

**AKENTEN APPIAH-MENKAH UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT**

DEPARTMENT OF MATHEMATICS EDUCATION

MPHIL MATHEMATICS EDUCATION

**ENHANCING STUDENTS' ACHIEVEMENT IN MATHEMATICS
THROUGH THE USEFULNESS OF MATHEMATICS AND INTEREST: THE
MEDIATING ROLE OF MOTIVATION**

MICHAEL KWADU AMONSEM

DECEMBER, 2023

**AKENTEN APPIAH-MENKAH UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT**

DEPARTMENT OF MATHEMATICS EDUCATION

**ENHANCING STUDENTS' ACHIEVEMENT IN MATHEMATICS
THROUGH THE USEFULNESS OF MATHEMATICS AND INTEREST: THE
MEDIATING ROLE OF MOTIVATION**

MICHAEL KWADU AMPONSEM

8210610007

**A THESIS IN THE DEPARTMENT OF MATHEMATICS EDUCATION,
FACULTY OF APPLIED SCIENCES AND MATHEMATICS EDUCATION
SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN PARTIAL
FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE
DEGREE OF
MASTER OF PHILOSOPHY (MATHEMATICS EDUCATION)
IN AKENTEN APPIAH-MENKAH UNIVERSITY OF SKILLS TRAINING
AND ENTREPRENEURIAL DEVELOPMENT**

DECEMBER, 2023

DECLARATION

STUDENT'S DECLARATION

I, **MICHAEL KWADU AMPONSEM**, declare that this thesis is my original work and has not been submitted, either in part or whole, for another degree in any other university/institution. The project has been enhanced by works that have been properly cited. Where data have been derived from other publications, including the internet, the sources are properly cited in compliance with anti-plagiarism standards.

SIGNATURE:

DATE:

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of research work outlined by the Akenten Appiah-Menkah University of Skills Training and Entrepreneurial Development.

SUPERVISOR'S NAME: PROF. YARHANDS DISSOU ARTHUR

SIGNATURE:

DATE:

CO-SUPERVISOR'S NAME: PROF. EBENEZER BONYAH

SIGNATURE:

DATE:

ACKNOWLEDGEMENT

My sincere gratitude goes to the Almighty God Who has been so good to me and has made it feasible for the successful completion of this thesis. Many people contributed in diverse ways to enable me come this far. First, I would like to thank the Akenten Appiah-Menkah University of Skills Training and Entrepreneurial Development for giving me the opportunity and scholarly support to study. My special thanks go to my hardworking supervisor, Prof. Yarhands Dissou Arthur for his sacrifice, keenness, motivation and unparalleled encouragement that did not only ensure quality of the output, but certainly enhanced my working capacity. His persistent reminder and demand to see me work and finish the work continuously urged my efforts and made me work harder.

My heartfelt thanks also go to my father in the Lord, the late Rev. Charles Sintim-Amankwah. May God grant you eternal rest for touching the lives of many, including mine. I am indeed grateful to you, daddy.

Finally, I would like to use this opportunity to thank my lovely wife and daughter for their patience, support, encouragement and for providing an environment conducive for my study.

DEDICATION

I dedicate this thesis to my lovely wife, Mrs. Sarah Okyere Amponsem and adoring daughter, Nana Ama Nkunim Gyasi Amponsem, whose love and unflinching support have made this work a reality.

TABLE OF CONTENTS

CONTENTS	PAGES
DECLARATION	ii
STUDENT'S DECLARATION.....	ii
ACKNOWLEDGEMENT	iii
DEDICATION	iv
TABLE OF CONTENTS.....	v
LIST OF FIGURES	ix
LIST OF TABLES	x
ABSTRACT.....	xi
CHAPTER ONE	1
INTRODUCTON	1
1.1 Overview.....	1
1.2 Background of the Study	1
1.3 Statement of the Problem.....	13
1.4 Purpose of the Study.....	17
1.5 Objectives of the Study	17
1.6 Research Questions	17
1.7 Significance of the Study.....	18
1.8 Delimitation of the Study.....	18
1.9 Limitation of the study	19
1.10 Definition of Terms	19
1.11 Organization of the study	19

CHAPTER TWO	21
LITERATURE REVIEW	21
2.1 Overview.....	21
2.2 Theoretical Framework.....	21
2.2.1 Behaviorist Learning Theory	22
2.2.2 Constructivist Learning Theory.....	24
2.3 Empirical Knowledge on the variables under study	28
2.3.1 Usefulness of Mathematics on Students’ Achievement	28
2.3.2 Motivation in Mathematics on Students’ Achievement	35
2.3.4 Achievement in Mathematics	51
2.4 Conceptual Framework.....	57
CHAPTER THREE	59
METHODOLOGY	59
3.1 Overview.....	59
3.2 Research Design.....	59
3.3 Research Paradigm	60
3.4 Research Approach.....	60
3.5 Population.....	60
3.6 Sample.....	61
3.7 Sample and sampling procedure	61
3.8 Research Instrument.....	62
3.9 Data Collection Procedure.....	63
3.10 Reliability of the Questionnaire.....	64
3.11 Validity of the Questionnaire.....	65
3.12 Data Analysis Procedure	65

3.13 Ethical consideration	65
CHAPTER FOUR.....	66
ANALYSIS AND DISCUSSION OF RESULTS	66
4.1 Overview.....	66
4.2 Demographic Characteristics of Respondents	66
4.3 Results of Analysis	67
4.4 Preliminary Analysis	67
4.4.1 Exploratory Factor Analysis	67
4.4.2 Descriptive Analysis	69
4.4.3 Confirmatory Factor Analysis Results.....	72
4.4.4 Discriminant Validity.....	75
4.4.5 Reliability Analysis	76
4.5 Path Estimates	76
4.5.1 Research Question One: What is the impact of usefulness of mathematics on students' mathematics achievement?.....	77
4.5.2 Research Question Two: What is the effect of mathematics motivation on students' mathematics interest?.....	78
4.5.3 Research Question three: What is the impact of interest of mathematics on students' mathematics achievement.	78
4.5.4 Research Question Four: What is the mediating effect of mathematics motivation between usefulness of mathematics and mathematics achievement?.....	80
4.6 Discussion of Results	81
4. 6.1 Relationship Between usefulness of mathematics and students' achievement ..	81
4.6.2 Relationship between mathematics motivation and students' mathematics interest	82

4.6.3 Relationship between students' interest in mathematics and students' achievement	83
4.6.4 The mediating effect of mathematics motivation between usefulness of mathematics and mathematics achievement	85
CHAPTER FIVE	86
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	86
5.1 Introduction	86
5.2 Summary	86
5.3 Conclusions	87
5.4 Recommendations.....	88
REFERENCES	90
APPENDIX.....	112
QUESTIONNAIRE	112

