A study was conducted by Al-Astal (2004) to examine the university students' mathematics anxiety level at the Faculty of Education and Basic Science in Ajman University, and its relationship with the students' academic achievement, gender and training throughout their practical training program, and math achievement. He modified and employed the mathematics anxiety Rating Scale (MARS) and used it on the sample of 127 math and science students at the end of the second semester of the school year 2001-2002. According to the findings, the students displayed a low level of mathematics anxiety and that the anxiety of those students possessing higher academic achievement was lower in comparison to those possessing lower academic achievement. The findings also revealed a low negative relationship between mathematics achievement and mathematics anxiety, and no significant gender difference in the latter. With regards to practical training, the findings revealed no significant difference between mathematics anxiety of students who completed their training and those who did not initiate it.

In sum, as mathematics anxiety has been revealed by studies to be a significant factor influencing math achievement, it should be kept into consideration during the study of factors impacting students' mathematics achievement (Feliciano, 2009). Moreover, the direction of mathematics anxiety -achievement relation has yet to be established (Witt, 2012).

2.9 The Relationship between MLS Factors

According to Gomez-Chacon (2003), mathematics learning involve emotion and upon learning it, MLS factors come into play in cognitive guidance either facilitating or blocking knowledge acquisition (as cited in Rovira & Sancho, 2012).

Recently, research reveals that MLS factors are main factors that explain student behavior in mathematics. Both emotions and beliefs have a role to play in student's success or failure in the subject. As such, some of the most prominent aspects highlighted by researchers include; the powerful affect the factors have on the students way of learning and using mathematics, the impact of the factors upon the structure of self-conception as a learner of mathematics, the resulting interrelations with the cognitive system and the issue the factors constitute for effective learning (Gomez-Chacon, 2000). Despite the increasing research in the past two decades concerning the role of affect in learning mathematics, there is still the need to come up with a consolidated theoretical framework to maximize the coherence between the various current approaches. Additionally, further research is called for to explore the dynamics of affect and cognition interactions (Gomez-Chacon, 2010; Hannula, Evans, Philippou & Zan, 2004). The distinction among the factors may be ambiguous among educators, but the relationship between Mathematics Learning Strategyfactors has been well-documented.

Studies were dedicated to the attitude-motivation relationship (Mata, Monteiro & Piexoto, 2012) where some of them have stressed on the relationship between the factors. According to Singh, Granville and Dika (2002), mathematics attitude is impacted by motivational factors as significant direct impact of motivation was pinpointed in student mathematics attitude. Similarly, Reynolds and Walberg (1992) revealed that motivation significantly impacts mathematics attitude. Luo et al. (2008) study involving 199 8^{th} graders in some cities located in northeast province of China revealed a significant correlation between students' attitude, anxiety and motivation. Other studies (Kwon, 2001; Riveiro, Cabanach & Arias, 2001) examined the relationship between motivational factors and self-regulation and established a relationship between motivational beliefs comprising of intrinsic goal orientation, extrinsic goal orientation, self-efficacy, control beliefs, task values and anxiety, and self –regulated learning. To sum up, despite the several studies revealing that student's self-regulated learning positively relates to their motivational beliefs, there is still the need for further studies to investigate the relationship between Mathematics Learning Strategyfactors in mathematics (Rovir & Sancho-Vinuesa, 2012; Mata et al., 2012). Hence, the present study attempts to examine the correlation hypotheses between Mathematics Learning Strategyfactors as recommended by Rovir and Sancho-Vinuesa (2012).

2.10 MLS Factors and Spatial Visualization

There is no consensus among researchers in literature concerning a single definition of spatial visualization. While McGee (1979) defined it as the ability of mentally manipulate, rotate, twist or invert a pictorially presented stimulus object, Battista (1994) defines it as the insight and achievement of imagined movements of objects in space. Meanwhile, Linn and Peterson (1985) defined it as the ability involving complicated multi-step manipulations of spatially presented information. It is the ability to designate spatial relations regardless of distracting information. Moreover, rotating 2D or 3D figures in a quick and accurate manner is considered as mental rotation (Linn & Petersen, 1985). A review of literature reveals that spatial visualization and spatial ability terms are used in a synonymous manner in some studies (Battista, 1990; Battista, Wheatley & Talsma, 1982). Bishop (1983) associated abilities of visual processing and interpretation of figural information to visualization. According to him, visual processing is "the visual processing of a non-figural data into visual terms, the manipulation and extrapolation of visual imagery, and the transformation of one visual image into another" (Bishop, 1983, p. 177). The other ability was defined by him as "the interpretation of figural information, involving knowledge of the visual conventions and spatial vocabulary used in a geometric work, graphs, charts and diagrams of all types and the reading and interpreting of visual images, either mental or physical" (Bishop, 1983, p. 177).

These provided definitions indicate that spatial visualization is the ability to understand the appearance of the image as well as the interpretation of the given visual information through reasoning. Moreover, another research on the same caliber (Cakmak, 2009) stressed on the significance of spatial visualization in mathematics achievement rather than other visual ability. This postulation is supported by Fennema and Sherman (1997) in that the most related component to mathematics achievement is spatial visualization. However, among the researchers, there is still lack of consensus of whether spatial ability is a genetic capability or a learned one through life with the assistance of teaching activities. Several studies indicated that spatial visualization skills heighten with grade level (Ben-Chaim et al., 1988). Moreover, some studies stressed that spatial visualization is impacted by many factors (Ben-Chaim et al., 1988). On the other hand, spatial ability is considered among the three basic factors of mathematics aptitude which Guilford (1967) categorized into two independent components namely spatial visualization and spatial orientation. The current study has confined the focus to spatial visualization.

Spatial visualization skills have been recognized as a requirement for success in the fields such as mathematics (Beswick, 2007; Zhang & Chen, 2012). For this reason, there has been an interest in understanding the role of MLS factors in the variation in spatial visualization (Levine, Vasilyeva, Lourenco, Newcombe, & Huttenlocher, 2005; Nelson, Lee, Gamboa, & Roth, 2008). However, Ramerz, Levine, and Beilock, (2012) stated that there is a little work evidencing that spatial visualization is influenced by MLS factors. Nonetheless, there is some indication that, similar to math's achievement, MLS factors can derail spatial visualization performance. For instance, it has been shown that female’s performance on spatial visualization tasks can be negatively impacted by the fear of confirming an existing gender stereotype about spatial visualization abilities (Campbell & Collaer, 2009). However, few studies have been done in the area of the relationship between MLS factors and spatial visualization.

For instance, in the context of Malaysia, Alias, Gray and Black (2002) carried out a study among 76 Malaysian Polytechnics College students to examine the attitude of engineering students towards sketching and drawing and the correlation with spatial visualization ability. They revealed a statistically significant relationship between the factor of attitude and spatial visualization ability.

In a related study, Bayrak (2008) experimental study attempted to look into the impact of visual treatment upon elementary school students' spatial ability and their attitude towards spatial ability problems. The sample study comprised of 21 sixth graders from Turkey. The findings revealed that visual treatment positively impacts students' spatial cognitive process and their attitude towards spatial ability problems. Furthermore, self-efficacy was also revealed to correlate with spatial visualization. Kinsey, Towle, O'Brien and Bauer (2008) conducted an analysis of the spatial ability and self-efficacy and their impact on engineering students' retention. They revealed a significant correlation between self-efficacy and spatial ability indicating that higher spatial ability results in higher self-efficacy for engineering students. They found that the self-efficacy of an engineering student in completing a spatial task directly relates to his/her score on the test which shows that students can accurately predict their performance on the test.

Similarly, Veurink and Hamlin (2011) studied the correlation between spatial visualization and self-efficacy with the help of 2686 college students at Michigan Technology Universities. The result of the STEM scores revealed a significant correlation between the two variables.

Tolar (2007) dissertation investigated the impact of working memory on math achievement and she contended that the former is utilized in math and the successful use relies on the strength of the working memory. Similarly, Miller and Bichsel (2004) showed that spatial visualization is negatively influenced by mathematics anxiety. In addition, Ashcraft (2002) contended that mathematics anxiety depletes math achievement as the individual is distracted by other thoughts (p. 183).

On the other hand, Remirez, Gunderson, Levine and Beilock (2012) studied the relation between spatial anxiety and spatial ability as a function of working memory in a study involving 162 American students. The findings revealed spatial anxiety to relate to reduced mental rotation of students having high working memory.

Moreover, Ozlem (2010) study revealed a negative correlation between anxiety and spatial visualization test. The test aimed to look into the spatial visualization efficacy – spatial anxiety of 1007 students in grades 3 and 4 pre-service teachers in Ankara Universities, Turkey. The result revealed a positive correlation between geometry self-efficacy and spatial visualization test.

In conclusion, although the importance of spatial visualization has been mentioned by many researchers and a number of researchers agree on its significance in mathematics education because it an intuitive view and an understanding in many areas of mathematics, the issue related to how spatial visualization is influenced by MLS factors has not been widely studied (Ramirez et al., 2012). Therefore, the present study is an attempt to fill the gap in the literature by examining the relationship between MLS factors and spatial visualization.

2.11 Relationship between Mathematics Achievement and Spatial Visualization

Spatial visualization is described as a basic skill of understanding and developing primary mathematical skills and a gateway to superior problem solving (Assel, Landry, Swank, Smith, & Steelman 2003; Augustyniak, Murphy, & Phillips 2005).

Despite the consensus of several researchers upon the importance of spatial visualization in mathematics learning as they improve the intuitive view and comprehension of various areas of math (Usiskin, 1987), other studies claimed that the relation between the two factors are still not clear (Idris, 1998).

The description of visualization by Albert Einstein indicated spatial visualization ability's positive relation with achievement in mathematics (Kayhan, 2005; Turgut, 2007). In addition, Turgut (2007) revealed that Mathematics high achievers among elementary school children possess high spatial visualization ability compared to low mathematics achievers. Also, Tartre (1990) noted that students in Grade 9 possessing higher spatial skills were better at analyzing mathematical problems, organizing their thinking and relating new problems with prior experience. Moreover, Assel et al. (2003) claimed that word problems are significantly related to spatial visualization skills as opposed to basic calculation skills. Spatial visualization processing seems to be a significant factor in developing basic skills as cardinality (Carr & Hettinger, 2003). Cardinality is described as the understanding that the complete number of items in a set is equivalent to the last number (Carr & Hettinger, 2003).

Rayan (2008) examined the impact of a set of indicators including gender, age, accumulative average and their related interactions on spatial ability of students enrolled in Al-Quds Open University with elementary school education as their major. The study sample comprised 132 students, with 25 male students and 107 female students. The sample was chosen with the help of stratified sampling among fourth year elementary education majors, registered in the first semester in the academic year 2006/2007. The author found statistically significant differences in spatial ability that he attributed to two variables namely gender for the benefit of the male students, and accumulative average for the benefit of the high average group. He also revealed no statistically significant differences in terms of age or variables interaction.

Similarly, Ghbari, Abu Shendi and Abu Sheirah (2008) conducted a study to examine the spatial ability development among IT students enrolled in Zarqa Private University in Jordan throughout the study years. The study sample comprised 221 students randomly selected from various sections, who took a mental rotation test that gauged their spatial ability. The findings showed no significant differences in performance on the test of spatial ability due to study years. They also showed no significant differences in spatial ability test performance due to social status or academic performance.

Also, Abu Mustafa (2010) focused on the relationship between spatial ability and the achievement of sixth graders in mathematics in an attempt to determine the impact of the gender variable, and to determine the students' diversity (in terms of high and low spatial abilities). The study sample comprised of students in 6 classes of sixth grade (228 students), distributed to three female classes and three male ones. The study employed the spatial orientation test-Card Rotation-by Whitley Test. The Pearson Correlation coefficient was computed between the scores of students in the spatial ability test and their math scores. The results showed an unexpected positive correlation with statistical significance between mathematics achievement and students' spatial ability. The results also showed that male students have higher spatial abilities compared to their female counterparts in the application of one way analysis of variance between the scores of both genders. In addition, the results showed that high achievers possess high spatial abilities compared to their average and low achieving counterparts.

The spatial visualization abilities of enrolled engineering students were examined by Seabra and Santos (2008) in order to assess the relationship between spatial abilities, gender and age. The sample consisted of 605 students in mental rotation test and 587 students in visualization test. They revealed significant differences between the genders in terms of their scores in spatial visualization abilities, where male students outperformed female students.

Sipus and Cizmesija (2012) investigated the differences in gender in light of spatial ability in Croatia with the help of the Mental Cutting Test. The study sample consisted of 130 students and the findings showed that male students outperformed female students.

Clifford (2008) study was conducted to investigate the relationship between spatial visualization and math achievement among students in grades 6-8 in American schools. The results showed that scales of spatial visualization (Stanford Binet Fifth Edition SB5 and Wechsler Intelligence Scale) predicted mathematics achievement in a significant way.

Similarly, Meyer, Salimpoor, Wu, Geary and Menon (2010) examined the differential contribution of particular working memory component to mathematical achievement of 98 students enrolled in San Francisco Bay Area. The study sample was required to take IQ assessments through Wechsler Abbreviated Scale of

Intelligence (Wechsler, 1999). The results showed that spatial visualization component was a predictor of mathematical reasoning and numerical operations skills.

Meanwhile, Idris (1998) studied the key role of cognitive variables including spatial visualization, field dependence / independence, and Van hiele levels of geometric in mathematics learning among 137 6^{th}-8^{th} graders enrolled in the Franklin County School in the United State of America (U.S.A). The findings revealed spatial visualization to be related to mathematics achievement.

In addition, Tartre (1990) studied the key role of spatial visualization skills in mathematical problem solving. The study sample comprised of 97 tenth graders with discrepant spatial skills who were required to take the Gestalt completion test and tenth grade mathematics achievement test. Students who obtained the top and bottom third scores were interviewed concerning their thinking processes and the findings revealed that students having higher spatial skills are able to accurate estimate and analyze problems, organize thinking and link new problems with prior knowledge.

On the other hand, Reuhkala (2001) studied the two variables among 15-16 year old high school freshman. In this study, the relationship between three spatial visualization tasks namely static, dynamic and mental rotation, and scores of students obtained from mathematical achievement test was examined. Reuhkala (2001) concluded that spatial visualization correlated in a significant way with the scores of students in their mathematical achievement test.

Similarly, Rohde (2007) revealed that from the three spatial factors namely visualization, perceptual speed, and closure speed, the first factor explained major variance in academic achievement and math achievement with independence from general intelligence (*g*). The author contended that visualization does not only influence math achievement but also scholastic achievement on the whole.

More evidence revealing the relationship between spatial visualization and mathematics was provided by Lee, Ng, Ng and Lim (2004). Their study is an investigation of the central executive functions comprising of phonological loop and spatial visualization sketchpad, and mathematical achievement among 10 year old students in Singapore. They revealed that spatial visualization sketchpad and phonological loop did not contribute to mathematical achievement indicating that the overall executive functioning of the combined elements of both spatial visualization do contribute to mathematical achievement and not individually (Lee et al., 2004).

The above studies from literature stressed the significance of spatial visualization in mathematics achievement (Clifford, 2008; Fuchs, 2005). As some studies reported no significant relationship between the two factors (Gould, 1996; Pandisco, 1994; Lee et al., 2004), the results are still not clear and inconclusive. This contention is compounded by Clifford (2008) who claimed that prior research (Fuchs, 2005; Reuhkala, 2001) concerning spatial visualization and mathematics achievement is still limited. Hence, in-depth research of the relationship between the two is still called for.

2.12 Relationship between Spatial Visualization, Numbers, Algebra and Geometry

It is widely known that spatial visualization and algebra are invaluable for students' development of mathematical achievement throughout their lives. It is a gateway for logical reasoning and it enhances abstract thinking (Stacey & McGregor, 1999). Although limited studies have been dedicated to the relationship between spatial visualization, algebra and numbers, one study contended that no study exists that examines the three constructs relationship (Chrysostomou, Tomou, Tsingi, Cleanthous, & Pitta-Pantazi, 2010).

Chrysostomou et al. (2010) attempted to examine the relationship between cognitive styles of individuals like verbal, spatial-imagery, object imagery and their mathematical achievement in light of numbers and reasoning in algebraic tasks as well as the strategies employed during task solving. The findings revealed that spatial imagery, as opposed to object imagery and verbal cognitive styles, relate to algebraic reasoning and number sense achievement.

In a related study, Ramirez, Gunderson, Levine, & Beilock, (2012) investigated the relationship between spatial skills and children's early knowledge. The findings showed that spatial skills can improve children's development of numerical knowledge by assisting them to obtain a linear spatial representation of numbers and hence, confirming the postulated hypothesis.

Similarly, Wheatley (1998) stressed on the significant role of mental imagery in different types of mathematical activity from the interviews conducted. He laid down a set of chips to primary level students and requested to count them. He then took some chips in his hand and closed it. He proceeded to ask the students how many chips there were in his hand while displaying the remaining chips. The students were then requested to draw circles to represent the number of all the chips and the task was repeated as some number of chips was replaced on the circle and the number of chips remaining was asked. Without the paper, some students performed better than how they had initially while others still drew circles in the air. This revealed that visualization assists in the students' number performance. Because studies did not extensively examine the relationship between spatial visualization, algebra and numbers, the present study attempts to study the said relation among 8th graders in Jordan.

Spatial visualization is described as a significant skill in learning geometry. It is the ability of an individual to manipulate information that is presented spatially such as image fold and movement or modifying their thinking of a two-dimensional object into a three dimensional one. In other words, it is the ability of an individual to manipulate complex spatial information concerning shapes configuration (Linn & Petersen, 1985), which serves engineering students and professionals (Leopold, Gorska & Sorby, 2001). It also plays a key role in different aspects of mathematics such as geometrical problem solving (Healy & Hoyles, 2002) and geometric reasoning (Clements & Battista, 1992; Mistretta, 2000).

Hoffer (1981) stated that learning geometry requires a total of five skills namely visual, verbal, drawing, logical and applied skills. Moreover, Karaman and Togrol (2000) described geometry as a mathematics branch concerning positions and locations in space. In history, scientific geometry was introduced through Euclidean metric geometry followed by projective geometry and lastly topology. This branch of mathematics in the primary level is concerned with activities including connecting points with line segments and identifying figures (triangles, squares and rectangles).

Cooper (1992) highlighted the existence of learning difficulties in this branch of mathematics and stressed on the visual imagery and ability to perceive space configurations in courses of geometry. Other studies such as Bulut and Koroglu (2000) evidenced the relationship between achievement of geometry and spatial visualization. They proceeded to claim that the ability to mentally rotate and manipulate figures appears to be a skill that is linked to geometry achievement.

According to Battista, Wheatley and Talsma (1982) study, spatial visualization scores improve with certain types of activities such as paper folding, tracing, symmetry among others. In their study, the sample comprised of 82 pre-service elementary teachers taking attending four geometry courses. They administered the only Purdue Spatial Visualization Test at the beginning of the semester and the Longeot test of cognitive development and the same Purdue Spatial Visualization Test at the end of the semester. The students' grades were based on the scores of the three course exams. They revealed that scores at the end of the semester were higher compared to scores at the beginning of the semester. A total of 36 students attending one of the four courses did not receive spatial visualization tasks while the others attending the remaining three courses did particularly for the improvement of their spatial visualization tasks. Those who received exhibited significantly higher scores over those who did not. The researcher eliminated to test-retest effect and concluded that some activities may enhance spatial visualization of students.

Similarly, Clements (1999) investigated the geometric and spatial thinking of young children and contended that geometry assists students in comprehending, interpreting and reflecting on their surroundings. He investigated the children's spatial ability in light of components of both spatial orientation and spatial visualization. He revealed that spatial ability reinforces geometry achievement and the creative thoughts concerning mathematics (Clements, 1999). Despite the stressed importance of spatial visualization in mathematics achievement and geometry achievement (Bulut & Koroglu, 2000), studies of this caliber are still few and far between (Dursun, 2010). Hence, the present study attempts to investigate the relationship between the two constructs to assist educators and policy makers of Jordan in keeping the two in consideration.

Summary

Current literature shows that students' mathematics achievements are lower compared to other subjects. An in-depth reason behind the issue through literature review revealed that the source includes low self-confidence, high level of anxiety towards the subject, lack of self-regulation strategies and problem solving strategies, low self motivation, reliance on listening skills and individual differences. Owing to the above specific issue in mathematics research, the relation between affect and cognition in students' mathematics learning process may contribute to their mathematics achievement. It is thus imperative to determine factors leading to mathematics success and to minimize the gaps highlighted in literature.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents research design, research population, sample size, instrumentation, questionnaire items and structure. MLS factor, cognitive factor instruments and content validity are also discussed. Pilot study conducted, reliability analysis, data collection procedure, data analysis procedure, data screening, missing data, normality, linearity, multicollinearity, descriptive analysis, factor analysis, reliability test analysis of construct, data analyses, independent sample t.test, correlation analysis, regression analysis, hierarichal regression analysis, conceptual framework and all this was sum up in the summary at the end of the chapter.

3.2 Research Design

There are two universally utilized research methods – quantitative method and qualitative method. The type of approach employed primarily depends upon the research objectives and questions in terms of their nature and requirements. In this regard, Yin (2003) contended that the research types can be divided into three according to their purposes; exploratory, descriptive and explanatory research. Hence, on the basis of the research questions and the nature of the present research's objectives, the most suitable method to employ is the quantitative descriptive survey design method.

According to Neuman (2003), a survey method is appropriate for research questions or objectives that address beliefs or behaviors. Consistent with this contention is

Zikmund (2003), who evidenced that surveys are superior at gauging awareness, opinions and behaviors. Therefore, in an attempt to obtain the relevant information from the sample, survey questionnaire was employed as the primary research strategy in the present study.

3.3 Research Population

The population of this study comprised of 8^{th} -grade students who were studying in the academic year 2013/2014 in Al-Koura District, Jordan. The sample division selected for the present study included 2257 8^{th} grade students; 1,101 (49%) males and 1,156 (51%) females representing (37) schools in the region; (18) male schools and (19) female schools.

3.4 Sample Size

In probability sampling, every individual holds an equal opportunity of being chosen for being a sample object (Sekaran, 2003). A representative sample in such a sampling design ensures equal and independent representation of data selected. This sampling method is advantageous as no researcher bias affects the choice of another (Salkind, 2003) and it facilitates greater generalizability (Cavana et al., 2001). In this study, sample is selected from different schools.

The sampling theory shows support for the stratified random sampling as a suitable choice as this type of sampling generates means that is closer to the mean of the overall population (Robson, 1993). In regard of this type of sampling, Leary (1995) claimed that it generally reflects the whole population's characteristic. Accordingly, the present study employs stratified random sampling to ensure independent representation of selected data.

According to Bless and Higson (1995), determining a suitable sample size is a significant component of the research success. In addition, according to Krejcie and Morgan (1970), it is appropriate to select a minimum sample of 331 students from the entire research population. The study sample consists of (360) 8th grade students enrolled in middle schools in Al-Koura District in Jordan; 178 (49%) were males while 182 (51%) were females enrolled in (4) male schools and (4) female schools chosen randomly from (37) schools. The number of students from each of the 8 schools was determined and the percentages were derived. Based on the derived percentages for each school, the proportion of males and females was then determined.

3.5 Instrumentation

In the present study, the main method of data collection is questionnaire and this was selected for collecting data owing to its high capability of covering a considerable portion of population throughout locations – in this case, Al-Koura District, Jordan. The survey questionnaire is superior to other methods in terms of efficiency of original data collection from the sample population (Babbie, 1990). In this study, the questionnaire was developed by adapting items from prior studies that have been validated. The research questionnaire is divided into five major sections namely mathematics attitude, mathematics motivation, mathematics self-regulation, mathematical self-efficacy and mathematics anxiety and comprises 83 items.

3.6 Questionnaire Translation

The questionnaire items were originally constructed in English, but because the language of the subjects is Arabic, it was translated to Arabic to make it easier for the students to understand. The questionnaire was translated into Arabic using a back translation technique in order to achieve the measurement equivalences in both languages (Brislin, 1970). First, the researcher gave the instrument to a native linguistic teacher to translate them from English to Arabic language after which the Arabic version was translated back into English by another bilingual expert in order to remove or solve any differences. Then the researcher gave the translated version to a number of mathematics teachers to make any needed correction or clarification as well as to check whether the questions will be appropriate for the 8th grade students.

3.7 Questionnaire Items and Structure

Laying down clear and understandable instructions is a significant phase prior to organizing the survey questions. Accordingly, a cover letter was attached to the questionnaire listing the purpose of the research, the estimated time of completion, the questionnaire sections and the Likert scale employed in the questionnaire. Specifically, the questions were categorized into five namely mathematics attitudes, mathematics motivation, mathematics self-regulation, mathematics self-efficacy and finally, mathematics anxiety. The questions were sequenced into each section to guarantee that the respondents do not experience discomfort and confusion (as recommended by Neuman, 2003). Table 3.1 presents the measured factors and their related elements included in the questionnaire.

Table 3.1

The Measured MLS Factors and Their Related Elements in the Questionnaire

Factor	**Dimension**	**No. of Items**	**Total**	**Developed by**
Attitude	Value	10	24	Aiken (1976)
	Enjoyment	14		
Motivation	Intrinsic	4	8	Foy & Olson (2009)
	Extrinsic	4		
Self-regulation	Concentration	8	32	Weinsten et al. (1987)
	Self Testing	8		
	Study Aids	8		
	Time Management	8		
Self-efficacy	-		5	Bandura (2006)
Mathematics anxiety	-		14	Betz (1978)
	Total		83	

The questionnaire items were closed-ended questions. The constructs were measured using a five- point Likert scale. The Likert scale is structured as strongly agree, agree, moderately agree, disagree and strongly disagree. In order to analyze the benefits behind the effect of MLS factors upon students, the questionnaire was divided into five major sections namely mathematics attitude, mathematics motivation, mathematics self-regulation, mathematical self-efficacy, mathematics anxiety. A brief description of the questionnaire is provided in the following section.

3.8 MLS Factor

Mathematics Attitude

Aiken Mathematics attitude scale was used to measure mathematics attitude and it encapsulates attitudinal domains through value and enjoyment, which both contribute to the determination of mathematical attitudes. The questionnaire was divided into two scales covering an extensive subject to measure mathematics attitude, consisting of (24) items and divided as follows; (10) items for value are designed to measure students beliefs on the usefulness, relevance and worth of mathematics in their life now and in the future, (14) items for enjoyments are designed to measure the degree to which students enjoy working mathematics and mathematics classes, and to ask students about their enjoyment in mathematics as a subject. Mathematics attitude questionnaire was adapted by Taylor (1997) from the Aiken Scale (1976).

Mathematics Motivation

The questionnaire for motivation was used to assess students' mathematics motivation. The motivation questionnaire consists of two subscales namely intrinsic and extrinsic motivation (Chen, 2011). According to Chen (2011), Intrinsic Motivation relates to students' interest concerning a topic or activity which is performed through the process of pursuit and has high impact upon student learning. He added that motivation refers to situations in which task success is significant for the achievement of goals. On the other hand, Extrinsic Motivation is described as environmental factors. In mathematics, each of intrinsic motivation and extrinsic motivation is represented by four items. The total items adapted from prior literature are eight items, and they were developed by Chen (2011).

Mathematics Self-regulation

LASSI or learning and study strategies inventory was created by Weinstein, Palmer and Schulte (2002). Four LASSI scales measure the self-regulation component of strategic learning: Concentration, Self-Testing, and Study Aids, Time Management. These scales measure how students self-regulate and control the learning process through focusing their attention and maintaining their concentration, using time effectively, checking to see if they have met the learning demands for a class or test, and using strategy supports such as tutors. According to Loong (2012), this questionnaire has been utilized extensively in the context of schools.

Mathematical Self-Efficacy

The revised mathematics self-efficacy scale has been utilized extensively in prior studies in measuring student's Mathematics self-efficacy. Mathematics self-efficacy instrument consists of five items that asked students questions including - to what extent they believe in their own ability to handle learning situation in mathematics effectively and overcoming difficulties. Mathematics self-efficacy questionnaire was developed by David Morris and Blair Lusby (2007).

Mathematics anxiety

The revised mathematics anxiety rating scale MARS-R has been utilized extensively in prior studies in measuring students' mathematics anxiety. MARS-R is described as a self-reported instrument consisting of (14) items that asked students to what extent they feel helpless and under emotional stress when dealing with mathematics. The instrument was adapted from Bai, Wang, Pan and Frey (2009) and was originally developed by Betz (1978). The English and Arabic versions of questionnaire are depicted in Appendix (B) and Appendix (C) respectively.

3.9 Cognitive Factors Instruments

Mathematics Achievement Test (MAT)

The Mathematics Achievement Test (MAT) is a modified and constructed version prepared by the Ministry of Education, Jordan. The test is categorized into three sections namely numbers, algebra, and geometry. Numbers consist of understandings and skills, which are related to whole numbers, fractions and decimals, integers, and roots. Algebra consists of patterns, algebraic expressions, equations and formulas, and functions. For geometry, five major parts are included: lines and angles, two-three dimensional shapes and locations. The Mathematics achievement test (MAT) employed in this study consisted of 30 multiple choice questions – 8 (numbers), 14 (algebra) and 8 (geometry) of one mark each. A correct response to an item was awarded one mark, while an incorrect response was given no marks. The Arabic version of Mathematics Test depicted in Appendix (D).

Spatial Visualization Test (SVT)

The spatial visualization Test (SVT) by Ben-Chaim, Lappan and Houang (1988) was employed to measure the students' spatial visualization in the present study. Idris (1998) made use of this test comprising of thirty two multiple choice items with each having two options. The test is considered as an untimed power test where it takes around 20-30 minutes of completion. Generally, the test items comprises of the 2D and 3D views of the building and mat plan including the description of the building base by square and numbers. Each square states the number of cubes within it. The test was initially created for 6^{th}-8^{th} graders and its validity has been tested by studies (Ben-Chaim et al., 1988; Fraenkel & Wallen, 2006). Hence, the SVT is considered suitable in the present study since the target sample comprises of 8th graders. Table 3.2 shows the cognitive factor instrument and the number of items. The Arabic version of spatial visualization test is despited in Appendix (E).

Table 3.2

Cognitive Factor Instrument

Instrument	**Dimension**	**No. of Items**
Mathematics achievement test (MAT)	Numbers	8
	Algebra	14
	Geometry	8
Spatial Visualization Test (SVT)	2D	13
	3D	19
	Total	62

3.10 Content Validity

As depicted in Table 3.3 below, the test contains three sections namely numbers, algebra and geometry. Numbers consist of 8 questions accounting for 27% of the test. The questions (4, 5 and 8) represent the knowledge and comprehension side (lower levels) according to Bloom's Taxonomy and account for 10% of the whole test. However, there is one question (1) in the application side (middle level) which represents a rate of 4%. Regarding the upper levels (analysis, synthesis and evaluation), there are 4 questions (2, 3, 6 and 7) which account for 13% of the whole test. However algebra consists of 14 questions and accounts for 46% of the test. The questions (12, 13, 14, 15, 19, 20, 21 and 22) represent the lower levels and accounts for 26% of the test. There are questions (9, 11, 16, 17 and 18), which constitute 16% representing the middle level, while the upper levels, represent 4% of the entire test. Finally, geometry consists of 8 questions and accounts for 27% of whole test. The questions (23 and 24) represent lower levels and accounts for 7% of the test. The questions (26 and 27) represent the middle level accounting for 7 % of the test. Regarding the high levels there are 4 questions (25, 28, 29 and 30) which account for 13% of the whole test.

Table 3.3

Test Specification Table

	Bloom's Taxonomy			
Subject content	Knowledge & comprehension	Application	Analysis, Synthesis & Evaluation	Total
Numbers	4, 5, 8 (10%)	1 (4%)	2, 3, 6, 7 (13%)	8 (27%)
Algebra	12, 13, 14, 15, 19, 20, 21, 22 (26%)	9,11, 16, 17, 18 (16%)	10 (4%)	14 (46%)
Geometry	23, 24 (7%)	26, 27 (7%)	25, 28, 29, 30 (13%)	8 (27%)
Total	43%	27%	30%	100%

3.11 Pilot Study

Pilot study has been acknowledged as a critical step in the development of measurement scales, in which it acts as an experimental study in achieving improvement within particular research instrumentations (Zikmund, 2003). By using its ability to identify weaknesses and even failure of the instruments, it increases the accuracy and consistency of measurements. Therefore, for the pilot test, an Arabic version of the instrument was distributed after an initial validation by a panel of experts.

A pilot studty was carried out in middle schools in Al-Koura District governorat, Northern part of Jordan. Data from 100 students studying in schools in April 2013 was collected and used in the pilot study, 50 male students and 50 female students were chosen. A study was carried out in order to identify the clarity and readability of the questionnaire as well as to test the internal reliability and validity of the measures. The distribution of the translated questionnaires to the chosen students was done by the researcher and followed by an examination to test the reliability and the validity of the instrument. Throughout the process, the researcher was present to inquire the students' opinions in relation to the instruments, and feedbacks given were taken into discussion and consideration before deciding to omit irrelevant questions.

3.12 Reliability Analysis

Reliability refers to the instrument's stability and consistency and it indicates the instrument's goodness of measure (Sekaran, 2003). Internal consistency was employed in the present study to examine the level of items inter-correlation (as suggested by Sekaran, 2003). Internal consistency is measured in various ways with the common among them being the use of Cronbach's alpha coefficients that indicates the average correlation of items forming the scale (Pallant, 2007; Zikmund & Babin, 2012). The values of coefficient alpha ranges from 0 to 1, with 0 indicating no consistency and 1 indicating complete consistency, with the latter presenting that the entire items produced corresponding values (Hair et al., 2009; Pallant, 2007; Zikmund et al., 2009). Owing to these range of coefficient alpha values the following threshold was proposed by Zikmund et al. (2009); scales that range from 0.80-0.95 are deemed to possess very good reliability, those that range from 0.60-0.70 are deemed to have fair reliability, and those less than 0.60 are deemed to have poor reliability.

In the present research, two methods are employed to determine scale reliability and internal consistency. First, Cronbach's alpha coefficient is utilized to indicate the average of the entire items' correlation making up the scale (Pallant, 2001), with the alpha coefficient over 0.60 deemed as acceptable (Nunnally & Bernstein, 1994; Sekaran, 2000). In other words, the recommended threshold of 0.60 was followed in the present research. Second, as recommended by Hair et al. (1998) and Henryson (1971), the corrected item total correlation of the entire items should be more than 0.30. Both methods were employed for the assessment of the reliability of the scale.

Reliability Analysis of Mathematics Attitude Questionnaire

The attitude scale consists of two dimensions, namely value and enjoyment. They comprise ten items and fourteen items respectively. Table 3.4 presents the results of the reliability test for attitude.

In terms of reliability, the Cronbach's alpha of the attitude measure was measured by two dimensions (value with 10 items & enjoyment with 14 items). The reliability analyses showed that six items (three from each dimension) were less than 0.30 for items correlation and were deleted. Table 3.4 shows the reliability analyses after the items were deleted.

Table 3.4

Reliability Analysis for Mathematics Attitude

Attitude	**Total Items**	**Corrected Item-Total correlation**	**A**
Value	7	0.81, 0.41, 0.55, 0.60, 0.62, 0.52, 0.79	0.85
Enjoyment	11	0.73, 0.69, 0.66, 0.83, 0.78, 0.79, 0.63, 0.70, 0.73, 0.75, 0.69	0.93

Reliability of Mathematics Motivation Questionnaire

In terms of reliability, the Cronbach's alpha for the motivation scale was measured by two dimensions (intrinsic 4 items and extrinsic4 items). The first run of the data for each dimension showed that the reliability value achieved the suggested value of 0.60. However, the data showed that the seven items were more than .30 for items correlation and one item in extrinsic dimension is less than 0.30, and this item was deleted. Table 3.5 below shows the reliability analyses after deletion of items.