LIST OF FIGURES

Figure1: Conceptual Framework.....	58
Figure 2: Confirmatory Factor Analysis.....	74
Figure 3: Path Analysis	79

LIST OF TABLES

Table 1: Demographic Characteristics of Respondents	66
Table 2: Exploratory Factor Analysis (EFA).....	68
Table 3: Descriptive Analysis	70
Table 4: Confirmatory Factor Analysis (CFA).....	73
Table 5: Discriminant Validity	75
Table 6: Reliability Analysis	76
Table 7: Direct Path	77
Table 8: Indirect Path.....	80

ABSTRACT

The usefulness of mathematics in one's daily life and career cannot be overstated. Mathematics is a required subject in most African countries, including Ghana. Because of the importance of mathematics, it has been declared a requirement for entrance to tertiary institutions. In spite of the importance of mathematics and it being made a prerequisite for tertiary education, the performance of students has been extremely appalling. This study looked at the role of usefulness of mathematics, interest of students and motivation on the achievement of students in mathematics. The study was a survey, and structured questionnaire was used to collect data. The population was senior high school student in the Kumasi Metropolis. However, 360 students from three selected schools in the metropolis were randomly sampled through the simple random sampling techniques. Approval was granted by the authorities of the schools where the data was collected. Data was gathered during classes hours, after permissions were sought from the tutors handling the classes at the time of data collection. The path analysis was by Structural Equation Modelling, by using Amos (v.23) software. It was concluded that mathematics motivation partially mediated the relationship between usefulness of mathematics and students' mathematics achievement. Also, mathematics motivation has a tendency of positively influencing students' interest in learning the subject.

CHAPTER ONE

INTRODUCTON

1.1 Overview

Chapter one delves into the background of the study, statement of the study, purpose of the study, objectives of study, research questions, significance of the study, delimitation of the study definition of terms, conceptual framework and the organization of the study.

1.2 Background of the Study

According to Algani (2022), the usefulness of mathematics can best be seen by considering how Galileo defined mathematics: “Mathematics is the language in which God has written this world.” Abdulaziz (2015) believes that a culture that considers itself civilized cannot push the study of mathematics to the side. According to him, one of the methods to determine how a civilization can progress is to study mathematics. Increased mathematics proficiency is intimately correlated with the growth of a society's many societal sectors. This demonstrates unequivocally that low mathematics enrolment and low mathematics performance among students lead to the downfall of every civilization.

On the why and how of studying mathematics, Liebeck (1984) outlines six questions. Why teach mathematics is the first question. Unquestionably, mathematics is a science that which is instrumental and useful when it comes to our day-to-day life activities. Secondly, why is it that a lot of people find mathematics appealing? According to Liebeck (1984), a lot of people still find enjoyment in mathematics despite the subject's appearance as dull and unappealing. 'How does mathematics make sense to one stylistically, in a manner that is analogous to music or art?' is the third question.

Mathematical aspects can be enjoyed in various ways, just as different people have different methods of appreciating music or other forms of art. Some people find enjoyment in the study of geometry, algebra, and other areas of mathematics. Every person has a unique favorite part of mathematics, just to how each person enjoys music or painting in a different way. The fourth question is, "Mathematics is frequently referred to be a vague subject. What does this mean? Without a question, the majority of mathematical ideas and concepts are challenging to comprehend and articulate. Understanding and expressing mathematical ideas and concepts become considerably easier when teachers make math lessons practical. Many people, especially very young toddlers, find it difficult to understand what the number "4" implies when they have not been made to physically handle one, two, three, and four different objects. How the human brain is able to deal with this hierarchy is the fifth question. A person does not picture two hundred and thirty-four objects laid out in front of one when one sees the symbol "234." Then, has one lost touch with reality? The response is no! The system of notation must be mastered in order to comprehend the reality in such an example. Four singles, three groups of ten, and two groups of one hundred must all be envisioned. Lastly, how does a kid learn to think abstractly? Again, Liebeck (1984) outlined four prerequisites for a child to be able to acquire abstract thought: first, exposure to concrete objects; second, verbal descriptions of that exposure; third, visual representations of that exposure; and fourth, generalization of that exposure through written symbols.

Hurst (2008) proposed that placing mathematics in a situation that is meaningful to students increases their interest in the subject. Students who have the capacity to relate mathematical concepts to real-world situations are those who exhibit high level of motivation, perceive how worthy to study mathematics, practice applying the

knowledge they acquire from mathematical, and eventually become great mathematical thinkers.

According to Okereke (2006), mathematics is applied to science and technology in diverse and multiple ways, which make it impossible to have other spheres of science and technology well developed without mathematics.

According to Hafiz et al., (2013), educationists share the strong belief that someone cannot advance in any field until they have a foundational understanding of mathematics. Mathematics is frequently referred to as "the queen of science" because of how important a role it plays in other academic fields. Mathematics can be used to comprehend a wide range of other topics and languages. It lays the groundwork for several sciences, including astronomy, physics, engineering, and science in general.

The goal of teaching mathematics, is to advance science, technology, and other fields. By using its logic and reasoning, mathematics investigates novel patterns in reality. Our efforts to understand both ourselves and the surrounding environment. Math is thought to be profoundly important to human reasoning and intellect. Numerous variables, including learner engagement, a lack of skilled teachers, inappropriate curricula, and the school climate, contribute to students' low arithmetic performance. Contrarily, a lack of student motivation clearly exceeds the capacities of adults and, in the end, contributes as one of the most significant factors for subpar mathematics achievement. The historical evidence that is currently available implies that practical experiences are where mathematics first evolved, according to Roshan (2021). It is believed that a great deal of mathematics was used in the creation of bricks, houses, bridges, gutters, temples, pyramids, numerous handicrafts, and planned towns. The rise of civilization in the ancient world was facilitated by the development of mathematics.

Educationally, mathematics and the study of mathematics are two distinct fields. The method and outcome of mathematics are basically its main concerns. The goal of mathematics is to create new mathematics while comprehending its fundamental principles. It does not address topics like who can learn mathematics, the content of mathematics that needs to be taught, and the rationale behind the study of mathematics, or why one cannot study this crucial subject. Mathematics education looks at mathematics from an educational standpoint. It is concerned with all aspects related to how mathematics is taught and learned, as well as the development and implementation of an acceptable mathematics curriculum.

Ghimire (2022) posited that from the time of the ancients to our dispensation, mathematics is regarded as a subject which plays a significant role in formal education. People have been using mathematics to address the issues brought on by natural disasters. Political proposals, plans for economic development, and other social events can all be seen in the early mathematical histories of various civilizations. The study of mathematics is regarded as the art of all arts and the science of all sciences. It also reigns supreme in science. Today, mathematics is employed in every human activity, and because it has such an enormous influence on people's lives, no one considers it to be a secondary topic that must be taught to every citizen. The value of mathematics is revered in many different respects.