Table 3.5

Reliability Analyses for Motivation towards Mathematics

Motivation	Total Items	Corrected Item-Total correlation	A
Intrinsic	4	0.63, 0.51, 0.57, 0.53	0.76
Extrinsic	3	0.53, 0.68, 0.65	0.78

Reliability analysis for mathematics Self-regulation Instrument

The internal consistency of the Cronbach's alpha for the self-regulation scale was measured by four dimensions (Concentration, Self Testing, Study Aids and Time Management). The first run of the data showed that the reliability value was more than the suggested value of 0.60 for all self-regulation dimensions. However, the first dimension (concentration) consists of 8 items and all achieved the suggested value of .30 for items correlation and the Cronbach's alpha value was 0.93.

The second dimension (Self Testing) consists of 8 items, six of which achieved more than 0.30 values for items correlation and the Cronbach's alpha for the dimension was 0.89. The third dimension (Study Aids) consists of 8 items, seven of which achieved more than 0.30 value of items correlation and Cronbach's alpha was 0.89.

Finally, dimension four (Time Management) consists of 8 items, six of which achieved the suggested value 0.30 of items correlation, with Cronbach's alpha of 0.95. Table 3.6 shows the reliability analysis for mathematics self-regulation after the items were deleted.

Table 3.6

Reliability Analyses for Mathematics Self-regulation

Self-regulation	**Total items**	**Corrected Item-Total correlation**	**Α**
Concentration	8	0.75, 0.79, 0.72, 0.75, 0.75, 0.84, 0.81, 0.63	0.93
Self Testing	6	0.70, 0.78, 0.82, 0.72, 0.70, 0.61	0.89
Study Aids	7	0.65, 0.59, 0.75, 0.65, 0.75, 0.75, 0.70	0.89
Time Management	6	0.79, 0.88, 0.89, 0.85,0.89, 0.76	0.95

Reliability of Math Self-Efficacy Instrument

To measure the internal consistency of the items prior to creating the indices for each construct, the Cronbach's alpha for the self-efficacy comprising of 5 items was measured. The first run of the data showed that the reliability value was 0.86. However, the data showed that all items were more than .30 for items correlation as shown in Table 3.7.

Table 3.7

Reliability analyses for Mathematics Self-efficacy

	Total items	**Corrected Item-Total correlation**	**Α**
Self-efficacy	5	0.81, 0.83, 0.53, 0.62, 0.62	0.86

Reliability of Mathematics anxiety Instrument

A reliability test was performed on mathematics anxiety scale. The mathematics anxiety scale consists of fourteen items. Table 3.8 present the results of the reliability test for anxiety. The first run of the data showed that four items were less than .30 for items correlation. The table below shows the reliability analyses for anxiety after deletion of items.

Table 3.8

Reliability Analyses for Mathematics anxiety

	Total items	Corrected Item-Total correlation	A
Mathematics anxiety	10	0.92, 0.86, 0.78, 0.92, 0.55, 0.58, 0.50, 0.50, 0.86, 0.92	0.93

Overall, the pilot study data revealed acceptable alpha reliability coefficient. Thus, the questionnaire was suitable to be distributed to the target sample. The full SPSS outputs of the pilot study reliability analysis are depicted in appendix (F).

3.13 Data Collection Procedure

Data collection in the present study was carried out through the survey questionnaire owing to the time constraints as recommended by Sari (2000). The schools used in this study were selected randomly. First, the researcher received the names of male and female schools and permission for involving students in this study from the Ministry of Education in Al-Korah District. Next, the researcher randomly selected four male and four female schools to obtain the required sample size. Then, the researcher contacted the principals of each school to ask for permission to collect data in their schools. Finally, the researcher applied the research tools on the data collected through the use of questionnaires which were distributed by the researcher. The students were given between 20-30 minutes to complete the questionnaire in their classroom. The data collection was carried out in a period of one month from February 2014 to March 2014.

Data was collected through self-administered questionnaires and the researcher favors this method due to its advantages such as the researcher can collect all the completed response within a short period of time, and the researcher can explain on the spot the terms or parts of the questions that the respondents cannot understand as well as the researcher can motivate the respondents to take part in the survey and give their honest opinions (Sekaran, 2003).

3.14 Data Analysis Procedure

In order to evaluate and examine the theoretical framework and the proposed hypotheses, statistical software package (SPSS) Version 19 was utilized for its flexibility. There are several methods entailed in this analysis including data screening and appropriate data analysis selection (Churchill & Lacobucci, 2004; Sekaran, 2003). Data was screened to determine errors in data entry and to test the way suitable data satisfies the statistical assumptions concerning missing data, descriptive statistics of variables, normality, linearity, homoscedasticity, multicollinearity and reliability.

3.14.1 Data Screening

Screening of data involves many steps to guarantee that the impact of the data characteristics may not adversely impact the outcome. Screening data steps are crucial as the decisions taken in the former steps impact the latter decisions.

3.14.2 Missing Data

The missing data test is a crucial test to be carried out prior to data analysis as data is frequently rife with errors such as data entry errors that could influence the outcome of the analysis (Hair, Anderson, Tatham & Black, 2006; Pallant, 2005). Before conducted the research hypotheses testing, the researcher tested the variables for their accuracy in terms of missing values, data entry and satisfaction of the multivariate analysis assumptions.

Missing data is described as those cases characterized by the entering of valid values of one or more variables by mistake or their unavailability for data analysis, particularly in case of multivariate analysis (Hair et al., 2006). Moreover, ambiguous nature of items in the questionnaire, unwillingness to answer or erroneously leaving out some items are issues that must be addressed as they can adversely influence the outcome of the analysis.

3.14.3 Normality

Normality refers to a statistical method that reveals the data distribution shape. It is part of the initial steps and basic assumptions in multivariate methods like multiple regressions. The normality test aims to ensure that the distribution is normal. Two methods are utilized to describe data distribution namely skewness and kurtosis. The close proximity of these values to zero indicates normal data distribution (Hair et al., 2006).

3.14.4 Linearity

Linearity or the linear relationship among variables is described as a statistical method that examines the level to which change in independent variable is related with the dependent variable. Notable researchers (Hair et al., 2006; Pallant, 2005) stated that the P-P plots can be employed to test the relationship among variables with the condition that when the plots are near the diagonal line, a significant relationship is present. In this study, linearity was determined by examining the residual plots in the SPSS outcome.

3.14.5 Multicollinearity

The case where the dependent variables are considerably correlated is known as multicollinearity (Pallant, 2001). Correlation values of any research should be lower than 0.80 (Hair et al., 2006) and those higher than this threshold value is considered to be multicollinear. In the context of services studies, two measures are utilized to examine multicollinearity namely tolerance (R) value and the variance inflation factor (VIF) value, with 0.10 as the recommended value for the former and 10 for the latter.

3.14.6 Descriptive Analysis

Descriptive statistics provide a description of the phenomenon under study through the use of bar charts and measures of central tendency for data summary (Sekaran, 2003). Descriptive statistics facilitate better data understanding through the visualization of patterns. According to Pallant (2001), these tests cover the mean, standard deviation, variance and range of scores, as well as skewness and kurtosis.

3.14.7 Factor Analysis

In this study, the instruments used have already been validated by prior researchers and thus, the researcher employs the principal component analysis to determine the set of common underlying dimensions, i.e. the factor of the construct (Hair et al., 2010). Factor analysis is also employed to determine whether or not the constructs form clusters and hence forming meaningful, interpretable and manageable factors sets (Cavana, Dalahaye & Sekaran, 2001).

The sample size required for factor analysis was achieved in this study. Specifically, Hair et al. (1998) and Coakes and Steed (2003) stated that the acceptable sample size for such analysis should be 100 and over, or it should be at least five times as many observations. The calculated sample size is 360 and therefore, the study samples are suitable for the requirement of factor analysis.

Factor analysis is primarily utilized for the identification of latent structure dimensions of a variable set. It minimizes the attribute space from a larger set of variables to a smaller one. The questionnaire items were grouped into components that comprised of items representing the study’s antecedent variables. Factor analysis has its basis on the principal component method along with varimax rotation for the entire components.

The principal components computation minimizes in the eigenvalue solution for a positive semi-definite symmetric matrix. With regards to the sample size, Coakes and Steed (2003) and Hair et al. (2010) guidelines show that a minimum of five subjects for every variables are required for the purpose of factor analysis.

Other criteria for factor analysis suggested by Hair et al. (2010) employed by this study are as follows:

1) Bartlett's test of Sphericity (test of presence of correlation among variables) needs to be significant at $p<0.05$ or smaller.

2) Kaiser-Meyer-Olkin (KMO)/Overall Measure of Sampling Adequacy (MSA) should be at least 0.50 or above. These values are presented as part of the output from the factor analysis.

3) Communalities (Gives information on how much of the variance in each item is explained). Low values (less than 0.50) could be deleted as it indicates that the item does not fit well with other items in the component. Removing items with low communalities values tend to increase the total variance explained.

4) Items for loading and cross loading of 0.50 or greater on one factor and 0.30 or lower on the other factor has been set to assess the significance for this study; if items load less than .30, the item is deleted (Steven, 2002).

5) To determine how many components (factors) to extract, there is a need to consider information provided by the output. First using Kaiser's criterion, which is based on components that have an Eigenvalue of more

than one. To determine how many components meet this criterion, the present study looked at the total variance explained table.

The discussions on the results of factor analysis for the variables are presented in the measures sections.

3.14.8 Reliability Test Analysis of Construct

Hair et al. (2010) signified the importance of reliability test of a measure where the test reflected the measurements stability and consistency in measuring particular concept and it was error-free with consistent measurement across time and across items in the measurement. Most researchers concurred on the necessity of performing reliability analysis in any scientific research and the analysis was simultaneously performed with validity analysis (Hair et al., 2010; Gliem & Gliem, 2003). Gliem and Gliem (2003) verified the essentiality of measuring and reporting internal reliability (cronbach's alpha coefficient) for any scale in any research especially when utilizing likert-scale type formatted scales. Most common and widely accepted internal consistency reliability was Cronbach's alpha (Cavana et al., 2001). Furthermore, corrected item-total correlations is suggested by Thompson (2004) as an essential value in reliability because the correction removes common variance associated with both the item and the total, providing a better estimate of the relationship between the item and the rest of the scale. In consistent with the aforementioned statements, all construct variables for the present study were tested using both values which are corrected item-total correlation and internal consistency to indicate that individual items of the scale measure the same construct and therefore would be highly correlated (Nunnally, 1978; Thompson, 2004).

3.15 Data Analyses

Data collected was analyzed with the help of Statistical Package for Social Sciences (SPSS), version 19.0. Data gathered via the study instrument was first summarized and then analyzed. In the context of quantitative research, the most important phase is the provision of answers to the developed questions and the hypotheses testing. In this study, the researcher made use of many statistical analyses techniques like descriptive statistics, Pearson correlation analysis, independent sample t-test, and path analysis for the analysis of the relationships (direct and indirect) among the study variables.

3.15.1 Independent Sample t-test

Sekaran (2003) stated that the independent sample t-test examines the differences between two groups (males and females). It is used to conduct a comparison between certain variables mean scores.

3.15.2 Correlation Analysis

Correlation analysis is carried out when there is a need to describe the relationship strength and direction between two variables which are often continuous in nature. In this regard, a positive correlation indicates that with the increase of one variable, the other also increases whereas a negative one indicates that with the increase of one variable, the other decreases (Pallant, 2007). The correlation coefficient is determined to confirm the existence of relationship between two variables, and its direction and strength (Behr, 1988).

Accordingly, the researcher made use of the Pearson correlation analysis to examine the variables relationship. The Pearson correlation coefficient (r) represents the estimated linear relationship, in terms of strength and direction, between the interval and ratio variables according to sampling data, and this differs along a range of +1 to -1. The direction of the relationship is indicated by the prefix (+, -), where the absolute value indicates the strength (values nearer to one indicates stronger relationship while those equal to zero indicates no relationship) (Cooper & Schindler, 2008).

3.15.3 Regression Analysis

Regression analysis examines the relationship between independent variables and the single dependent variable. In the present study, both multiple and hierarchical regression analysis were carried out to determine the relationship between the study's independent variables namely mathematics attitude, motivation, self-regulation, self-efficacy and mathematics anxiety factors, and the dependent variable namely mathematical achievement. It also identifies the study's mediating variable namely spatial visualization.

3.15.4 Hierarchical Regression Analysis

Spatial visualization's mediating role in the MLS factors (i.e. mathematics attitude, mathematic motivation, mathematics self-regulation, mathematics self-efficacy, mathematics anxiety) – mathematics achievement relationship was examined through multiple regression analysis. In this regard, Baron and Kenny (1986) procedure was followed. A detailed explanation of such an analysis is provided in the next chapter. According to the descriptions of the data analyses used, Table 3.9 presents the summary of the primary statistical tests employed to determine the answers to the research questions and in turn, achieve the research objectives.

Table 3.9

The Data Analysis Techniques Used in the Research

Research Questions	**Analysis Techniques**
1- Identify the level of difficulty of numbers, algebra, geometry and mathematics achievement among middle school students in Jordan.	Frequencies
2- Is there a significant difference between gender base on numbers, algebra, geometry and mathematics achievement.	T-Test
3- To what extent would the students' mathematics leaarning strategy factors such as mathematics attitude, mathematics motivation, mathematics self-regulation, mathematics self-efficacy and mathematics anxiety predict mathematics achievement.	Multiple Regression Analysis
4- Does spatial visualization mediate the relationship between MLS factors and mathematics achievement.	Hierarchical Multiple Regression & Baron & Kenny (1986**)** approach

3.16 Conceptual Framework

Various models in education have come up with the conceptualized relationship between MLS factors to explain student's learning of mathematics. Hence, it is imperative to know that knowledge of cognitive aspects on its own may not lead to the promotion of mathematics achievement; instead, students must also have positive affective characteristics to effectively make use of their cognitive skills (Pintrich & De Groot, 1990). In several models brought forward to explain academic achievement in mathematics, cognitive variables and affective characteristics (Malpass, O'Neil & Hocevar, 1999) were proposed including motivation (Hsiao, 2003; Linnenbrink & Pintrich, 2002), self-efficacy (Hampton & Mason, 2003; Margolis & McCabe, 2003; Schunk & Pajares, 2002), mathematics anxiety (Ashcraft & Kirk, 2001; Hopko, McNeil, Lejuez, Ashcraft, Eifert, & Riel, 2002), attitude (Schreiber, 2000) and finally self-regulation (Bembenutty & Zimmerman, 2003) were revealed to have a significant impact.

In addition, several linked concepts were also studied including motivation, self-regulation, attitude, anxiety and self-efficacy (Nicolaidou & Philippou, 2002; Bandura, 1994; Hammouri, 2004; Cretchley, 2008). Kuhl (2000) stated that even high self-efficacy and motivation are not sufficient for the individual to initiate action and hence, he incorporated self-regulatory processes in his theory of motivation, better known as the Theory of Action Control. The theory postulates that self-regulatory abilities are needed to put intentions into practice and strategies have a significant role in the actions that are taken (Kuhl, 2000). Researchers stated that self-efficacy is related to self-regulation and motivation variables (Zimmerman, 2000; Pajares & Miller, 1994). Bandura (1989) also stated that self-efficacy is a critical factor in the motivation of learning in light of expectancy as this may enable the learner to predict and perceive his/her learning goals. This is further compounded by Pajares and Kranzler (1995) who stated that mathematics self-efficacy and mathematics anxiety negative correlate indicating that high mathematics self-efficacy corresponds to low mathematics anxiety and vice versa. Despite the difference between the factors, it may be less clear to educators and hence, the relationship between MLS factors is well documented in extant studies.

MLS issues have a critical role to play in mathematics learning and teaching (Mcleod, 1992). According to Fennema (1989), studies that are dedicated to the increasing understanding of the development of MLS factors of the learner and their impact upon learning mathematics is important for mathematics education while Nasser (2004) is convinced that MLS factors including attitude and motivation either facilitate or hinder the student's learning and achievement in mathematics. In addition, studies also examined students' self-efficacy and mathematics anxiety and causal attributions as causes of either mathematics success or failure, along with the impact of these individual differences upon student motivation and mathematics achievement (Mcleod, 1992). Differences in gender have been examined time and again in research (Ifamuyiwa & Ajilogba, 2012). However, most of the researches concerning mathematics education were conducted from a cognitive point of view of mathematics achievement (Mcleod, 1992). The link between the variables and their impact on mathematics achievement was studied to shed a light on the underlying mechanisms (Nasser, 2004; Sorge & Schau, 2002). Nasser (2004) investigated the level to which anxiety and attitudes toward mathematics and statistics, motivation and mathematical aptitude explained achievement. He measured all factors related to achievement and his findings were consistent with Sorge and Schau (2002) findings which revealed a significant positive impact of mathematical aptitude and a low significant positive impact of attitudes upon achievement (Sorge & Schau, 2002; Wisenbaker et al., 2000). In addition, mathematics anxiety was revealed to be related to attitudes in a strong negative manner indicating that high level of mathematics anxiety relates to low level of positive attitude towards the subject. Motivation was found not to have a direct link with achievement but it has a positive but modest impact upon attitudes as consistent with Auzmendi (1991) finding.

According to the literature reviewed, the relationship between MLS factors and mathematics achievement is not straightforward and that MLS models require students' individual characteristics. Basing our argument on these premises, we aim to better determine the effect of mathematic learning strategy factors upon mathematics achievement. The major findings of the findings in literature are taken into consideration when development the present study's model of mathematics achievement and MLS factorsr. MLS factors are are hypothesized to be directly and indirectly related to mathematics achievement. On the basis of literature, the present study develops the relationship between the independent and dependent variables as depicted in the Figure below.3.1.

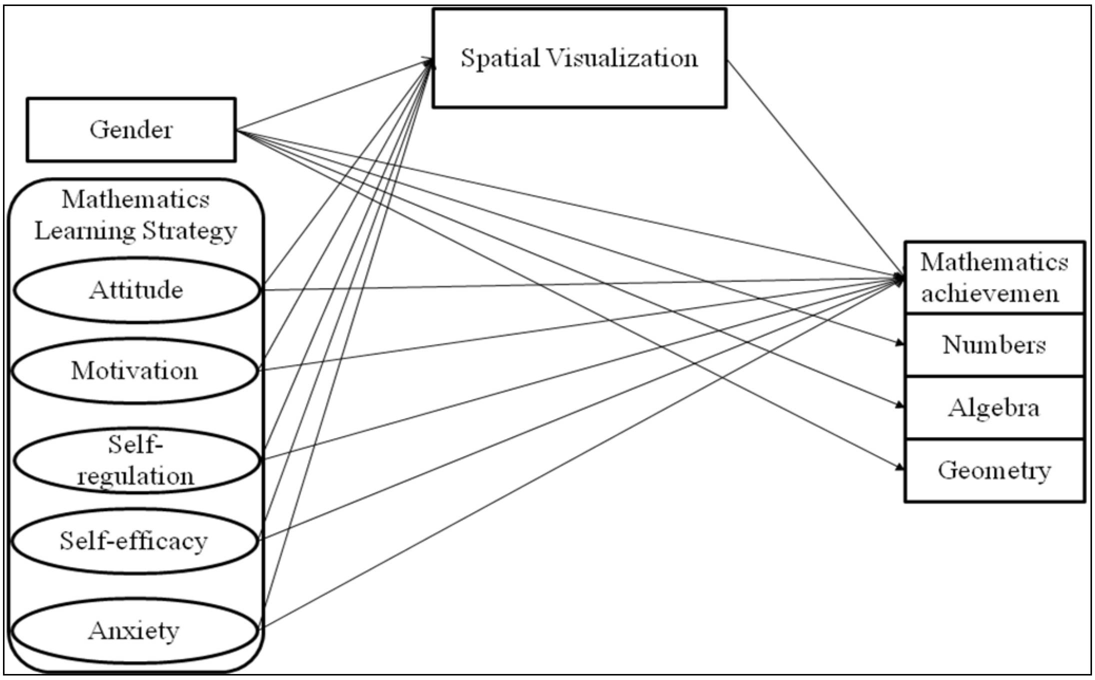

Figure 3.1. Research Framework for Spatial visualization mediating between MLS and Mathematics achievement

The MLS factors in this study are mathematics attitude, mathematics motivation, mathematics self-regulation, mathematics self-efficacy and mathematics anxiety.

Summary

The chapter provided a description of the way the study was carried out to determine the answers to the research questions and to achieve the research objectives. Specifically, the chapter provided an overview of the relevant methodological issues including research design description, population, research sample, procedures for data collection, variables measurement and data analyses. The findings of the study reached through data analyses are presented in the next chapter.

CHAPTER FOUR
DATA ANALYSIS AND FINDINGS

4.1 Introduction

The main aim of the present research is to investigate the MLS factors that influence students' achievement in mathematics achievement in Jordan. This chapter presents descriptive analysis, data screening, missing data, response rate, normality assessment, linearity, homoscedasticity, linearity, homoscedasticity, multicollinearity, goodness of measures of MLS factor instrument, answering the research questions and testing hypotheses, reliability analysis and summary that describes all the results obtained during data analysis. Finally, the chapter is concluded by a summary of the obtained results.

4.2 Descriptive Analysis

To identify the situation of construct (independent variables), descriptive statistics, such as mean, and standard deviation, were used as a way of clarification. The mean value of the variables was obtained by the measure on a five-Likert scale – the greater the number of the five point scale, the greater the goodness of the variable will be. Values nearer to five are considered better, while values close to zero are considered bad. A score equal or more than 4 shows a high agreement with a particular criterion; a score equal or less than 2 were considered as low, and a mean score of 3 was considered as a moderate agreement. A descriptive analysis of the five variables is illustrated in Table 4.1

Table 4.1

Means and standard deviations for all Variables

Variables	**Mean**	**Std. Deviation**
Mathematics attitude	2.93	0.56
Mathematics motivation	2.78	0.68
Mathematics self-regulation	2.95	0.64
Mathematics self-efficacy	2.66	0.91
Mathematics anxiety	2.97	0.70

As shown in Table 4.1, it can be observed that the mean scores of MLS factors (mathematics attitude, mathematics motivation, mathematics self-regulation, mathematics self-efficacy, mathematics anxiety) ranged from 2.66 to 2.97 whilst the standard deviation values ranged from 0.56 to 0.91, indicating a moderate level of agreement.

4.3 Data Screening

4.3.1 Missing Data

A frequency test was carried out for every variable to detect any missing responses. According to this, 19 of the total returned questionnaires were found to be unusable because of missing responses. A review of the data set showed that there were incomplete responses in some part of the questionnaire. Consequently, these missing responses were removed from the data analysis, which resulted in 331 usable responses. This method is known as a case wise deletion and was preferred to other methods of analyzing missing responses (Malhotra, 1998).

4.3.2 Response Rate

Three hundred and sixty questionnaires were distributed in eight public schools in Al-Koura District in Jordan. Out of 360 questionnaires, 350 were returned making the response rate (97%). After a thorough checking of the returned questionnaires, it appeared that only 331 were useable for analysis. The ignored questionnaires were either incomplete or filled in with mistakes and were eventually dropped. Hence, the final usable response rate is 92%, which is considered acceptable. Table 4.2 illustrates the response rate and the usable questionnaire for this research, which is relatively acceptable as proposed by Krejcie and Morgan (1970).

Table 4.2

Summary of the Total Questionnaire and the Response Rate

The sample size of the study	**360**
Returned questionnaire	350
Returned and unusable questionnaire	19
Non- returned questionnaire	10
Response rate	97%
Usable response rate	92%

4.3.3 Normality Assessment

Normality is the fundamental assumption for multivariate techniques such as multiple regression, indicating the shape of the distribution of the data for an individual metric variable and its similarity to the normal distribution. Hair et al. (2006) termed the normality as the benchmark for statistical approach. The difference in the normal distribution is supposed to be small. For large variations, this will cause all statistical measurement resulting from the analysis to be invalidated (Hair et al., 2006). The normality was assessed utilising two techniques, a visualization of the normal distribution histogram, as shown in Figure 4.1, and also the values of skewness and kurtosis for all variables as shown in Table 4.3.

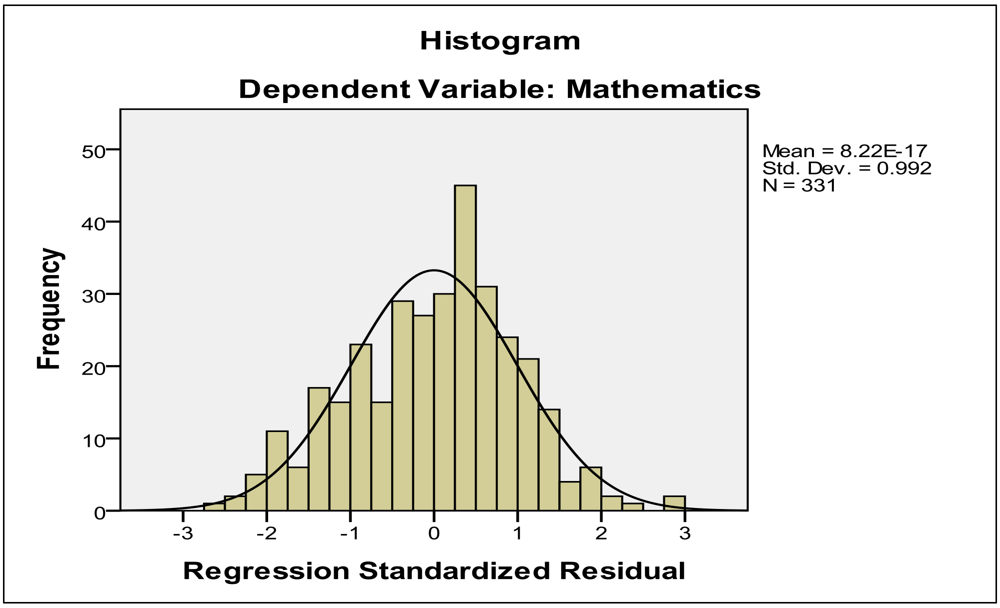

Figure 4.1. Normality Test Histogram of Standardized residuals

As portrayed in Figure 4.1, the sample of study was normally distributed because the histogram displayed a bell shaped curve for all the examined residuals and no exaggerated cluster was observed. Therefore, the normality assumption was already met.

Skewness and kurtosis are the most popular ways used by many researchers for describing the shape of the data distribution. Skewness is an indicator that shows to what extent a distribution of data leans from the center (symmetry) around the mean (George & Mallery, 2010). Skewness values which are outside the range of +1 to -1 imply a substantially skewed distribution (Hair et al., 2006). In this study, the skewness values were investigated and found that all variables are within the -1 to +1 range.

Kurtosis is a test of flatness or peakedness of data distribution. A negative value for kurtosis refers to a shape flatter than normal while the positive value for the kurtosis refers to a data distribution more peaked than normal (George & Mallery, 2010).

Table 4.3

Statistic Values of Skewness and Kurtosis (Descriptive Statistics) (n =331)

Variable	**Skewness**		**Kurtosis**	
	Statistic	Std. Error	Statistic	Std. Error
Mathematics attituude	.414	.134	-.203	.267
Mathematics motivation	.364	.134	-.137	.267
Mathematics self-regulation	.493	.134	-.158	.267
Mathematics self-efficacy	.503	.134	-.142	.267
Mathematics anxiety	.239	.134	-.438	.267

In this research, the kurtosis values are filled within the recommended range +1 to -1. This result indicated that the data set has not violated the normality assumption. Thus, it shows that all variables are normally distributed.

4.3.4 Linearity

In order to assess the linearity, the normal plot diagram was utilised. Figure 4.2 illustrates the results of testing the linearity.

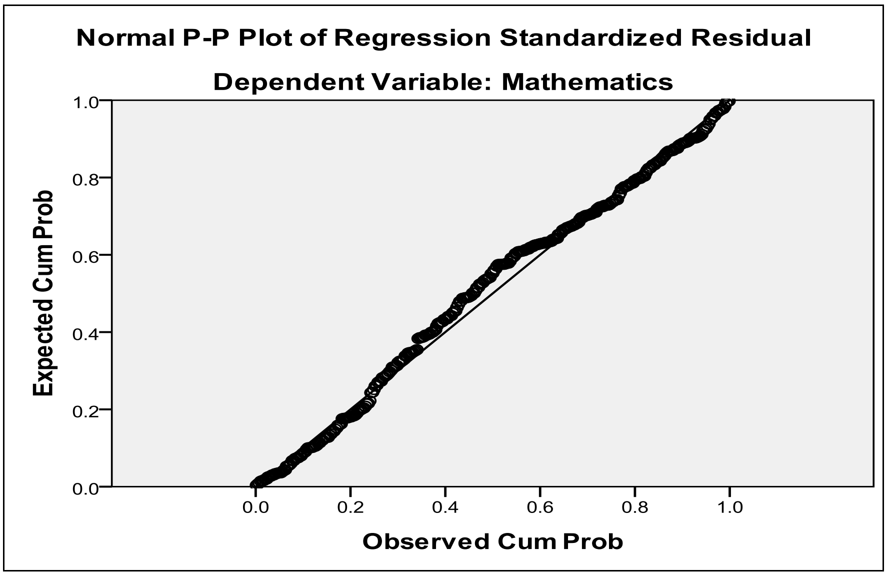

Figure 4.2. Normal Probability P-Plot Regression of Standardized residuals

Not observed cases were faraway above or below the diagonal line and all the observed values did not have any substantial departures. Therefore, the obtained residuals were considered to be normal. Hence, the required outcome of linearity test was met and further analysis could be performed.

4.3.5 Homoscedasticity

Homoscedasticity was verified using the scatter plots of regression standardized residuals versus regression standardized predicted value. The randomised pattern of the plot indicated that the assumption of Homoscedasticity was achieved. Figure 4.3 shows the results of the Homoscedasticity test, which shows that the data is normally distributed.

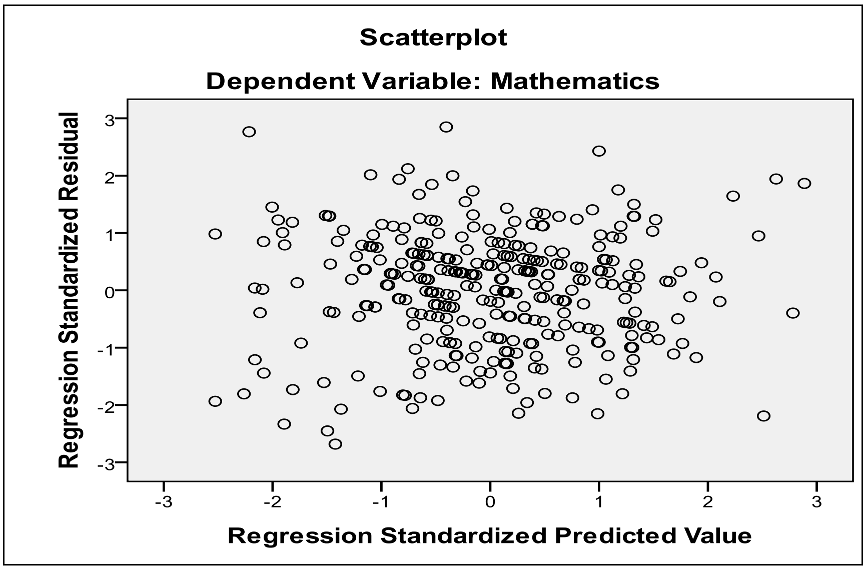

Figure 4.3. Homoscedasticicty test for mathematics achievement

4.3.6 Multicollinearity

Multicollinearity appears when any individual predictor variable is highly correlated with another group of predictor variables (Mayer, 1999). According to Hair et al. (2006), acceptable values for collinearity are considered from the tolerance value of more than 0.1 or the VIFs value of less than 10 to indicate little or no multicollinearity.

Table 4.4

Tolerance Value and the Variance Inflation Factor (VIF) test

	Collinearity statistics	
MLS factor	**Tolerance**	**VIF**
Mathematics attitude	0.13	7.62
Mathematics motivation	0.19	4.99
Mathematics self-regulation	0.58	1.73
Mathematics self-efficacy	0.37	2.68
Mathematics anxiety	0.22	4.61

Based on the multiple regression analysis as shown in Table 4.4, the results reveal that the tolerance value was between 0.13 and 0.58, and the variance inflation factor (VIF) value was in the range of 1.7 to 7.6. Because the tolerance value is substantially greater than 0.10 and the VIF value is less than 10, it can be concluded that multicollinearity among the variables is not a problem and the hypothesis and research question can be investigated and answered.

4.4 Goodness of Measures of MLS Factor Instrument

In order to examine the goodness of measures, two procedures need to be accomplished before carrying the necessary analyses, factor analysis and reliability analysis. The findings of factor analysis and reliability analysis for all the items tapped for the dependent and independent variables were included in this research.

Factor analysis is employed when the underlying structures of studied constructs require understanding (Hair et al., 2006). Additionally, multivariate technique – a technique that confirms the dimensions of measured concepts – was operationally defined and the suitable listed items relating to every dimension has been identified as recommended by Sekaran (2003). The next sections illustrate each dimension's validity. For the full outcome of SPSS, refer to Appendix (G).

Mathematics Attitude

Attitude consisted of two dimensions namely, Enjoyment and Value. A total of 18 items were used to measure the Mathematics attitude variable. Table 4.5 provides the results of the factor analysis on attitude items.

Table 4.5

Factor loading for the Mathematics Attitude variable

Items	**Dimensions**		**Total Variance**
	Enjoyment	Value	
Atte1	0.89		
Atte2	0.85		
Atte3	0.84		
Atte4	0.83		
Atte5	0.80		
Atte6	0.79		40.0%
Atte7	0.79		
Atte8	0.78		
Atte9	0.78		
Atte10	0.68		
Atte11	0.67		
Attv1		0.96	
Attv2		0.96	
Attv3		0.95	
Attv4		0.85	26.69%
Attv5		0.75	
Attv6		0.73	
Attv7		0.72	
Toatal Variance Expalaind			66.69%
KMO	0.91		
Bartlett's test of sphericity approx. chi square	6406.41		
Pd	153		
P	.00		

Table 4.5 presents that the KMO value for attitude towards management is 0.91 and a significant Bartlett's sphericity of ($p<.05$) indicating that factor analysis is appropriate. The results showed that enjoyment explained 40.0% of total variance

(7.20 Eigenvalue) with the items factor loadings ranging from 0.67-0.89, and value explained 26.69% of the total variance (4.80 Eigenvalue) with the items ranging from 0.72-0.96. The results indicated support in favor of using mathematics attitudes to measure mathematics achievement and factor analysis was deemed suitable to be employed on the items of mathematics attitude with eleven items focused on enjoyment, and seven on value.

Mathematics Motivation

A total of seven items were used to measure the motivation variable. Motivation consisted of two dimensions namely, intrinsic motivation and extrinsic motivation. Table 4.6 provides the results of the factor analysis on motivation items.

Table 4.6

Factor loading for Mathematics Motivation

Items	**Dimensions**		**Variance explained**
	Intrinsic	Extrinsic	
Moti1	0.83		
Moti2	0.82		39.10%
Moti3	0.82		
Moti4	0.79		
Mote1		0.90	
Mote2		0.85	30.25%
Mote3		0.81	
Total Variance Explained			69.35%
KMO	0.73		
Bartlett's test of sphericity approx. chi square	877.85		
Pd	21		
P	.00		

Table 4.6 displays the overall KMO as 0.73, a value that exceeds 0.50 (minimum requirement) and the Bartlet's sphericity is significant at ($p<0.05$). The results indicated that the Eigenvalues of intrinsic and extrinsic motivation is higher one and explained 39.10% of the total variance; specifically, the former explained 39.10% of the total variance (Eigenvalue of 2.74) with items factor loadings ranging from 0.79-0.83, and the latter explained 30.25% of the total variance (Eigenvalue 2.12) with items factor loadings ranging from 0.81-0.90. The evaluated items were deemed capable to measure mathematics motivation.