Ochieng (2022) believed that living in our world which is mathematically-oriented, requires that one should have a firm knowledge of mathematics, else one would be likened to a person who closes his eyes and walks through an art museum. He regards mathematics as life. Again, he is of the firm conviction that without mathematics, people will have a distorted view of this beautiful world we live in. Mathematics is seen and felt everywhere and contributes to making us fathom our world in a much

meaningful way. Life will continue to be meaningless until humanity values mathematics and its impact in everything we do as a people.

Many other subjects and languages can be understood with the help of mathematics. For many of the disciplines, including science, physics, engineering, and astronomy, mathematics in its broadest meaning serves as the ground and foundation. In order to motivate people, mathematics is taught, which enables growth in science as well as technology. Whether we like it or not, mathematics has become an essential component of human logic and thought, as well as a key component of efforts to better know and understand ourselves and the world we live in. The significance mathematics in everything we do as humans is known by educators everywhere, but students' mathematics achievement has been appallingly low. Truly speaking, there is poor mathematical performance on the part of students. Girls in particular avoid mathematics in the classroom. Sadly, some people believe that mathematics is a punishment and a form of pain for them. When taught by inexperienced and unqualified instructors, this problem is at its greatest.

Why ought I to pursue mathematics? "How can it benefit me in my daily life?" These are common questions from students. It is a widely held belief that the way mathematics is taught in schools makes the subject look abstract and somewhat unrelated to students' everyday requirements.

According to Eshun (1999), it is often believed that the subject that is most challenging and threatening to students, especially females is mathematics. Mathematics learning challenges are prevalent, significant, and in need of serious instructional attention. Students who experience failure repeatedly may respond by ceasing to try, developing a negative sense of self, and engaging in avoidance tactics. Significant mathematics

deficiencies can also negatively affect one's ability to manage daily tasks as well as one's chances of getting a job or a promotion.

A large number of people today, feel that mathematics merely is boring and that it involves unconnected notions and thoughts as a result. Russell (1901) a mathematician and renowned theologian, said mathematics is "an area whereby you have no idea what is it that you are doing and whether what you are claiming is correct." This definition of Russell unequivocally illustrates the complexity of mathematics.

Millions of schoolchildren, their parents, and even their teachers have come to believe a variety of harmful and ubiquitous myths in the United States, for instance, concerning the learning of mathematics. These various beliefs have had a major negative impact on students' academic progress and learning (Boaler, 2016). The myth that some people are born with a "math brain" and some are not, and that high accomplishment is only possible for particular students, is the most devastating of the many. Students will undoubtedly perform poorly in mathematics if they continue to hold this false belief about the subject. A second detrimental myth is the notion that learning mathematics is only about memorizing formulas and rules rather than thoughts, ideas, concepts and creativity. According study findings, students that regard mathematics as an arena of concepts that call for deep contemplation are far more probable to perform well than those who consider it as a subject that is mostly about how to recall knowledge (Boaler et al., 2016). Since students' perceptions of mathematics are skewed, their interest in the subject is quite low. Most of them are not even aware of how important math is. Contrary to students' misguided perceptions of mathematics, particularly their claim that they are unaware of the importance of the subject, mathematics has huge significance that our generation of science-oriented people cannot ignore.

According to Bodinet (2016), pedagogical innovations are essential to achieving the Sustainable Development Goals' (SDG4) fourth target, which is making high-quality education accessible to all children of school-going age. For education to be of high quality and value, it must use cutting-edge pedagogies to teach students and foster the spirit of inquiry that leads to the discovery of new information that can be used to solve a variety of issues. It is an obligation of the instructor of mathematics to create surroundings that are suitable for learners to investigate, analyze, and exchange information about their own lives, their lives to date, and the global community where they reside.

According to the most current study by Alzahrani (2022), teachers' novel ideas they use to teach mathematics to students are the source of their students' motivation. The use of meta-cognitive strategies increases the enthusiasm of learners in their skills and finally affords them the sense that they can successfully control how they learn. As a result, these competencies allow learners to perform well in mathematics classes, according to Alzahrani (2022). Each mathematics instructor should prioritize employing customized instructional practices and tactics because the main objective is to boost the desire of learners for studying mathematics and their performance in the subject.

Eccles (1984) reaffirmed that the perception of students about mathematics and its usefulness is what motivates them to study it now and at the tertiary level. According to him, one's perception of the value of mathematics will influence whether or not they continue their studies in the subject. The utility or value of mathematics is a key determinant of whether or not students will continue to study mathematics related courses and programs at the tertiary level.

The aforementioned claims are reinforced by Fennema (1979), who argues that if students—especially female students—do not value careers in mathematics, they might not be willing to study mathematics. There is no doubt that this explains why fewer students, particularly female students, choose to study mathematics at our higher education institutions like universities.

The perceived value of mathematics plays a crucial role in explaining why students choose to major in mathematics. Students that choose careers in mathematics see mathematics as being tremendously relevant and, as a result, adopt a favorable attitude toward it.

Many reasons contribute to students' low interest in mathematics, which leads to poor performance. Some of these influences include students' attitudes toward mathematics. According to Willis (2010), the first step toward math proficiency is a good mindset. Students' attitudes toward mathematics are extremely negative since they lack enthusiasm and desire in studying the subject, particularly in terms of its utility. Aysun (2017) also stated that students' bad attitudes about mathematics played a big effect in their failure to succeed in mathematics. Many experts believe that how students view mathematics has a favorable and great bearing on how they perform, notably in mathematics (Papanastasiou et al., 2004).

Naturally, every student who views mathematics in a positive way has a strong longing to do mathematics, because he understands the usefulness of the subject, and shows confidence in doing mathematics. Such a student shows commitment in studying mathematics which will undoubtedly, promote his performance in the subject. Sadly, there is a cross-section of students who have think that they are not meant to do mathematics and that there is no way they can do mathematics. Unfortunately, this wrong perception students have still persists even today. They think that they are not

good enough to do mathematics. Consequently, most students are simply not interested in mathematics. The onus now lies with mathematics teachers to provide sufficient motivation, both intrinsically and extrinsically to arouse and sustain interests' students to learn mathematics.

Every educational institution strives to produce students who are capable of transforming their country by giving them knowledge, skills, attitude, and passion needed for the growth and survival a country. This is when the three learning domains come into play. Our students' education is designed to help them develop their three domains of learning: cognitive domain, affective domain, and psychomotor domain. The development of these fields is critical to the survival of any nation. Consider what might happen in a country if a bigger proportion of its citizens have enhanced their cognitive abilities.

Because of the rapid development of new technology, the mathematics taught in school is made in such a way that students can have more hands-on activities instead of mere memorization of formulars and rules. The curriculum allows students to engage in mathematics independently. This is made feasible with the advent of computers in facilitating how mathematics is taught and studied (Solano et al., 2017).

Arthur et al., (2017), intimated that the drive and interest students show in their quest to learn naturally intensify when they are able to discover the relevance of the link between what they learn and their day-to-day lives. According to them, in order to ensure that students completely participate in mathematics sessions and attain the best that the subject has to offer, mathematics curriculum planners and designers must strive to connect classroom mathematics to students' immediate surroundings. According to them, in order to ensure that students completely participate in mathematics sessions and attain the best that the subject has to offer, mathematics curriculum planners and

designers must strive to connect classroom mathematics to students' immediate environment. They also stated that mathematics subject that is unrelated to the students' immediate environment rarely piques their attention. Stemhagen and Smith (2008) have also shown students must be made to understand that the knowledge they gain from mathematics is for the benefits of their daily lives, and not for the sake of just gaining knowledge. There is no doubt that motivation boosts students' mathematics achievement. In fact, studies have shown that highly motivated perform better academically, not just in mathematics, whereas unmotivated students perform badly academics in general.

For example, Chelliah et al., (2017) studies on motivation revealed that students who are motivated do exceptionally well than their counterparts who are lowly motivated. The findings corroborated the finding made by Bank and Finlapson (1980) in their study. They posited that whereas all unmotivated students are unsuccessful in their studies, motivated students are successful.

Woolfolk (2008) asserted that motivation is an innate force that arouses and leads a person to do something. In simple terms, why students think the way they do in a given situation is what he referred to as motivation. As humans, we frequently do things not because we have to, but because we are inspired to do so. Without a question, motivation in whatever form is the primary reason why most students study mathematics.

Trying to motivate student to learn mathematics can be tough but vital part when it comes to teaching mathematics, that mathematics teachers cannot gross over it. Nevertheless, the fact that various things inspire children to learn is something teachers should always make good use of. In current technologically advanced environment,

adopting creative teaching methods gives the required motivation to pique students' interest in learning the seemingly tough subject.

Students are ideally expected to be active participants as far as learning is concerned, but we should also know that the teacher's external support is extremely important. Students' learning can be influenced by their own natural drive to perform or finish a task; yet, extrinsic influences such as prizes or incentives can also influence students' learning, according to Theobald (2006). We can learn from this that teachers play a pivotal role in students' learning. The following are the ways and manner a teacher can motivate the students; provision of a good a learning classroom which enhances learning of mathematics. The teacher can equally use encouragement of autonomy, significance, and relationship between what is being learnt and the usefulness of it to one's daily life to motivate students in their learning. In addition, the teacher's capacity in improving the competence of students, arouse their interest to learn mathematics, and self-efficacy perception are all essential aspects influencing students' drive to study. Motivation improves students' learning to the extent of increasing and maintaining their interest in mathematics (Theobald, 2006). Motivating students to study, essentially to study mathematics, is of absolute importance to both mathematics researchers and educators owing to the fact that it has a bearing on the motivation of students and consequently, how they perform.

Ryan and Deci (2000) classified motivation into different kinds using different causes and objectives in Self-Determination Theory. They discovered that motivation can be either internal or external, which they succinctly referred to as motivation and extrinsic motivation respectively. They defined intrinsic motivation as engaging oneself in an activity due to the fact that such an activity is certainly exciting and delightful, whereas extrinsic motivation is defined as engaging oneself in an activity due to the fact that the

activity brings a separate consequence. Personal interest and satisfaction in studying a subject, as well as pleasure in learning activities, were listed as instances of intrinsic motivation, whereas awards, parent and teacher praise, and value were cited as examples of extrinsic motivation. In intrinsic motivation, the students happily involve himself in the learning process because he considers it delightful and rewarding. On the contrary, extrinsic motivation involves the engagement of a learner in an activity because he wants to reach a specific goal, either to obtain a reward or eschew punishment.

According to Boekarts (2002), motivational beliefs serve as a positive backdrop for learning and also pertain to the perceptions of students on the efficacy the methods and pedagogies used by the teacher. He defined motivating beliefs as attitudes, judgments, and values that involve objects, events, or domains of subject matter. Students are enthralled by what goes on in class due to the fact that they have acknowledged that what the envisaged to achieve is dependent on what is being taught them, and this is what motivation seeks to do. However, not all pupils are intrinsically driven since students who have formed unfavorable motivational beliefs are uninterested in process-oriented feedback in mathematics. According to Boekarts (2002), one practical solution to this problem is for mathematics teachers to be aware of which classroom settings encourage positive motivational beliefs and which promote negative motivational beliefs.

Academically, motivation and what it seeks to accomplish in teaching and learning can be regarded as significant. It is a catalyst for academic accomplishment. Nonetheless, the manner in which a student responds to mathematical learning defines the height to which he or she will ascend the educational ladder. As a result, the importance of academically inspiring students to learn mathematics cannot be overstated. This is why

Hall (1989) believes that academic motivation for students learning mathematics is necessary whenever our desire as teachers is to generate and retain the interest of students to learn mathematics. The determination to be successful in the things a person is doing, whether in one's education, profession or career, employment, and so on are all part of motivation.

1.3 Statement of the Problem

The achievement of Ghanaian students in mathematics has been appalling. For instance, since the start of The International Mathematical Olympiad (IMO) in 1959, hosted in Romania, Ghana's participation in this worldwide mathematics program has been uninspiring, and our successes have been pitiful. Ghana first participated in this worldwide program in South Africa in 2014. The International Mathematical Olympiad (IMO) is a global event hosted every year in a different country for high school students. Ghana has competed in the program less than 10 times in the last sixty-four years, and it was only in 2020 that we won our first and only medal (Amponsah, 2010). This among other reasons justifies why it can be stated that Ghanaian students perform poorly in mathematics.

Mathematics is a necessary tool for success in today's world, however most Ghanaian learners regard it as a challenging subject (Arthur et al., 2021). The recent study conducted by Yunos et al., (2022) made an assertion that students have the misconception that mathematics is a killer subject and that to study it, is likened to doing any herculean work. Nevertheless, (Arthur et al., 2021) reported that because mathematics is an important subject, it has been made a compulsory subject from the primary level to the senior high level. Hence, regardless of the program a student does in school, he will compulsorily do mathematics. The capacity of a student to perform

well in mathematics obviously reflects the heights to which the student will ascend in terms of career advancement.