Mathematics Self-regulation

Mathematics self-regulation consisted of four dimensions namely, Concentration, Self Testing, Study Aids and Time Management. A total of twenty seven items were used to assess self-regulation. Concentration was assessed using eight items and Self

Table 4.7

Factor loading for the Mathematics Self-regulation variable

Items	**Dimensions**				**Variance Explained**
	Concentration	Self testing	Study aids	Time management	
Srcn1	0.90				
Srcn2	0.87				
Srcn3	0.86				
Srcn4	0.83				34.23%
Srcn5	0.76				
Srcn6	0.75				
Srcn7	0.74				
Srcn8	0.69				
Srst1		0.88			
Srst2		0.87			

Srst3		0.78			21.28%
Srst4		0.78			
Srst5		0.77			
Srst6		0.61			
Srsa1			0.85		
Srsa2			0.84		
Srsa3			0.83		7.06%
Srsa4			0.82		
Srsa5			0.79		
Srtm1				0.95	
Srtm2				0.70	
Srtm3				0.68	5.63%
Srtm4				0.63	
Srtm5				0.56	
Srtm6				0.54	
		Total Variance			68.20%
KMO	0.91				
Bartlett's test of sphericity approx. chi square	5718..94				
Pd	300				
P	.00				

Testing consisted of six items. Study Aids contained seven items while Time Management had six items. The results of principle component extraction method and Promax rotated analysis are given in Table 4.7.

Table 4.7 presents that the overall KMO for Mathematics self-regulation is 0.91 with a significant Bartlett's sphericity (p<.05). The Eigen values of concentration, self-testing, study aids and time management explained accounted for 68.20% of the total variance explained. Specifically, concentration accounting for 34.23% of total variance (Eigenvalue of 8.56) with items loadings that ranged from 0.69-0.90, self-testing accounted for 21.28% of the total variance (Eigenvalue of 5.32) and item loadings ranging from 0.61-0.88. As for study aids, it explained 7.06% of the total variance (Eigenvalue of 1.76) with items loadings ranging from 0.79-0.85. Finally, time management explained 5.63% of the total variance explained (Eigenvalue of 1.41) with items loadings ranging from 0.54-0.95.

Mathematics Self-Efficacy

A total of five items were utilized to assess mathematics self-efficacy. Table 4.8 provides the results of the factor analyses of self-efficacy in math. As represented in table 4.8, the KMO is 0.84 and considered acceptable (>0.50) and the Bartlett's test of sphericity is significant ($p<.05$). The mentioned values indicated the appropriateness of conducting a factor analysis for self-efficacy acceptance variable. Results from Promax rotated analysis indicated that self-efficacy accounted for 67.74% of the total variance explained with Eigenvalue of 3.39. Factor loading for the self-efficacy items ranged from 0.79 to 0.88. Thus, the mathematics self-efficacy factor can be measured with the evaluated items.

Table 4.8

Factor loading for Mathematics Self-efficacy

Items	**Self-efficacy**	**Variance explained**
Sef1	0.88	
Sef2	0.85	
Sef3	0.80	67.74%
Sef4	0.79	
Sef5	0.79	
KMO	0.84	

Bartlett's test of sphericity approx. chi	874.63
Df	10
P	.00

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Mathematics anxiety

Mathematics anxiety consists of ten items which reflects the student's anxiety towards mathematics. The results of Promax rotated analysis is given in table 4.9. As portrayed in Table 4.9, the KMO is 0.95, which is considered acceptable because it is more than 0.50, Bartlett's test of sphericity is significant ($p<.05$). It can be said that the factor analysis was appropriate and could be performed on these items.

Mathematics anxiety accounted 66.29 % of the total variance explained with an Eigenvalue of 6.63. Factor loading for items in this variable ranged from 0.73 to 0.88, which is considered acceptable and justifiable. Thus, mathematics anxiety factor can be measured with the evaluated items.

Table 4.9

Factor loading for Mathematics anxiety

Items	**Mathematics anxiety**	**Variance explained**
Anx1	0.89	
Anx2	0.88	
Anx3	0.88	
Anx4	0.87	
Anx5	0.83	66.29%
Anx6	0.78	
Anx7	0.77	
Anx8	0.75	
Anx9	0.75	
Anx10	0.73	

KMO	0.95
Bartlett's test of sphericity approx. chi	2616.27
Df	45
P	.00

4.5 Reliability Analysis

Reliability refers to the instrument's stability and consistency and it indicates goodness of measure (Sekaran, 2003). Internal consistency of items was tested in the present study to identify the level of inter-correlation among them as suggested by Sekaran (2003). Various methods can be used for this test but the most extensively used method is the Cronbach's alpha coefficient (Pallant, 2007; Zikmund & Babin, 2012), with alpha values ranging from 0 to 1 (0 indicates no consistency while 1 indicates complete consistency) (Hair et al., 2009; Pallant, 2007; Zikmund et al., 2009).

Coefficient alpha values that are diverse have the following interpretation criteria (Zikmund et al., 2009); alpha values ranging from 0.80 to 0.95 show good reliability, those falling between 0.60 and 0.70 show fair reliability, whereas those under 0.60 show poor reliability. Accordingly, this research makes use of two ways to measure scale reliability and internal consistency. First, Cronbach's alpha coefficient was used to show the average of the entire items' correlation that forms the scale (Pallant, 2001), where coefficient higher than 0.60 were accepted (Nunnally & Bernstein, 1994; Sekaran, 2000). Second, the corrected item total correlation throughout the entire items was guaranteed to be over 0.30 as suggested by Hair et al. (1998). Both measures ensured scale reliability. The reliability of each factor is demonstrated in the next section with the result of SPSS attached in Appendix (H).

Reliability analysis of mathematics attitude questionnaire

The mathematics attitude questionnaire was analyzed for its reliability. The questionnaire comprised two dimensions, which are value and enjoyment, each having seven and eleven items respectively. The results of the mathematics attitude variables reliability test are listed in Table 4.10.

Table 4.10

Reliability analyses for attitude towards mathematics

Attitude	**Total Items**	**Corrected Item-Total correlation**	**α**
Value	7	0.67, 0.66, 0.68, 0.78, 0.91, 0.91, 0.90	0.93
Enjoyment	11	0.62, 0.73, 0.73, 0.72, 0.81, 0.86, 0.62, 0.79, 0.75, 0.78, 0.75	0.94

According to Table 4.10, the Cronbach's alpha value for the first dimension (Value) is 0.93, indicating an acceptable reliability level for this dimension. The corrected item total correlation ranged from 0.66 to 0.91, which are considered as acceptable as well as highly correlated. The Cronbach's alpha value of the second dimension (Enjoyment) is .94, indicating an acceptable reliability level for this dimension. The corrected item total correlations ranged from 0.62 to 0.86, and they are considered as acceptable.

Reliability of Motivation towards mathematics Scale

With regards to the motivation towards mathematics scale's reliability, Cronbach's alpha was obtained for both dimensions (intrinsic and extrinsic) and the results obtained are presented in Table 4.11.

Table 4.11

Reliability analyses for motivation towards mathematics

Motivation	Total Items	Corrected Item-Total correlation	α
Intrinsic	4	0.64, 0.60, 0.65, 0.67	0.83
Extrinsic	3	0.76, 0.59, 0.67	0.82

According to Table 4.11, the Cronbach's alpha value for the first dimension (Intrinsic) is 0.83, indicating an acceptable reliability level for this dimension. The corrected item total correlation ranged from 0.60 to 0.67, which are considered as acceptable. The Cronbach's alpha value of the second dimension (Extrinsic) is 0.82, indicating an acceptable reliability level for this dimension. The corrected item total correlations ranged from 0.59 to 0.76, and these are considered as acceptable.

Reliability Analysis for Mathematics Self-regulation

As with the other study constructs, mathematics self-regulation was exposed to a rigorous reliability test. This construct consists of four dimensions which are, concentration having eight items, self-testing having six items, study aids having five items and finally, time management having six items. The reliability test results for this construct are listed in Table 4.12.

Table 4.12

Reliability analyses for Mathematics Self-regulation

Self-regulation	Total items	Corrected Item-Total correlation	α
Concentration	8	0.72, 0.66, 0.80, 0.78, 0.80, 0.81, 0.71, 0.71	0.93
Self Testing	6	0.70, 0.77, 0.74, 0.78, 0.73, 0.72	0.91
Study Aids	5	0.71, 0.72, 0.73, 0.75, 0.74	0.89
Time Management	6	0.70, 0.67, 0.72, 0.76,0.74, 0.59	0.88

The results in Table 4.12 indicate that the Cronbach's alpha value for Concentration is 0.93, indicating an acceptable reliability level for this dimension. The corrected item total correlation ranged from 0.66 to 0.81 which are considered as acceptable. The Cronbach's alpha value of Self Testing is 0.91. The total items corrected correlation ranged from 0.70 to 0.78, which are considered as acceptable. The Cronbach's alpha value of Study Aids is 0.89, indicating an acceptable reliability level for this dimension. The corrected item total correlation ranged from 0.71 to 0.75, which are considered acceptable. The Cronbach's alpha value of Time Managemant is 0.88. The total items corrected correlation ranged from 0.59 to 0.76, and are hence considered as acceptable.

Reliability Analysis of Math Self-Efficacy

A reliability test of mathematics self-efficacy was performed. Table 4.13 presents the results of the reliability test for the mathematics self-efficacy. The mathematics self-efficacy variable has five items.

Table 4.13

Reliability analyses for Mathematics Self-efficacy

	Total items	Corrected Item-Total correlation	α
Self-efficacy	5	0.67, 0.68, 0.68, 0.75, 0.78	0.88

As portrayed in Table 4.13, the Cronbach's alpha value for Mathematics Self-efficacy is 0.88, indicating an acceptable reliability level for this variable. The corrected item total correlation ranged from 0.67 to 0.78, which are considered as highly correlated and acceptable.

Reliability Analysis of Mathematics anxiety

A Reliability tests on mathematics anxiety was performed. Table 4.14 represents the results of the reliability test for mathematics anxiety which has ten items.

Table 4.14

Reliability analyses for Mathematics anxiety

	Total items	Corrected Item-Total correlation	α
Mathematics anxiety	10	0.72, 0.72, 0.85, 0.84, 0.78, 0.84, 0.83, 0.69, 0.70, 0.67	0.94

According to table 4.14, the Cronbach's alpha value for mathematics anxiety is 0.94, indicating an acceptable reliability level for this variable. The corrected item total correlation ranged from 0.69 to 0.85, which are considered as acceptable as well as highly correlated. Over all, the Cronbach's alpha values for all the variables were acceptable and justifiable.

4.6 Answering the Research Questions and Testing Hypotheses

Research Question One

Identify the level of difficulty of numbers, algebra and geometry as indicator of mathematics achievement among middle school students.

The findings of this study show that female students displayed higher scores in overall average mathematics achievement as well as in numbers and algebra as compared to male students; for number (male, M = 57% , female, M= 62%), algebra (male, M= 54%, female, M=60%) and geometry (male, M= 53%, female, M= 53%), (Figure 4.4).

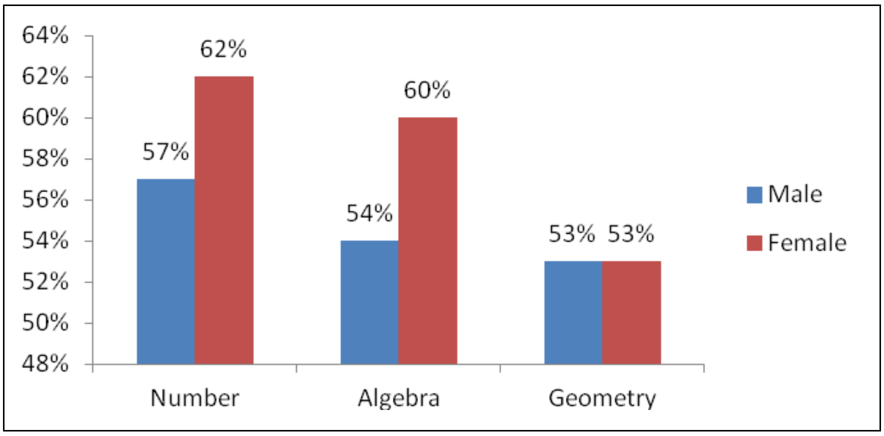

Figure 4.4. Students results with numbers, algebra and geometry

Numbers in Mathematics Achievement

The number test consisted of eight multiple choice items related to whole numbers, fractions and decimals, integers, and roots. For male students, items 3 and 8 were the most difficult to answer and only 24 percent of male students were able to answer correctly while the remaining 76 percent of male students were not. Similarly, for item 8, only 22 percent of male students managed to answer correctly while the remaining 78 percent were not able to answer the item (Figure 4.5).

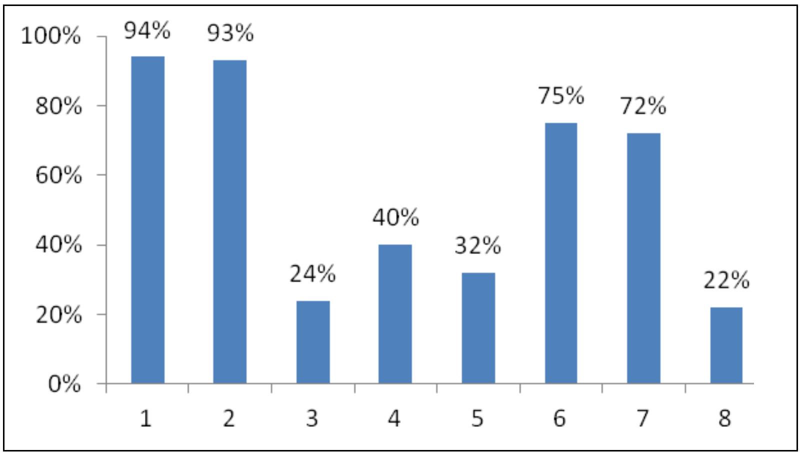

Figure 4.5. Items difficulty for numbers in mathematics for male students

Item 8 (Fractions) is the most Difficult in Numbers for Male Students

Which of these fractions is less than $\frac{3}{5}$

A. $\frac{3}{6}$ B. $\frac{7}{10}$ C. $\frac{4}{5}$ D. $\frac{12}{20}$

For female students, item 3 related to square roots in numbers was the most difficult item in which only 30 percent of female students were able to answer correctly while 70 percent of female students were unable to answer the item (Figure 4.6).

Item 3 (square roots) is the most Difficult in Numbers for Female Students

The value of ($5\sqrt{12} - \sqrt{3}$) is equal to:

A. 10 B. 15 C. $9\sqrt{3}$ D. $6\sqrt{3}$

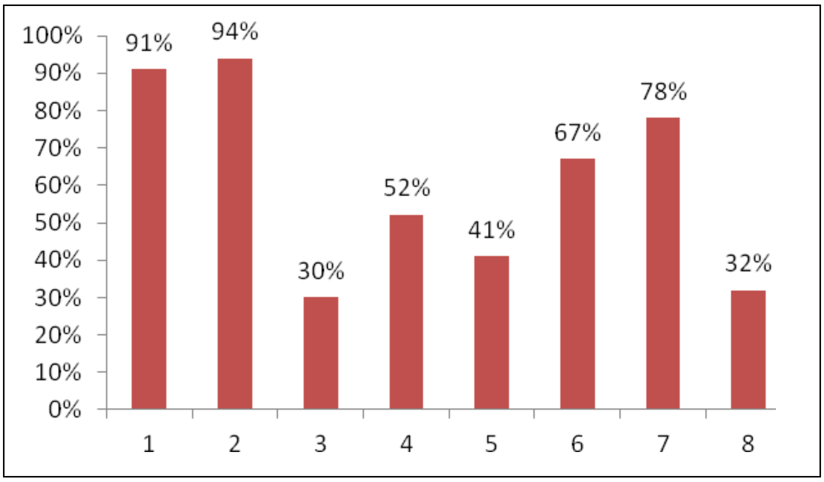

Figure 4.6. Items difficulty for numbers in mathematics for female students

Algebra Achievement in Mathematics

Algebra test consist of 14 items, namely patterns, algebraic expressions, inequality, equations and formulas, and relationships. Of these fourteen items, item 11 was the most difficult item where only 23 percent of male students were able to answer correctly while 77 percent of male students were not (Figure 4.7).

Item 11 (Inequality) (The most Difficult item in algebra for male and female students with Difficult Index is 0.23)

The inequality that represents the bold line below:

A. $-5 \leq x < 7$ **B.** $7 \leq x < -5$ **C.** $-5 < x \leq 7$ **D.** $7 < x \leq -5$

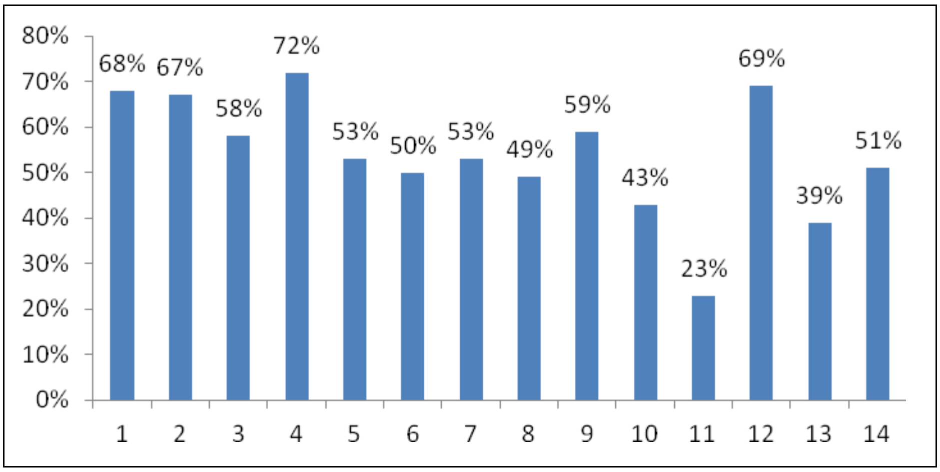

Figure 4.7. Items difficulty for algebra in mathematics for male students

Similarly, for female students, item 11 were the most difficult to answer and only 23 percent of female students able to answer correctly while 77 percent of female students were not able to answer this item correctly (Figure 4.8).