It is widely assumed that a variety of factors have led to students' poor academic success in mathematics. Students' negative attitude toward mathematics, insufficient teacher motivation, insufficient unavailability of teachings and learning materials, incompetent mathematics instructors, using teaching methods that are teacher-oriented instructional strategies, teachers' refusal to incorporate ICT resources in mathematics instruction are some of these factors.

On the West African Senior School Certificate Examination (WASSCE), a bigger percentage of senior high school students unfortunately do appallingly poorly in mathematics. For instance, 65.71% of students who took the WASSCE in mathematics in 2020 achieved the required passing grades (A1 to C6) for university study (WAEC, 2021). But according to data from the 2021 WASSCE, just 54.11 percent of students had mathematics scores ranging from an A1 to a C6 in the said examination (WAEC, 2021). It is concerning because this percentage was lower than the WASSCE pass rates for 2019 and 2020.

Globally, students' achievements in mathematics have become topical issues for every country owing to the integral role mathematics plays in our dispensation which is regarded as an era of scientific and technological era. For example, available statistics indicate that Nigerians students' performance in mathematics is extremely poor, according to Sa'ad et al., (2014). In his studies, he mentioned that the root cause of the abysmal performance of students are the negative behaviors of students towards mathematics and teachers' inability to use proactive instructional strategies and others. Furthermore, A study in Kenya by Mbugua et al., (2012) also posited that students' mathematical performance is generally unimpressive. He further indicated that the

factors responsible for their performance is not different from that of the Nigerian students enumerated above. Moreover, the students in Tanzania exhibit abysmal achievement in the subject, mathematics. Ndume et al., (2020) reported that the percentage pass of form four students in national examination in mathematics was 16%. There is a pattern of low performance in mathematics. Various research indicates that in the year 2012 alone, 69% of form four students were unsuccessful in mathematics (Mazana et al., 2020). The same issue occurs once one moves beyond Africa's borders. Peteros et al., (2020) reported on the achievements of Philippine students, indicating that the students performed poorly when they took the mathematics examination. In 2020, for example, a greater numbers candidates, representing 53.01% scored below the national average.

There are numerous teething difficulties to be overcome in the field of learning. Researchers are ideally suited to investigate these, as they must examine, comprehend, and find solutions to such problems.

Over the years, stakeholders in education, including teachers, parents, and the government, have expressed concern over Ghanaian students' poor performance in mathematics. This is largely because mathematics education has a big impact on the nation's overall development. A lot of researchers have done studies to ascertain how students' motivation correlates with students' mathematical performance. For example, in the words of Fraser and Killian (2005), students with inadequate motivation put forth fewer strokes, which leads to unsatisfactory achievement in school. They also proposed that students' mathematical performance may be improved by providing motivation. Mathematics is, admittedly, abstract in nature, and most schools lack enough concrete visual instructional resources to pique the learner's zeal required to comprehend mathematics. Steinmayr et al., (2019) evaluated the impact of student motivation for

general academic accomplishment and reported that student motivation positively influences students' mathematical achievement.

Gbollie et al., (2017) also explored the effect of motivation, tactics, and other contributing factors on junior and senior high students' learning. They emphasized that the motivational approaches and learning method utilization are critical to increasing the performance of students.

Aliyu et al., (2017) observed in their study that numerous studies have taken place with the hope of overcoming students' abysmal mathematics achievement. They pointed out that those research works basically and essentially focus on finding initiatives to curtail the problem of appalling achievement of students in mathematics. Some of these initiatives include improving the pedagogical skills of teachers, which will largely lead to an improvement in excellent lesson delivery on the part of mathematics educators which aims at promoting students' motivation and improved performance of students. The problem identified is that students are not adequately motivated intrinsically and extrinsically to learn mathematics, hence they exhibit poor performance in the study of this all-important subject.

A meticulous look at the available research work shows that relatively little research has investigated the role motivation plays in improving students' mathematical performance. However, further search revealed that there has not been any research on how the motivation of students influences students' interest and their knowledge about the usefulness of mathematics in their daily lives and profession as a whole. It is against this backdrop that this topic is worthy of research. This is because it will seek to establish how motivating students can influence students' interest and the usefulness of mathematics leading to achievement in mathematics.

1.4 Purpose of the Study

Using motivation as a mediator, this study primarily aims to determine whether the usefulness of mathematics and students' interest increase their mathematics achievement in senior high schools in the Kumasi Metropolis in the Ashanti Region.

1.5 Objectives of the Study

The following are the objectives that the researcher anticipates to achieve:

- (i) To investigate the impact of the usefulness of mathematics on the achievement of students.
- (ii) To find out the effect of motivation in mathematics on students' mathematics interest.
- (iii) To investigate the impact of students' mathematics interest on their mathematics achievement.
- (iv) To investigate the mediating effect of mathematics motivation between usefulness of mathematics and mathematics achievement

1.6 Research Questions

- (i) What is the impact of the usefulness of mathematics on students' mathematics achievement?
- (ii) What is the effect of motivation in mathematics on students' mathematics interest?
- (i) What impact does students' mathematics interest have on their mathematics achievement?
- (ii) What is the mediating effect of mathematics motivation between usefulness of mathematics and mathematics achievement?

1.7 Significance of the Study

The conclusions of this present study are meant to give government, curriculum designers, and other education stakeholders a framework for thinking about motivation as a powerful tool that facilitates the how students perform in the subject, mathematics.

Likewise, the study will be very helpful to students since, once they are motivated by their teachers, they will be interested in learning mathematics because they will be aware of how important the subject will be to them both now and in the future.

The study will also add to the repository of knowledge and turn into a priceless resource for students as well as professionals looking to advance their education in a related subject.

1.8 Delimitation of the Study

It was the wish of the researcher to include all the senior high school students in the country in the data collection. Nonetheless, factors such as time constraints, limited logistics and finances, the researcher used three senior high schools in the Kumasi Metropolis of the Ashanti Region only. These schools were:

1. Kumasi Girls' Senior High School
2. Prempeh College
3. Armed Forces Senior High School

Again, there were other variables that the study could have considered as well for the purposes of measurement purposes, but only four variables were considered for the study. They were Usefulness of Mathematics, Interest in Mathematics, Motivation in Mathematics and Achievement in Mathematics.

1.9 Limitation of the study

Since this present study was limited to only three schools in the Kumasi Metropolis, its findings cannot be used to make any meaningful generalization regarding the achievement of students in mathematics in any part of the country. Again, even with the three schools that were used for the study, the total number considered was so insignificant relative to the total number of students in the three schools and in the whole of country at large. Undoubtedly, if more schools in the country had been included, the study would have given a better picture about students' achievement in mathematics. Hence, the researcher did not make any attempt to generalize the findings of this research work outside the coverage of what is being studied.

1.10 Definition of Terms

Usefulness: The quality of having utility and especially practical worth or applicability.

Interest: The feeling of wanting to give your attention to something or of wanting to be involved with and to discover more about something.

Motivation: It is a reason or reasons for acting or behaving in a particular way.

Achievement: It is a thing done successfully with efforts, skill, or courage.

1.11 Organization of the study

This research has been organized into five (5) chapters. Chapter one highlights the background of the study, statement of the study, purpose of the study, objectives of study, research questions, significance of the study, delimitation of the study, limitation of the study, definition of terms and the organization of the study.

Chapter two focuses on theoretical framework which backs this study. Again, the empirical knowledge of the variables under study has been discussed here. Also, this

chapter focuses on the literature review, where the works of various writers relating to the topic under study have been reviewed. The conceptual framework for the study has also been captured in this chapter.

Chapter three describes the methodology that was adopted. Under the methodology, research design, population of the study, sample and sampling procedure, data collection procedure and data analysis procedure.

Chapter four delves into the presentation and discussion of the result of the study. All the research questions set to be answered in the study have been answered here in this chapter.

Furthermore, the last chapter, that is Chapter five, is about the summary, conclusion and recommendations for the future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

Chapter two primarily focuses on theoretical framework that supports this present study. The empirical knowledge on the variables under study has been discussed here. Again, this chapter focuses on the literature review, where the works of various writers relating to the topic under study have been reviewed. The conceptual framework for the study has also been captured in this chapter.

2.2 Theoretical Framework

In the section, the researcher introduced the theoretical discussion which is relevant for interpreting the results and findings of the study. A theoretical framework, according to Vinz (2022), is "a foundational review of existing theories that serves as a roadmap for developing the arguments a researcher will use in his work." The researcher did introduce some learning theories most appropriate for the study to aid in providing precise, accurate and spot-on interpretations of the study's findings. In general, learning is considered to have occurred when a person behaves, reacts, and responds positively to a situation after going through a behavior change. Theories about how students learn and remember information are referred to as learning theories. It is worthy to note that educators and instructors have a lot of frameworks to adapt to the various learning preferences and academic requirements of students by using the principles of learning theory. There are various learning theories related to children's learning and development. However, the three main learning theories are the behaviorism or the behaviorist theory, constructivism or the constructivist theory and the cognitivism or

the cognitivist theory. This study adopted two main theories to interpret its findings. They are the behaviorist theory and the constructivist theory.

2.2.1 Behaviorist Learning Theory

As stakeholders of education, like the government, school, and parents show high interest in students' achievement in their academic work, behaviorist learning theory becomes one that cannot be ignored in meeting the expectations of these educational stakeholders. Behaviorist learning theory has throughout the years emerged as one of the most prevalent ideas in mathematics education. To put it another way, once we want our pupils to flourish in math, behaviorist learning theory must be given top attention. According to this behaviorism theory, how students learn is dependent on a number of stimulus-response processes; as a result, one can consider education as imparting knowledge to students to react in a particular manner to a number of acknowledged cues. John B. Watson (1878–1958), B. F. Skinner (1904–1990), Edward Thorndike (1874–1949), Ivan Pavlov (1849–1936), and others are some of the proponents of this learning theory. However, John B. Watson (1878–1958) and B. F. Skinner (1904–1990) are credited for being the two main persons who first proposed the theory of behaviorism in education. The classical conditioning and operant conditioning theories make up the two primary pillars of the behaviorist learning theory. In classical conditioning, learning occurs when a certain behavior is linked to environmental cues. This assumes that when the corresponding stimulus is present, learning in terms of classical conditioning occurs. In operant conditioning, behavior's results serve as the basis for learning. The advocate of this conditioning thinks that the individual will experience either a desired or undesirable outcome depending on whether stimuli are added or removed. Rewarding or punishing the subject is what happens as a result, and

it can take either a positive or negative form. What naturally brings adjustment in a person's behavior is when the person wants to avoid being punished or when the person envisages to receive something worthy.

Edward Thorndike, a psychologist, wrote *The Psychology of Arithmetic in 1992* and *The Psychology of Algebra in 1923*. In these publications, he discussed some of the efficient approaches to math instruction. The associations between the stimulus and reaction are reinforced as they are put to use, according to the law of exercise, which he indicated. The law of impact was brought up once more. He underlined that it is just as crucial to enhance responses that result in positive outcomes and feedback.

Behaviorist theory is a tool that educators can utilize to increase student motivation. Since everyone wants to feel good, employing reinforcement schedules to deliver such feelings will encourage students to modify their conduct. Behaviorism is still widely used as a method of behavioral control. One of the most practical ideas from the theory is the use of rewards and itinerary to encourage students to work hard and perform their best. According to Bargh et al. (2000), the behaviorist approach is the ideal theory for teachers to take into account while trying to motivate children to learn.

Proponents of behaviorist learning theory are of the view that if teachers are able to provide good classroom atmosphere and make skills acquisition and repetition their prime focus in teaching and learning process, learning will automatically take place. The behaviorists say that teachers' priority as far as their theory is concerned is to fill the learners with knowledge.

Behaviorists' primary objective is the provision of an enabling environment which has the necessary stimuli. Once this is done, students will be motivated to act in the anticipated ways. Behaviorists advise educators to make use of positive reinforcement to modify behavior of students to learn. Knowledge of Skinner's reinforcement

schedules can help educators to utilize the best methods in the classroom to promote students learning. The behaviorist learning theory holds the belief that having understood the relevance of reinforcement in education, teachers are better equipped to create a good classroom atmosphere that maximizes teaching and learning (Holland 1978).

In a nutshell, since behaviorism believes in the provision of antecedent stimulus to elicit the right responses, the provision of intrinsic and extrinsic motivation to students will be crucial in enhancing their performance in the study of mathematics.

2.2.2 Constructivist Learning Theory

An elementary philosophical thought of learning, constructivism has helped educators from many academic disciplines. Constructivism's central principle is that by actively building on previously learned knowledge, students have the ability to actively create new knowledge. What this theory says essentially is that, the present information students receive serves as a basis in to form understanding of the previous information they have acquired. The philosophy of constructivist, according to Serhat (2021), is predicated on the notion that students are active participants in the tasks they are expected to perform rather than passive recipients of their academic education. According to him, students create knowledge themselves using their already gained expertise in life.

Each person considers their prior knowledge and incorporates new ideas in the process of learning. To arrange their knowledge, students create schemas. Jean Piaget (1896–1980), John Dewey (1859–1952), Albert Bruner (1925–2021), Lev Vygotsky (1896–1934), Ernst von Glasersfeld (1917–2010), and Robert Mills Gagne (1916–2002) are a few of the constructivist learning theory's proponents.