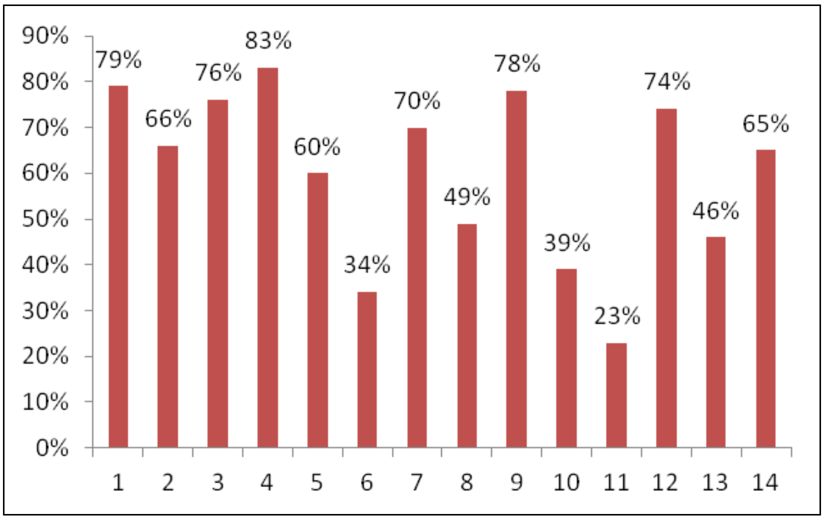

Figure 4.8. Items difficulty for algebra in mathematics for female students

Geometry Achievement in Mathematics

The geometry test consists of eight items including line and angles, two and three - dimensional shape and location. For male students, items 6 and 8 were the most difficult to answer and only 26 percent of male students able to answer correctly while 74 percent of male students were not able to answer this item. On the other hand, for item 8, only 12 percent of male students managed to answer correctly while 88 percent of male students were not able to answer the item (Figure 4.9).

Item 8 (volume in three dimension) (The most Difficult Item in Geometry for male and female Students)

A cubic of ice with volume 125 cm^3, melts while maintaining shape; if the rate of changes in the length of side equal 1cm\min, find the volume of the cubic after two minutes in cm^3.

A. 123 **B.** 64 **C.** 27 **D.** 16

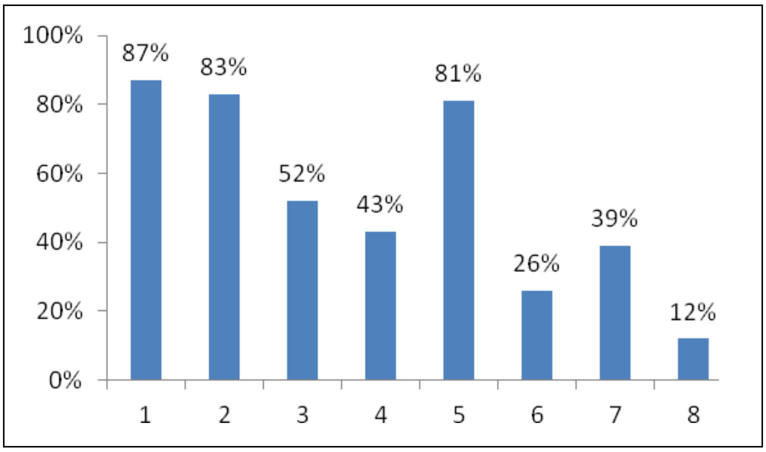

Figure 4.9. Items difficulty for geometry in mathematics for male students

For female students, item 8 was the most difficult to answer and only 33 percent of female students able to answer correctly while 67 percent of female students were not able to answer the item (Figure 4.10).

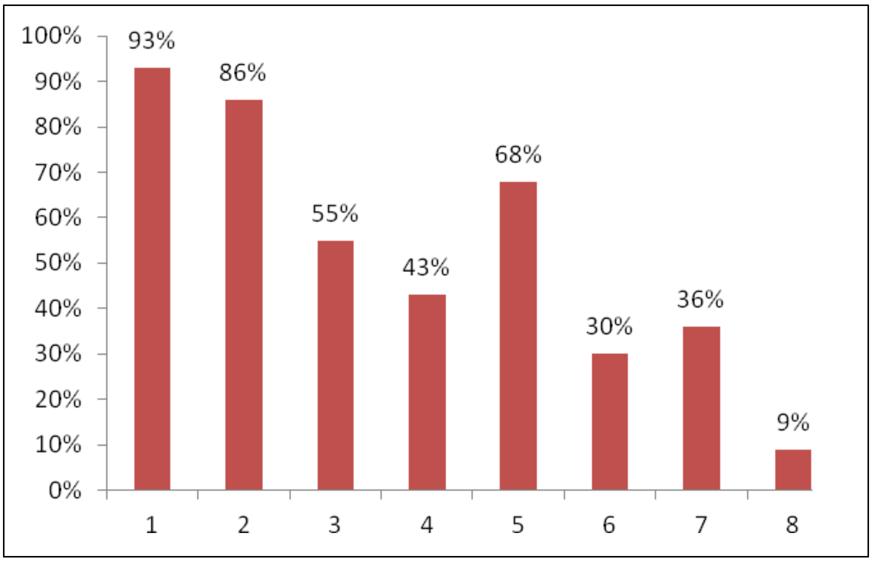

Figure 4.10. Items difficulty for geometry in mathematics for female students

Research Question Two

Is there a significant difference between genders based on numbers, algebra, geometry, mathematics achievement and spatial visualization among Jordanian 8th grade school students?

H_A (1): There is a significant difference between gender and numbers among Jordanian 8th grade school students.

The numbers achievement among male and female students showed statistically significant differences at ($t(329) = -2.40$, $p < .05$). The findings showed that the score of female students ($M=4.53$, $SD =1.68$) in number achievement is higher than the score of male students ($M=4.95$, $SD = 1.48$).

H_A (2): There is a significant difference between gender and algebra.

The result in table 4.15 shows that there is a statistically significant difference for students achievement in algebra based on gender at ($t\ (329) = -2.93$, $p < .05$). This finding showed that the score of female students ($M=8.37$, $SD = 2.90$) in algebra achievement was higher compared to the score of male students ($M=7.57$, $SD = 3.11$).

H_A (3): There is a significant difference between gender and geometry.

Meanwhile, findings in table 4.15 revealed no statistically significant difference in geometry achievement. ($t(329) = .10$, $p > .05$) between male and female students. This findings showed that the score of male students ($M=4.24$, $SD = 1.88$) in geometry achievement was higher compared to the score of female students ($M = 4.23$, $SD = 1.58$).

H_A (4): There is a significant difference between gender and mathematics achievement.

For the mathematics achievement based on gender, there is a statistically significant difference ($t(329) = -2.20$, $p < .05$). The findings showed that there is a difference in mathematics achievement between male and female students. The mathematics score for female students ($M=17.55$, $SD = 4.02$) is higher than the male students ($M=16.35$, $SD = 5.63$).

H_A (5): There is a significant difference between gender and spatial visualization.

Finally, the spatial visualization test among male and female students is statistically significant differences ($t(329) = -2.20$, $p < .05$). The findings showed that the score of male students ($M=18.94$, $SD =2.15$) in spatial visualization is higher than the score of female students ($M=17.87$, $SD = 4.45$).

Table 4.15

Gender differences based on Numbers, Algebra, Geometry, Mathematics achievement and Spatial visualization

Mathematics		**N**	**Mean**	**SD**	**df**	**T**	**p**
Numbers	Male	176	4.53	1.68	392	-2.40	0.02*
	Female	155	4.95	1.48			
Algebra	Male	176	7.59	3.11	392	-2.93	0.02*
	Female	155	8.37	2.90			
Geometry	Male	176	4.24	1.88	392	0.10	0.92
	Female	155	4.23	1.58			
Mathematics achievement	Male	176	16.35	5.63	392	-2.20	0.03*
	Female	155	17.55	4.02			
Spatial visualization	Male	176	18.94	4.61	292	2.15	0.03*
	Female	155	17.87	4.45			

* $p < .05$ (2-tailed), $p > .05$

Research Question Three

To what extent would the students' MLS Factors such as mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation, and mathematics anxiety predict mathematics achievement?

It was hypothesised that MLS factors are related to mathematics achievement.

The extent of MLS factors (Mathematics attitude, Mathematics motivation, Mathematics self-efficacy, Mathematics self-regulation, and Mathematics anxiety) was found to be positively and statistically significantly associated with overall mathematics achievement. Among the five predictors, Mathematics attitude ($\beta = .47$, $t = 2.77$, $p < 0.05$) had the highest and significant standardized beta coefficient, which indicates that mathematics attitude was the most important variable in predicting the mathematics achievement. The other important predictor, was self-efficacy in predicting mathematics achievement (β = 0.36, t = 2.05, p < 0.05).

Table 4.16

Multiple Regression Result between MLS Factors and Mathematics achievement

R	**R^2**	**Adjusted R^2**	**Std.Error.Est**	**F**	**P**
.291	0.09	0.07	4.80	6.00	.00*
Model	Un-Std. β	Std.Error	Std. β	T	P
(constant)	11.19	1.59		7.03	.00
Attitude	4.26	1.53	.47	2.77	.00**
Motivation	-4.58	1.57	-.63	-2.61	.00**
Self-regulation	-1.14	.55	-.14	-2.08	.03*
Self-efficacy	1.98	.96	.36	2.05	.04*
Mathematics anxiety	1.38	.84	.19	1.64	.10

a. Dependent Variable: Mathematics achievement

Model of Mathematics Learning Strategy factors and mathematics achievement

$y = \alpha + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 ++ b_5 X_5 + e$

MA= 11.19 + 4.26 Attitude – 4.58 Motivation – 1.14 Self-regulation + 1.98 Self-efficacy + 1.38 Mathematics anxiety + e
t=2.77*   t= -2.61*   t=-2.08*   t= 2.05*   t= 1.64

The result of this study shows that the relationship between mathematics attitude and mathematics achievement is positive and significant, with t-value (t = 4.26, p < 0.05). This means that as the mathematics attitude increases, the level of mathematics achievement also increases. In addition, mathematics motivation is significantly and negatively associated with mathematics achievement, with t-value (t = -2.61, p < 0.05).

MA= 11.19 + 4.26 Attitude – 4.58 Motivation – 1.14 Self-regulation + 1.98 Self- efficacy + e

Moreover, the results show a significant and negative relationship between mathematics achievement and mathematics self-regulation, with t-value ($t = -2.08$, $p < 0.05$). On the other hand, the results indicated that mathematics anxiety is not significantly associated with mathematics achievement, with t value ($t = 1.64$, $p > 0.05$). SPSS outputs of regression analysis are depicted in Appendix (J).

Research Question Four

Does spatial visualization mediate the relationship between MLS factors such as mathematics attitude, mathematics Motivation, mathematics self-efficacy, mathematics self-regulation, mathematics anxiety and mathematics achievement?

This question aimed to examine the mediating effect of spatial visualization on the relationship between the internal independents variables, namely mathematics attitude, motivation, self-regulation, and self-efficacy, Mathematics anxiety and students' achievement in Mathematics. In order to investigate the mediating effects, five hypotheses were formulated.

The assumed hypotheses of mediation were examined using hierarchical regression analysis and Baron and Kenny’s (1986) approach, as shown in Figure 4.11.

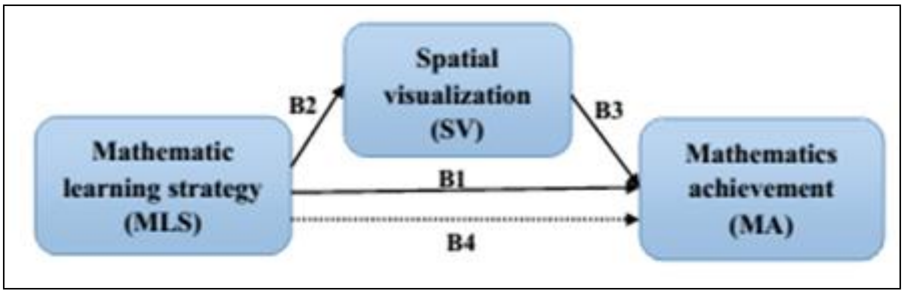

Figure 4.11. Mediation Model

Source: Baron and Kenny (1986)

Equation1: **β1** must be significant
(IV must influence DV significantly)
Equation2: **β2** must be significant
(IV must influence MV significantly)
Equation3: **β3** must be significant
(MV must influence DV significantly)
Equation4: If **β4** insignificant, Y fully mediated.
If β4 significant, Y partially mediated.

According to Baron and Kenny (1986), mediation analysis of spatial visualization requires the following four steps: 1) a significant relationship between the MLS factors and mathematics achievement, 2) a significant relationship between the MLS factors and spatial visualization, 3) a significant relationship between the spatial visualization and mathematics achievement, 4) the full mediation occurs when the significant relationship between the independent variables is reduced and is not significant after the mediating variable enters the equation. Moreover, partial mediation takes place when the significant relationship is reduced but not decreased. The Baron and Kenny's significant criteria were partially met because the correlation analysis between the targeted variables revealed that there were significant relationships between variables (IVs with DV, IVs with MV& MV with DV).

Therefore, the hierarchical regression analysis with Baron and Kenny model could be processed.

The first hypothesis states that spatial visualization mediates the relationship between mathematics attitude and mathematics achievement. To examine the hypothesized statement, hierarchical regression was performed.

The results in table 4.17 demonstrate the results of the hierarchical regression analysis using spatial visualization as a mediator in the relationship between mathematics attitude and mathematics achievement.

Table 4.17

The result of hierarchical regression analysis using spatial visualization as a mediator in the relationship between mathematics attitude and mathematics achievement

Model		**Un. B**	**Std.Error**	**St. β**	**t**	**p**
Step 1	(constant)	11.32	1.43		7.90	.00**
(Model 1)	Mathematics attitude	1.91	0.48	0.21	3.96	.00**
Step 2	Constant	1.74	1.29		1.34	.17
(Model 2)	Mathematics attitude	0.88	0.38	0.09	2.31	.02*
	Spatial visualization	0.68	0.05	.62	14.67	.00**
R^2= .05 in step 1 , R^2= .42 in step 2						

*p<.05, **p<.01

As portrayed in table 4.17, the results indicated that in the first model, Mathematics attitude significantly contributed to mathematics achievement, R^2= 0.05, F= 15.73, p<.05. Model one shows that mathematics attitude was positively related to mathematics achievement β = .21,   t= 3.96, at the significant level of p = <.05. In model two, spatial visualization was added to the equation, the R^2= 0.42 significantly changed with F= 120.65, p<.05. Model two shows that mathematics attitude was reduced β= .09, t = 2.31, at the significant level of p<.05 in testing the mediation effect of spatial visualization: in model 1, the relationship between mathematics attitude (IV) and mathematics achievement (DV) was significant while in model 2 the relationship between IV and DV although reduced is still significant and not decreased. Therefore, Spatial visualization partially mediated the relationship between mathematics attitude and mathematics achievement.

The second hypotheses H_A(7) stated that spatial visualization mediates the relationship between mathematics motivation and mathematics achievement.

The results in table 4.18 demonstrate the results of the hierarchical regression analysis using spatial visualization as a mediator in the relationship between mathematic motivation and mathematics achievement.

As portrayed in table 4.18, the results indicated that in the first model, mathematics motivation significantly contributed to mathematics achievement, R^2= 0.02, F= 6.20, p<.05. Model one shows that motivation was positively related to mathematics achievement β = .14, t= 2.49, at the significant level of p = <.05. In model two, Spatial visualization was added to the equation, the R^2= 0.42 significantly changed with F= 119.04, p<.05. Model two shows that mathematics motivation was reduced β = .08, t = 1.86, at the significant level of p >.05 in testing the mediation effect of spatial visualization: in model 1 the relationship between motivation (IV) and mathematics achievement (DV) was significant while in model 2 the relationship between IV and DV reduced and not significant. Therefore, spatial visualization fully mediated the relationship between motivation and mathematics achievement.

Table 4.18

The result of hierarchical regression analysis using spatial visualization as a mediator in the relationship between mathematics motivation and mathematics achievement

Model		Un-St. β	Std.Error	St. β	t	P
Step 1	(constant)	14.17	1.13		12.49	.00**
(Model 1)	Mathematics motivation	0.99	0.40	0.14	2.49	.01**
Step 2	Constant	2.52	1.12		2.15	.03*
(Model 2)	Mathematics motivation	0.57	0.31	0.08	1.86	.06
	Spatial visualization	0.70	0.05	.63	15.08	.00**
R^2= .02 in step 1 , R^2= .42 in step 2						

*p<.05, **p<.01

The third hypothesis states that spatial visualization mediates the relationship between self-regulation and mathematics achievement.

However, the results in table 4.19 demonstrate the results of the correlations of the independent variable self-regulation and mathematics achievement and they showed no relationship between independent variable self-regulation and dependent variable mathematics achievement. Therefore, it can be concluded that the hypothesis did not achieve the first condition of the mediation variable analysis which is independent variable have to influence the dependent variable in order to test the mediation hypothesis. Therefore, hypothesis number three, which states that spatial visualization mediates the relationship between self-regulation and mathematics achievement, was rejected.

Table 4.19

The result of hierarchical regression analysis using spatial visualization as a mediator in the relationship between mathematics self-regulation and mathematics achievement

Model		**Un-St. β**	**Std.Error**	**St. β**	**t**	**p**
Step 1	(constant)	15.96	1.30		12.25	.00**
(Model 1)	Mathematics Self-regulation	0.32	0.43	0.04	.74	.45
Step 2	Constant	4.99	1.22		4.07	.00**
(Model 2)	Mathematics Self-regulation	-0.40	0.33	-0.05	-1.20	.22
	Spatial Visualization	0.71	0.46	.65	15.25	.00**
R^2= .002 in step 1 , R^2= .42 in step 2						

The fourth hypothesis states that spatial visualization mediates the relationship between self-efficacy and mathematics achievement.

However, the results in table 4.20 demonstrate the results of the correlations of the independent variable self-efficacy and mathematics achievement and show no relationship between independent variable self-efficacy and dependent variable mathematics achievement. Therefore, it can be concluded that the hypothesis did not achieve the first condition of the mediation variable analysis which is, the independent variable have to influence the dependent variable in order to test the mediation hypothesis. Therefore, hypothesis number four, which states that spatial visualization mediates the relationship between self-efficacy and mathematics achievement, was rejected.

Table 4.20

The result of hierarchical regression analysis using spatial visualization as a mediator in the relationship between mathematics self efiicacy and mathematics achievement

Model		**Un-St. β**	**Std.Error**	**St. β**	**t**	**p**
Step 1	(constant)	15.51	0.84		18.39	.00**
(Model 1)	Mathematics Self-efficacy	0.52	0.30	0.09	1.74	.08
Step 2	Constant	2.58	1.06		4.07	.00**
(Model 2)	Mathematics Self-efficacy	0.51	0.22	0.09	-1.20	0.02
	Spatial Visualization	0.70	0.04	.64	15.25	.00**
R^2= .009 in step 1 , R^2= .42 in step 2						

Lastly, fifth hypothesis states that spatial visualization mediates the relationship between mathematics anxiety and mathematics achievement.

The results in table 4.21 demonstrate the results of the hierarchical regression analysis using spatial visualization as a mediator in the relationship between mathematics anxiety and mathematics achievement.

As portrayed in table 4.21, the results indicated that in the first model, Mathematics anxiety significantly contributed to mathematics achievement, R^2= 0.04, F= 14.59, p<.05. Model one shows that mathematics anxiety was positively related to mathematics achievement β = .21, t= 3.82, at the significant level of p <.05. In model two, Spatial visualization was added to the equation, the R^2= 0.41

significantly changed with F= 116.84, p<.05. Model two shows that mathematics anxiety was reduced β = .04, t = .94, at the significant level of p >.05 in testing the mediation effect of spatial visualization: in model 1 the relationship between mathematics anxiety (IV) and mathematics achievement (DV) was significant while in model 2 the relationship between IV and DV was reduced and not significant; therefore, Spatial visualization fully mediated the relationship between mathematics anxiety and mathematics achievement. SPSS output of hierarchical regression analysis are depicted in Appendix (K).

Table 4.21

The result of hierarchical regression analysis using spatial visualization as a mediator in the relationship between mathematics anxiety and mathematics achievement

Model		Un-St β	Std.Error	St. β	t	P
Step 1	(constant)	12.54	1.17		10.66	.00**
(Model 1)	Mathematics anxiety	1.47	0.38	0.21	3.82	.00**
Step 2	Constant	3.29	1.12		2.94	.00**
(Model 2)	Mathematics anxiety	0.29	0.31	0.04	0.94	.34
	Spatial visualization	0.69	0.05	.63	14.48	.00**
R^2= .04 in step 1 , R^2= .41 in step 2						

*p< .05, **p< .01

Summary

The data used in this study was obtained from 360 respondents, which represented a response rate of 97% and several tests were used to analyze the data. Normality test was carried out and showed that the variables are normally distributed. All the variables obtained reliable Cronbach's alpha, which supported the internal consistency of the study and the assumption of factor analysis were met. To determine the strength of the relationship between the variables, Pearson correlation was used. Multiple regression analysis was conducted to determine the independent relations as well as the contribution of MLS factors in predicting mathematics achievement as dependent variable. Hierarchical regressions were used to test the effect of spatial visualization as a mediating variable on the relationship between MLS factors and mathematics achievement. The next chapter will discuss and conclude the findings of this study.

CHAPTER FIVE
DISCUSSION AND IMPLICATIONS

5.1 Introduction

The main focus of the current study is to investigate the MLS factors that influence the student mathematics achievement in middle school level in Jordan. A research model was developed to investigate the influence of MLS factors on the student's mathematics achievement. The research model was an extension and elaboration of the previous studies models in order to investigate and determine the factors that could influence the student's mathematics achievement. The mediation role of spatial visualization on the relationship between MLS factors and students mathematics achievement has been partially supported. This chapter is organized in parts as follows: summary of the findings, discussion of the findings, the research implication, and recommendations for future research and all this was sum up in the summary at the end of the chapter.

The study is systematically organized in a way that it is guided by the traditional way of research report. The chapters are divided into five, whereby each chapter deals with a specific aspect of the research. Chapter one consists of the general introductory aspect of the study, highlighting the background and importance of the research area. In chapter one, it is stated that the mathematics achievement of 8^{th} grade Jordanian school students is low based on statistical reports from Trends in Intrnational Mathematics and Science Study in 1999, 2003, 2007 and 2011 in Jordan. The report stated that the mathematics achievement level among middle school students has shown significant decline within four years (2007-2011).

Currently, multiple studies all over the world revealed low level of mathematics achievement of school students particularly 8th graders.

The problem highlighted in the research lies in the relationship between students' mathematics achievement and MLS factors and students' characteristics. The area of study is quite broad requiring the attention of researchers for an in-depth exploration. Studies didecated to mathematics are still insufficient and they paid minimal attention to schools. The researchers recommended continued research to explore the effect of MLS factors in middle school level.

An important detail included in chapter one is the key objectives of the research which includes the following: to determine a set of factors in MLS underlaying questionaier of mathematics achievement, to identify the level of difficulty of numbers, algebra and geometry as indicator of mathematics achievement among Jordanian 8th grade school students, to identify the differences in gender base on numbers, algebra, geometry, mathematics achievement and spatial visualization, to identify determine the relationship between MLS factors such as mathematics attitude, mathematics motivation, and mathematics self-efficacy, mathematics self-regulation, mathematics anxiety and mathematics achievement and spatial visualization and to determine whether spatial visualization mediate the relationship between MLS factors such as mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation, mathematics anxiety and mathematics achievement. Therefore, four significant research questions are posed in the study.

The second chapter deals with the review of related literature, beginning form journal theories to major conceptual framework and specific concepts. Chapter three deals with the research methodology including study design, measurement, population and sample size. 360 students were chosen to fill the questionnaire and were selected randomly to participate in this study. Chapter four comprises the results of the study and the hypotheses testing as well as discussion the results. Finally, chapter five discusses the purpose of the study, summery of the key research conclusions, discussions of the implications, study limitation, and suggestion for future research in this area and recommendation.

5.2 Summary of findings

The finding related to the instrument is validated by items and factors, where 65 items remained from the initial 83 items. The reliability for all factors scales were sufficient and exploratory factor analysis indicated that the five factors were sufficiently reliable and valid.

Findings of the first question of this study showed that female students obtained higher scores in overall average mathematics achievement as well as in numbers and algebra as compared to male students. The results showed that there is a statistically significant difference for students' achievement in numbers, algebra and overall mathematics achievement based on gender. Meanwhile, findings showed that there is no statistically significant differences in geometry achievement. On other hand, the findings showed that the score of male students in spatial visualization is higher than the score of female students, and there is a statistical signifecant defference in spatial visualzation based on gender.

The results indicated that MLS factors such as (mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation, and mathematics anxiety) were found to be positively and statistically significantly associated with overall mathematics achievement. They also showed that the relationship between mathematics attitude, mathematics self-efficacy and mathematics achievement is positive and significant whereas mathematics motivation and mathematics self-regulation is significantly and negatively associated with mathematics achievement. On other hand, the results indicated that mathematics anxiety is not significantly associated with mathematics achievement.

The last question states “Does spatial visualization mediate the relationship between MLS factors such as mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation, mathematics anxiety and mathematics achievement?”

The results of this study showed that spatial visualization partially mediated the relationship between mathematics attitude and mathematics achievement. Also, the findings showed that spatial visualization fully mediated the relationship between motivation, mathematics anxiety and mathematics achievement. On other hand, spatial visualization failed to mediate the relationship between mathematics self-regulation, mathematics self-efficacy and mathematics achievement.

5.3 Discussion of the Findings

The instrument was validated by items and factors, where 65 items remained from the initial 83 items. It takes 20 to 25 minutes to respond to it according to researcher's observation. The findings provided evidence of good psychometric properties for the Arabic version of the MLS factor instrument. The reliability for all factors scales were sufficient and exploratory factor analysis indicated that the five factors were sufficiently reliable and valid, which provided additional support to the factorial validity of the scales found in the earlier studies. MLS factors play an important role in evaluating and maximizing mathematics learning strategy. This finding concerning the MLS factors provides information on how to improve and develop student's ability to understand mathematical concepts.

5.3.1 Research Question One

The first question was geared towards the the identification the level of difficulty of numbers, algebra and geometry as indicator of mathematics achievement among middle school students.

The findings showed that the scores in numbers for female students were higher than male students among Jordanian 8^{th} graders. This result is consistent with findings of Mullis et al. (2012) and Awang and Ismail (2007) but contrary with other findings (Isiksal & Cakiroglu, 2008; Hyde & Linn, 2006) that showed no differences between male and female students in numbers achievement.

Additionally, the results of this study showed that the scores in algebra for female students were higher than male students. This finding is contrary with the findings by Shafiq (2013) and McCoy (2005) which revealed no differences between male and female students on algebra achievement.

The present study also established that there were no differences between male and female students in terms of geometry achievement. This result is consistent with findings by Erab and Yenmez (2011) and Byran (2004). At the same time, study conducted by Mullis et al. (2012) yield different results that showed differences in favor of female regarding geometry achievement.

In conclusion, the findings showed that overall average achievement for female students was higher than male students. Although the average achievement for female students was greater than male students in two content areas, and the difference were noted in numbers and algebra.

5.3.2 Research Question Two

Research question three states, “Is there a significance differences between gender base on numbers, algebra, geometry, mathematics achievement and spatial visualization among Jordanian 8th grade school students?”

The result showed differences in student's mathematics achievement, numbers, algebra and spatial visualization in terms of gender. However, there were no differences between males and females in terms of geometry.

Gender and Number

The findings showed differences in number achievement in mean scores based on their gender among Jordanian students in middle school. The findings of this study were supported by prior studies (Awang & Ismail, 2007; Mullis et al. 2012), which showed gender differences in number achievement. However, these findings are inconsistent with those reported by other studies (Isiksal & Cakiroglu, 2008; Hyde & Linn, 2006), which showed no gender differences in number achievement. The results of current study showed that the female students outscored their male counterparts in numbers achievement - this result is inconsistent with the findings by Singh (2009) found among Malaysian middle school students. The findings also inconsistent with the findings by Aunio et al. (2006) which showed that no gender differences in number sense.

The present study's results concerning girls superior achievement in numbers may be attributed to the materials instruction focusing more on practice activities, where girls are normally good at. Also, in the Arab countries owing to the teaching practice and teacher-student interaction, girls normally overperform boys. Furthermore, the result supported that Jordanian culture in that female students spend more time than males at home studying their subjects due to culture issue as they are not allowed to spend time out of their homes after their classes unlike male students. In addition, the significant differences in gender support the culture domain that girls often concentrate on their subjects in order to be employed later on as a teacher as this is a favorable profession for female individuals among Jordanian families - therefore, family factors may also play a crucial role in the result. Hence, the significant difference in student's number achievement in terms of their gender is justified.

Gender and Algebra

The findings of this study showed differences in algebra achievement based on gender in Jordanian middle school students. This finding is consistent with the findings by Gamer and Engelhard (1999) and Alkhateeb (2001) but inconsistent with the study by Shafiq (2013) and McCoy (2005), which revealed no differences between male and female students on algebra achievement. The results of current study showed that the score in algebra achievement for female students were higher than the score for male students. This finding concerning female students is consistent with findings by Mullis et al. (2012), which showed that female students in middle school in Jordan outscored the male students in algebra achievement but it is contrary with the findings reported by Atovigba, Vershima, Kwu and Ijenkeli (2012) in that they revealed male students to outperform their female counterparts at the significant level in algebra.

Gender and Geometry

The results of this study indicated no significant differences in geometry achievement based on gender. This contradicts reports by Mullis et al. (2012) report, where significant differences in the performance of boys and girls in geometry were noted. Specifically, the report indicated that girls performed better than boys in geometry test among Jordanian 8th grade students. Also, the findings of this study are inconsistent with the findings by The Lee, Grigg, and Dion (2007) study which showed that there’s a significant differences between male and female students in light of their achievement in geometry with the male students outperformed female student’s counterpart. On other hand, the result of the present study was supported by previous studies who did not find significant differences between males and females.

The reason behind the present study result is the fact that instructors rely on several approaches of teaching during geometry class - therefore, students may feel that geometry is a valuable subject in their life and is related to their interest, desire and their life needs. Furthermore, the textbook of the geometry section may have better presentation where the instructors provide explanations about geometry followed by exercise in order to maximize the students' motivation to learn geometry. Hence, the insignificant difference is due to the instructional strategies that can enhance equal achievement among the gender in geometry. Vale (2009) and Achor, Imoko and Ajai (2010) supported no gender differences in geometry achievement between male and females when good teaching method is used. Hence, the non-significant difference in student's geometry achievement in terms of gender is justified.

Gender and Mathematics Achievement

The study indicates a difference in mathematics achievement based on gender. The finding is supported by Mullis et al. (2012) study in the context of Jordan where differences were reported between male and female students in middle school. In addition, the present study study shows that the score in mathematics achievement for female students is higher than that of male students. This is consistent with the findings by Arslan, Carli and Sabo (2012), which showed significant differences between male and female students in light of their achievement in mathematics with the female outperforming their male counterpart. However, the findings reported by Ross, Bruce and Scott (2012) are in contrast with this as they revealed that gender differences in mathematics achievement was quite minimal, it was nearly zero.

The result obtained from the present study might be due to the fact the materials instruction is focused more on practice activities and normally girls are better than boys when it comes to mathematics performance in Arab countries because of teaching practice and teacher-student interaction. Furthermore, the result supported that Jordanian culture that female normally performed better than boys. The significant differences of gender was supported by culture in that girls tend to focus more on subjects that easily land them teaching jobs in the future - therefore, family factors may also play a crucial role in the result. In other words, girls performed better than boys because teachers and parents stress the importance and value of mathematical skills which encouraged girls to persist and persevere in the face of academic and social obstacles. In addition, the differences between males and females on mathematics achievement can be attributed to some predictor's MLS factors since differences between them starting in middle school (Voyer, Voyer & Bryden, 1995). These predictor's factors may lead to gender differences in mathematics achievement. Hence, the significant difference in student's mathematics achievement in terms of gender is justified.

In conclusion this study succeeded in answering research questions even though the study does not explains the existent of gender- based differences. Overall, the numbers, algebra and mathematics achievement among Jordanian Middle School students favorable to female students compare to male students.

Gender and Spatial Visualization

The results of this study showed a statistically significant difference in spatial visualization mean scores based on students' gender. The finding is supported by

Abu Mustafa (2010) who investigated the differences between males and females on spatial visualization test and found that male performed better than females on spatial visualization test.

Furthermore, Sipus and Cizmesija (2012) in their study showed significant differences between male and female students in light of their score in spatial visualization abilities with the male students outperforming their female counterparts. On other hand, Tal and Abu-wardih (2013) study showed that female students score in spatial abilities higher than male students score.

The present study result was supported by studies in literature that demonstrated – in spatial visualization, males are more highly developed than females as the former's advantage emerges in adolescents and is maintained in adulthood (Kali & Orion, 1996). Furthermore, the differences of the spatial visualization for males may be based on biological, genetic as well as financial and cultural factors. Hence, the significant difference in student's spatial visualization achievement in terms of their gender is justified.

5.3.3 Research Question Three

Research question four states, "To what extent would the students' MLS factors such as mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation, and mathematics anxiety predict mathematics achievement?"

In this study, overall mathematics achievement reflects the mathematics achievement in terms of numbers, algebra and geometry. This study found that mathematics attitude, mathematics motivation; mathematics self-efficacy and mathematics self-regulation are predictors of mathematics achievement. The other variable which is mathematics anxiety is not significantly related to the overall performance of mathematics.

Mathematics Attitude

First, the result indicated that mathematics attitude is related to the overall performance of mathematics. In other words, the level of achievement in overall mathematics achievement may depend on the student attitude and belief about mathematics. A positive attitude towards mathematics may lead to higher level of overall performance of mathematics. The finding is consistent with Marsh and Tapia (2001) who found that mathematics achievement of students was strongly and positively influenced by student attitude. They cited a researcher that backed the impact of attitude on students' inclination to engage in math activities and the degree of their mathematics attainment. This is in line with Ajayi et al. (2013), and Arslan et al. (2012) who argued that students mathematics achievement need to have a positive attitude towards mathematics.

The reason behind the present study result is also compounded by the fact that mathematics is likely to be taught in school than any other subject. In addition, the students attitudes towards the usefulness of mathematics was positive and that many of them believed that mathematics is a valuable and necessary subject which can help them in their future life; therefore, how students may perceive the importance of mathematics as is strongly relevant to their lives. Furthermore, teaching materials used by teachers, content knowledge and personality as well as factors from the home environment and society also affect the relationship between attitude and mathematics achievement. Therefore, the finding of this study indicates statistical significance of mathematics attitude and mathematics achievement that is in line with prior studies including Nasser and Birenbaum (2005) and Manoah et al. (2011).