The constructivist learning theory stands in stark contrast to behaviorists' claims that students should be treated as "tabula rasa," which is their theory. The belief that new born babies are empty or blank at birth. So it becomes the responsibility of educators to fill their empty skulls with knowledge is known as the tabula rasa. However, constructivism holds that regardless of age, every child is born with some innate aptitude that allows them to create their own knowledge.

The main tenet of constructivists theory of learning is how expertise develops according to its advocates. Regarding the aforementioned leaning approach, learners create their personalized learning. This fundamental tenet states that all information is constructed upon other forms of information. Students select components then assemble each one in a unique manner to create a concept that is distinct from how other children would construct. Prior information, experiences, convictions, and insights of the learner serve as crucial building blocks for subsequent study.

Again, constructivists frequently hold the viewpoint which states that knowledge acquisition is an individualized phenomenon. Every person's unique perspective and experiences are the foundation of the constructivist learning paradigm. It is expected of our learners to enter the learning environment carrying different and distinctive experiences and perspectives on life because they differ from one another in so many ways. Therefore, it is not surprising that children learn at varying rates despite receiving instruction from the same teacher in the same classroom.

to really fathom the processes involved in students learning learn requires knowledge of constructivist theory. Constructivism's basic tenet is that knowledge is actively constructed by learners. Learners develop (or add) what they have learned in addition to the knowledge they already possess. Woolfolk (1993) argued that acquiring

knowledge involves purposeful cognitive effort rather than receiving passively what is being taught by the teacher.

One key element in the constructivist learning theory is that of motivation. Motivation is paramount when it comes to learning and making progress of what is being learnt. In a manner analogous to involvement, motivation serves as crucial for forging links that enhance comprehension.

According to Serhat (2021), if students lack the ability to put to use their mental processes and analyze on prior knowledge, learning cannot occur. It is imperative that teachers make an effort to inspire their pupils to participate in the learning process. Constructivists think that rather than acting as a producer of knowledge in the teaching and learning process, teachers should instead guide and facilitates the teaching and learning process. Because students are inherently and externally driven, they are going to acquire knowledge both inside and outside of the learning environment with no teacher's help.

According to constructivists, learning should be regarded as a proactive process. They believe that it is not feasible for learners to learn and retain what is being learners when the learners do not make full participation during the time of learning. They recommend that students must be made to actively participate in classroom discourse to acquire knowledge. must be forced to actively engage in debates and activities, which is why they see learning. This explains why they consider learning as a social activity. Interaction between students is a novelty in promoting learning amongst students. Therefore, putting students in groups, using other teaching methods such as discussions, conversations, and interactions should be incorporated in the activities in the classroom to promote learning.

The notion of constructivist education also holds that individuals build the ability to acquire knowledge as they go along. Each learner advances in information organization skills as they proceed through the learning process. They can more effectively categorize concepts and produce structures of thought that have greater profound meaning. Students additionally commence to realize that they are learning several concepts at once; for instance, when composing a piece about past occurrences, students are also learning written grammatical rules. When people study significant dates, they also learn how to arrange significant material in chronological order.

Within the realm of thought, there is education. Physical exertion and interactive instruction seem insufficient for memory retention. The learning path requires dedicated involvement and assessment. Students must also mentally experience activities in order to get a complete knowledge.

Cognitive constructivism, social constructivism, and radical constructivism are a few of the popular varieties of the theory of learning that are constructivist. According to cognitive constructivism, educational pursuits ought to relate to the student's level of cognitive growth. The ideas behind cognitive constructivism were developed by Jean Piaget. The core tenet of social constructivism is that studying ought to be an atmosphere of collaboration. How people relate to one another, their social and cultural environment at large shapes knowledge. Lev Vygotsky (1994) is famous for being acknowledged as the one who proposed and developed social constructivism. Cognitive and social constructivism are considerably distinct from radical constructivism. It emphasizes upon the premise that learning and the knowledge that results from it don't actually tell us anything; they merely enable us to function effectively in our surroundings. The underlying assumption being that knowledge is produced, rather than gaining it.

From the ongoing discussion, it is abundantly glaring that students can construct their own knowledge using existing schemas. Once they are made to appreciate the usefulness of mathematics in their daily lives and career, they will be interested and motivated to learn mathematics even in the absence of their teacher. They will see mathematics more than what do learn in class. They will be able to do (construct) mathematics wherever they find themselves using what they learn in class as a foundation for obtaining further knowledge in mathematics.

2.3 Empirical Knowledge on the variables under study

The empirical evidence has been categorized into four separate categories that support the links between the variables studied and the ideas underlying the research questions. These variables are usefulness of mathematics, interest in mathematics, motivation in mathematics and achievement in mathematics.

2.3.1 Usefulness of Mathematics on Students' Achievement

According to Fatima (2013), all subjects that students study in schools have great importance to both the learners and educators. She further stressed that, despite the seeming importance of all school subjects, the importance of mathematics is second to none. The development that gradually occurs in people's minds, bodies, social, and economic systems provides an overarching goal for schooling that makes mathematics instruction unparalleled. Niss (1996) is of a firm belief that mathematics education is what makes people creative and responsible thereby making them fit into the society they find themselves. Learning mathematics helps students satisfy the demands of society to create a versatile and highly skilled pool of workers.

However, Musto (2008) noted, that there are students with significant mathematical skill in secondary education who don't seem to understand the significance of mathematics and how usefulness it is to their tertiary education and future career (Onion, 2004). Even when they like studying mathematics, it is just a small number of learners who are privy to the connection between the classroom mathematics they learn, and the day-to-day mathematics they do in the real-world (Borko et al., 1992).

Ghimire (2022) quoted Devkota who intimated that, "Mathematics is deeply ingrained in daily life." Mr. Devkota claims that since the beginning of time, humans have used mathematics in their daily lives. Math was first developed by man to provide an answer to questions like "how many," "how much," "how big," etc. As a result of this, we might assert that mathematics evolved in response to the necessities of humanity.

According to Johnston (1994), by making mathematics has become a requirement for many degree courses expands the options available to students who want to pursue a university education.

Numerous reasons can encourage learners to do mathematics, according to literature. Mathematics education is extremely important in many spheres of academic, professional, and everyday life. Mathematical abilities create a variety of skills necessary for problem-solving, making decisions, and navigating the intricacies that life poses to humanity in a daily basis, according to English & Gainsburg (2015). These abilities are necessary for pursuing a variety of lucrative jobs and succeeding at work.

In order to guarantee the overall well-being and welfare of their populace, practically every nation in the entire globe aspires to attain a high standard of innovations in technology. This reinforces what is needed for the growth of mathematical expertise as the cornerstone of technological advancement. The science of numbers used to offer solutions to issues is known as mathematics. According to Awofala (2014),

mathematics encompasses quantities, magnitudes, and space in addition to logical thinking and judgment.