Mathematics Motivation

Motivation has been found to negatively influence overall achievement of mathematics. Motivation in this study was evidenced to be significantly related with mathematics achievement, which is consistent with the findings of Shores and Shanon (2007) who reported that student's motivation influenced mathematics achievement. And also consistant with the findings of Areepattamannil (2014), who reported that extrinsic motivation, was a negative predictor of mathematics achievement. Motivation is the most evident learning factor that directly affects the success of the students in mathematics subject (Gottfried, Fleming, & Gottfried, 2001; Wentzel, 1998). Possible explanation for the study result of the effect of motivation on mathematics achievement is that students generally place more value on engaging in academic activities than in mathematics subject, where the quality of their engagement is less valuable. Furthermore, it could be attributed to the similarity of their cognitive stage of development. In addition, instructors may use the traditional teaching methods and strategies which make the learning of mathematics inactive and lower student's interest to learn mathematics.

Mathematics Self-regulation

In this study, there is a negative effect of self-regulation on student mathematics achievement. In this study self-regulation reflects the level of student’s concentration, self-testing, and use of study's aids and time management; therefore, the effect of self-regulation on mathematics achievement is in line with the studies of Kimer (2009) who reported a strong effect of self-regulation as one of the reason for success in mathematics. Also, Otts (2010) reported that implemented self-regulation strategies connect with teaching approach, and this affects the output of mathematics among students in terms of their achievement. The findings also consistant with Um, Corter & Tatsuoka (2005), who stated that external regulation negatively influences math performance. Possible explanation for the study result of the negative effect of self-regulation on mathematics achievement is that students are generally not trained to use self-regulation strategies during regular classes. Furthermore, the instructor may not ensure a direct transfer of self-regulation strategies to the subject related tasks on mathematics. In addition, the students are less motivated and less persistent to achieve their tasks related to mathematics subject.

Mathematics Self-efficacy

Another important finding is related to self-efficacy. In this study, the term self-efficacy refers to the students' judgments about their ability to successfully accomplish a task, as well as to a student's confidence in his/her skills to perform that task (Pintrich et al., 1993). Based on previous research on self-efficacy, it was hypothesized to have a positive influence on mathematics achievement (Watts, 2011; Shores & Shanon, 2007). This study found significant influence of self-efficacy on mathematics achievement. These finding are consistent with previous studies on self-efficacy. The result may be attributed to the strong-inter correlation between self-efficacy and mathematics achievement. The possible explanation of the result may be that the students were confident to do excellent job in math, they understood the most difficult materials presented in math classes, and they do excellent job on mathematics assignments and master skills being taught in their math classes, and therefore, students tend to have higher confidence in performing mathematical tasks. In sum, the result of the influence of self-efficacy on mathematics achievement was supported for the present study sample.

Mathematics anxiety

Finally, this study shows that mathematics anxiety has an insignificant effect on mathematics achievement. The insignificant outcome of the hypothesis is in line with the studies of Joseph (2012) who reported that anxiety is not a significant predictor of students' mathematics achievement. On other hand, the result of the present study contradicts other previous studies (Birgin et al., 2010; Ovez, 2012) who found that mathematics anxiety is a significant predictor of math outcome. A possible explanation for the current result may be that mathematics anxiety was fairly stable over a short period of data collection. Furthermore, the result could be insignificant due to scale used for this study as the previous studies confirmed that different scales used to measure mathematics anxiety may get different results by testing in other samples and environment. Therefore, the insignificant result of this study is justified.

5.3.4 Research Question Four

The fifth research question states, "Does spatial visualization mediate the relationship between MLS factors such as mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation, mathematics anxiety and mathematics achievement?"

The tested hypotheses set out to examine the mediating effect of spatial visualization on the relationship between independent variables, namely mathematics attitude, mathematics motivation, mathematics self-regulation, mathematics self-efficacy, mathematics anxiety and mathematics achievement.

The obtained findings indicated that the spatial visualization mediated the relationship between MLS factors namely (mathematics attitude, mathematics motivation, mathematics self-regulation, mathematics self-efficacy and mathematics anxiety) with mathematics achievement. Results from regression analysis revealed that spatial visualization played a mediating role between mathematics attitude, mathematics motivation, mathematics anxiety and mathematics achievement. On other hand, spatial visualization did not mediate the relationship between self-efficacy, self-regulation and mathematics achievement. Hence, the result of the hypotheses was partially supported. This result is supported by Kabiri (2003) who claimed that there are some causes for mathematics anxiety such as learning style. Hence, the result of this study confirmed the role of mediating effect between mathematics attitude, mathematics motivation and mathematics anxiety and math achievement is due to teaching style employed by teachers at schools.

Another possible explanation for the mediating effect of spatial visualization on the relationship between attitude and mathematics achievement is having a high spatial visualization ability encourages students to learn mathematics and this leaves a positive attitude among students to learn mathematics in order to obtain high scores in mathematics. In addition, the relationship between spatial visualization a mathematical ability is based upon the fact that operations performed while interacting with mental models in mathematics are often the same as those used to operate in spatial environment (Battisa, 1994). A visual representation not only organizes the data at hand in meaningful structure, but is also an important factor guiding the analytic development of a solution (Fischbein, 1987). It is possible that the increasing positive attitude together with the increasing importance of spatial visualization have strengthened the positive association between mathematics attitude and spatial visualization with mathematics achievement. This association might have encouraged student attitudes as spatial visualization is important to success in mathematics while mathematics is important in academic success. In terms of spatial visualization findings, the result indicated that spatial visualization has an important role in enhancing the students attitude towards mathematics and higher their achievement in mathematics subject. More importantly, the relationship between the mathematics attitude and mathematics achievement through spatial visualization was fully supported.

A mediating effect for spatial visualization was also found between motivation and mathematics achievement. It was possible that having high spatial visualization ability encourages students and motivated them to enhance academic achievement. This statement was supported indirectly by researchers (Battista & Clements, 2002; Wheatley, 1992) where spatial abilities have been accepted as crucial for high mathematical abilities. In addition, Lowrie and Kay (2001) asserted that students prefer to select visual methods to complete difficult mathematics problems. This finding could be interpreted as views of the important role of spatial visualization that motivate students and lead them to higher mathematics achievement. Hence, it can be concluded that creating students awareness on the importance of spatial visualization to their future undertakings would be one way of motivating students in their mathematics learning. In terms of spatial visualization findings, the result indicated that spatial visualization has an important role in enhancing the students' motivation towards mathematics and heigthen their achievement in mathematics subject. However, the relationship between the mathematics motivation and mathematics achievement through spatial visualization was only partially supported.

Furthermore, the result indicated that spatial visualization does not play an important role in enhancing student's ability to apply self-regulation strategies while doing mathematics tasks. In other words, the relationship between the self-regulation and mathematics achievement through spatial visualization was not supported. Learning spatial visualization topics normally require various learning techniques and do not rely on cognitive processing spatial information. Hence, the insignificant results of the mediating spatial visualization on the relationship between self-regulation and mathematics achievement maybe due to the fact that the participants may rely on other abilities but not spatial visualization for learning mathematics, and therefore, the their decisions to use other abilities are based on personal preferences than intellectual ability. Furthermore, various interpretations of the definition of self-regulation have led to a multiplicity of instruments to measure the construct. Therefore, self-regulation measure used for this study may have led to the insignificant result for the mediating role of spatial visualization on the relationship between self-regulation and mathematics achievement.

In addition, the results showed no mediating effect between self-efficacy and math achievement. Students who believe that mathematics will be useful to them in the future develop a desire to learn mathematics and vice versa. Feeling are the emotional reactions that are given by the students when they deal and face with spatial ability problem. Poor performance on spatial visualization level among may directly affect perceptions of self-efficacy, especially in girls. Students who have the opportunity to improve their spatial-visualization skills demonstrated greater self-efficacy and are more likely to persist in their study. Girls were more apt to display under-confidence relative to their actual spatial visualization tasks and to attribute spatial visualization failure than were boys. Therefore, girls in this study showed less mean scores on spatial visualization and this may have led to the insignificant result.

Lastly, the results showed a mediating effect between mathematics anxiety and math achievement. Since anxiety can create worries that are verbal in nature (Beilock et al., 2010), and some students use verbal strategies while others use spatial ability, and since male students perform better than girls on spatial visualization, the researcher assumed that the effect of mediating variable may be due to the fact that majority of the study sample are males so they may effect the result of mediating variable. In other words, students who rely heavily on verbal strategies to solve mental rotation problems should show the strongest relation between spatial visualization and anxiety and mathematics. To this end, female students have been reported to engage in more verbal strategies such as thinking of words for features and matching shapes based on those features, whereas males have been reported to engage in more spatial strategies such as mentally rotating one shape and comparing the resulting visual representation with another shape. In sum, the relationship between the mathematics anxiety and mathematics achievement through spatial visualization was fully supported.

In conclusion, the research findings could be justified and since literature has not provided any interpretation for the mediating role of spatial visualization with other variables, the findings of the present study contribute to literature by highligting partial support for its mediating role in the relationship between MLS factors and mathematics achievement.

5.4 Implication

In education system, the evaluation of student's success in mathematics in schools has been recently considered as a major focal point. Based on several studies' reports on the issue, a large number of 8^{th} grade school students failed or scored low in their 8^{th} grade mathematics. More importantly, previous studies encouraged the examination of the MLS factors impact on student's mathematics achievement. Therefore, in response to the literature, and based on this study's findings, several implications have surfaced. These implications are divided into theoretical, empirical and practical implications.

Theoretical Implications

A thorough look at the previous literature review regarding the topic revealed no such study has been carried out on the MLS factors that especially effected students' success in mathematics during 8^{th} grade school. Therefore, the research elaborated the MLS factors based on social cognitive theory to determine and understand the factors affecting students' mathematics achievement in the Jordanian education system. This is the basis of Bandura's (1986) conception of reciprocal determinism which is the underlying notion behind his model of triadic reciprocal causation. According to his study in 1989, social cognitive theory postulates that individuals evaluate their own experiences and thought processes by self-reflecting and this form of self-reflection is used by individuals to evaluate and change their environments and social systems. This is the reason why social cognitive theory has been employed to various areas of psychosocial function including attitude, anxiety, self-efficacy, self-regulation and motivation (Pajares & Graham, 1999; Landry, 2003). Researchers (Ashcraft & Kirk, 2001; Bembenutty & Zimmerman, 2003; Hampton & Mason, 2003; Hopko, McNeil, Lejuez, Ashcraft, Eifert, & Riel, 2002; Hsiao, 2003; Linnenbrink & Pintrich, 2002; Malpass, O'Neil & Hocevar, 1999; Margolis & McCabe, 2003; Schreiber, 2000) who stated that testing Bandura model with other factors provide richer understanding of individual behavior. Therefore, the researcher found it imperative to create a theoretical model which examined significantly contributing factors in order to provide in depth understanding of how these factors (Mathematics Learning Strategy) affected Jordanian school students success in mathematics (Sabah & Hammouri, 2007). Even though the current study's analysis of results presents partially statistical significant results regarding the effect of MLS on student mathematics achievement, the researcher urges further researches to carry out studies in order to furnish several theoretical, empirical and methodological implications in school education settings.

The applicability and validity of the current study model and its related original construct were confirmed in the educational context especially in the area of mathematics in Jordan's school system as consistent with the previous studies Beswick, 2007; Capraro, et al., 2009; Farooq & Shah, 2008; Ghanbarzadeh, 2001; Ifamuyiwa & Ajilogba, 2012).

As mentioned earlier, studies claimed that MLS factors (mathematics attitude, mathematics motivation, mathematics self-efficacy, mathematics self-regulation and mathematics anxiety) are significant in improving students' mathematical achievement (Beswick, 2007; Capraro, et al., 2009; Farooq & Shah, 2008; Ifamuyiwa & Ajilogba, 2012). Prior literature examining the above variables relationship with mathematics achievement found inconsistent results. Some studies revealed a positive relation between the variables and mathematics achievement (Barton, 2004; Ma & Xu, 2004; Stevens, Olivarez, Lam & Tallent-Runnols, 2004), others found the variables to be related to mathematics achievement and some others indicated no significant results (Furinghetti & Pekhonen, 2002; Pajares & Graham, 1999; Pintrich, 1999; Vancouver, Thompson & Tischner, 2001). Hence, inconsistent results abound literature concerning the relationship between the variables and mathematics achievement. It is also notable that prior studies highlighted the need for studies to examine the impact of these variables in school settings in Jordan and other countries while other studies calls for more study to investigate the relationship between the variables and mathematics achievement (Beswick, 2007; Capraro, et al., 2009; Ifamuyiwa & Ajilogba, 2012). Regardless of comprehensive findings, there is still the need to investigate the variables on a global scale and in the context of Jordan as there is still a gap in literature (Hammoury, 2004; Roviro & Sancho-Vinuesa, 2012).

Theoretically, this study attempts to present a new contribution by developing a model that gathers several MLS factors that affect student's mathematics achievement. Additionally, the current study is a pioneering study in that it examined MLS factors in a single model. The findings from the present analysis reveal empirical partial consistency with the previous studies claiming that some of the MLS factors affected student's mathematics achievement. On the other hand, the present study failed to find an empirical support for the important role of some MLS factors in mathematics achievement. Moreover, the findings also partially supported significant differences between males and females in mathematics achievement and achievement subscales namely number, geometry, algebra and spatial visualization.

Empirical Implications

The significant factors have been derived from well-known theories and validated studies to provide richer understanding of the nature of the previous relationship between factors and to determine whether the construct model whether agrees with or contradicts previous findings. It indicates significance of examined factors compared with previous research recommendation and suggestions.

In particular, one of the more interesting findings of this study is the demonstration of the presence of a novel empirical evidence of mediating effects that expounds the relationship between MLS factors with mathematics achievement. According to Summers' (2001) classification, the empirical contributions comprises of 'testing a theoretical linkage between two constructs that has not been previously tested, examining the effect of a potential moderator or mediator variable on the nature of the relationship between to constructs, and testing a theoretical linkage between two constructs'.

Furthermore, the study identifies the influence of spatial visualization as a mediator variable between the relationship of MLS factors and mathematics achievement. In other words, empirically, spatial visualization is revealed in this study to partially mediate the linkage between Mathematics Learning Strategyand mathematics achievements. The reason behind this lies in the strength of the relationship between independent and dependent variables in students who demonstrate high spatial visualization.

In addition, the study contributes another implication regarding the methodology area in terms of the data collected from the questionnaire survey, which should be tested for reliability and content validity as well as construct validity. The current study took to the challenge and enhanced the construct validity for measurement through the establishment of reliability and validity in actual tests for the main survey. In other words, the present study answers the research call made by academic researchers and provided a more empirical inquiry in establishing a more reliable, valid measurement of the study constructs.

Practical Implications

This study attempts to present MLS factors that affect student's mathematics achievement. Additionally, the current study is a pioneer in examining MLS factors in a single model. The findings from the present analysis reveal empirical partial consistency with the previous studies claiming that some MLS factors affected student's mathematics achievement.

This study showed that mathematics attitude is the most powerful predictor of mathematics achievement among 8^{th} grade students in Jordanian schools. Therefore, the teachers should pay attention to math and consider it as one of the important and necessary materials in school and everyday life. This could be done through the development of students' skills in mathematics knowledge in its various aspects, using suitable techniques and teaching methods for making mathematics interesting subject and attractive for the students.

Self-efficacy is considered as the second factor in terms of the prediction of mathematical achievement. In this regard, teachers must provide mathematical concepts in an easy and simplified ways so that the students could understand the content and educational material provided. In addition, teachers could praise and reward students after doing homework and tasks entrusted to them in class. Moreover, mathematics anxiety is considered one of the factors which could cause low achievement in mathematics. However, the current findings indicate a lack of anxiety concern among the students during the learning of math and this could be positive indicator, as it becomes easy to deal with the problems faced by the students in achieving and learning math.

The present study showed that student's mathematics achievement was affected by the MLS factors. Therefore, the school management and academic staff should take into account the important role of these factors in enhancing the student's mathematics achievement. Furthermore, the teachers can provide the students with all the relevant teaching approaches in order to achieve the students and school objective which is to maximize student's achievement in mathematics.

5.5 Recommendations for Future Study

This section provides recommendations for future researchers. The main recommendations from this study are for teachers and other educational professionals to focus on the numbers and algebra for male students to improve the learning of mathematics, and on the feeding program by taking benefits from tutorial classes to avoid weakness in different aspects of mathematics achievement.

Students in middle School-Koura District, in particular and all the middle schools in Jordan in general, should be motivated to understand that mathematics could be studied and passed just like other subjects, and to appreciate that the subject is an essential tool, a prerequisite for further education and in many vocations.

This study should be conducted in both elementary and high school students, as the current study is confined only to middle school. It would be productive to compare the results of studies focusing on younger students directly with the results of this one. Such a comparison might point out directions for ameliorating early conditions that have negative effects on students in middle school.

A further recommendation is for a replication of this study in private schools, as private schools usually have fewer students in class and they pay more individual attention to students and employ different teaching styles in their schools in comparison with government schools.

The present study employed quantitative method of study and recommends future studies to make use of qualitative approaches to gain more insight into the perception of students of mathematics.

Finally, the study recommends enlightening the students and the workshop members of the educational sector in the importance of MLS factors through the provision of these factors in the curriculum and training sessions.

Summary

The current study investigated the factors affecting the student's mathematics achievement in school education in Jordan. The study model was tested and validated among 360 8^{th} grade school students. This study focused on the factors affecting student achievement in mathematics in Jordan and is invaluable for academicians and educators in understanding factors affecting student achievement in mathematics. The findings showed significant differences between males and females in number test and algebra test in favor of female students. Furthermore, the results also showed no significant differences in geometry test between male and female students. In addition, the result a significant difference in overall mathematics achievement between males and females students in favor of females. In terms of spatial visualization test, result showed that male students scored better than females and was statistically significant. Hence, it can be concluded that females students scores better than males in overall mathematics and some mathematics subscales.

Personal correlation and regression test were performed in order to test the extent of MLS factors influence on mathematics achievement and the result found positive and significant associations. The results also showed that among the five predictors, mathematics attitude and self-efficacy were the top predictor variables of mathematics achievement. The other variable which is mathematics anxiety is not significantly related to the overall performance of mathematics. Finally, this study also make a significant theoretical contribution to this area of research by examining the mediating variable of spatial visualization between independent and dependent variables and the result supported partial effect of mediating variable.

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