Generally speaking, the usefulness and value of a thing is what make people exert all their energy in pursuing that thing. The study of mathematics is a prime illustration. Even though many students perceive mathematics to be tedious and difficult to master, they nonetheless see its value in everyday life. It is paradoxical. The quest to have a decent profession and, to some extent, to live a better life might be cited as a practical justification for the importance of mathematics. According to Niss (1994), the majority of young people are aware that, for mysterious reasons, mathematics competence is essential to securing desirable academic and job prospects. This concept has been brilliantly stated by Jens Hjøgaard Jensen in the phrase Mathematics is worthless to me, but at the same time I know that I am worthless without mathematics, as Jens Hjøgaard Jensen so brilliantly put it (Niss, 1994).

Despite the importance it holds, mathematics comprises procedures and concepts that may make it seem like an intimidating subject. Students frequently develop an aversion for mathematics since it tends to involve meticulous steps that involve intricate computations and is often seen as being excessively abstract (Awofala, 2017; Awofala & Odogwu, 2017). Many students have developed a fear of mathematics, which prevents them from realizing its significance and functions.

According to Awofala (2017), many Nigerian children do not appear to develop and exhibit a strong comprehension of or aptitude for mathematics. The lack of motivation to learn mathematics is not unrelated to the mathematics anxiety, because it is believed that motivation is a key element in completing every activity of learning successfully (Awofala & Falolu, 2017 in Awofala, Lawani & Adeyemi, 2020).

Michaelides et al., (2019) reiterated that subjective characteristics including happiness, fascination, and self-perceived significance, in addition to costs and utility assessments, are all related to how well children perform academically. These passionate and inspirational qualities are recognized as well as being critical, not solely as signals of achievement but likewise for optimum outcomes in education.

According to (Eccles & Harold, 1991), discovering a meaning and significance in one's task may additionally promote participation on the part of students, their growth of competence, and an improvement in performance. In response, Ali et al. (2009) pointed out that during an era of modernization and advancements in technology, learning is seen as the first step in all human endeavors. It is essential to the growth of human capital and is associated with a person's wellbeing and prospects for a better quality of life. It ensures people attain the knowledge and skills required to increase their productivity and improve their quality of life. This increase in efficiency, opens up new revenue streams, that fosters the financial expansion of a country.

For educators, the degree of achievement among students remains vital. Its advantageous implications have been targeted at local, regional, national, and international levels. A nation's labor force, which is subsequently accountable for the development of the nation's economy and society, is made up of graduates of the highest caliber who have the potential to lead the country in the years to come.

The significance of mathematics in contemporary society cannot be overstated, in Obuba's (2013) opinion. Students that perform poorly on math exams at the state, national, and international levels are deprived of the benefits that come with learning the subject, such as academic and career opportunities, as well as the economic benefits that come with having a well-educated populace. Political and institutional leaders in the United States, as in a number of other developed nations, are gravely worried that

scoring substandard in mathematics, a core subject associated with, technology, engineering, and science, will lead to being disadvantaged in the marketplace and a step toward being outpaced commercially by advanced economies in the world.

The growing interest of a lot of research work on the achievement of mathematics among senior high students lately stems from the role mathematics plays in both formal education and students' routine activities in life (Jansen et al., 2013). Jain et al., (2009), for example, underscored the relevance of mathematics in all spheres of human life by stating that understanding in mathematics is crucial for an individual's private and professional lives. Success in mathematics has been linked to well-being, life satisfaction, health, income, employability, and lifespan, according to Lipnevich et al. (2016).

The subject of mathematics is regarded as one of the most crucial ones in the school curriculum around the world, according to Suleiman et al. (2019). According to Enu et al. (2015), mathematics is one discipline that has an impact on all facets of daily life. Sa'ad et al. (2014) said that without the understanding of mathematics, education and human life cannot successfully function, which supports their argument. Learners require mathematics to succeed in their scholastic endeavors, market merchants need a basic understanding of the subject to conduct daily business, even the chef, whose job it is to create delectable meals, needs mathematical knowledge to accurately make those dishes, etc.

Witte (2022) stated that the Ghanaian mathematics curriculum stimulates the utilization of mathematics in everyday situations by helping students recognize and put into practice efficient methods for solving issues. According to research by Shikalepo (2021), many mathematics education programs in Ghana place a strong emphasis on helping students acquire the problem-solving abilities and skills necessary for success

both inside and outside of the classroom. As a result, the mathematics curriculum in Ghana requires students to develop their critical thinking abilities, develop strategies, generate ideas and inventive solutions, and understand common scientific difficulties. Globally, if people recognize the usefulness of mathematics in everything we do, we will attach a great deal of attention it deserves to it. Yuan (2002) wrote that the recognition of the usefulness of mathematics motivates students to take courses in mathematics. To him, who on this planet will not learn a subject which will in the future serve as a foundation for further courses and careers? A student's readiness and enthusiasm in learning mathematics can always be enhanced if and only if he or she recognizes the importance of mathematics.

Das et al. (2019), saw that mathematics is useful in several scholastic disciplines. As examples, they gave the subjects of history, geography, fine arts, and physical education. Without a question, having a solid understanding of arithmetic is crucial since it gives kids the opportunity to learn other disciplines. Since our modern geography, physics, chemistry, economics, and other subjects require mathematical proficiency, no student with insufficient arithmetic skills can study those subjects.

Motivating students to learn mathematics is key as it will lead to improvement in their performance. Maria et al, (2017) believed that the duty of a mathematics teacher then becomes more than a thorough knowledge of the subject matter to be taught. He is expected to possess some skills and techniques of teaching each particular topic or aspect of the subject and knowledge in a way that will motivate, arouse and sustained the students' interest in learning mathematics.

The perceived usefulness is defined by Adelson et al. (2011) as the opinion students have regarding the applicability or significance of mathematics in both the present and the future. They also stated that learners' broad views about the topic, which will

ultimately improve their academic success in the subject, are directly influenced by how they view the important nature of mathematics. Students who possess an understanding underlying the value of mathematics in their daily lives and future careers will, according to Syeeda (2016), have an inner desire and impulse to delve into, apply, and become familiar with the subject. According to Guy et al.'s (2015) study, profitable performance is positively predicted by how useful mathematics is.

Most professions and jobs are said to involve some level of math. In a range of vocations and tasks that are not clearly mathematical, Hoyles et al. (2002) believed that mathematics is present implicitly. In order to determine the degree of how workers were using mathematics in the workplace, Hoyles et al., (2002) undertook a study of organizational mathematics. They found that, regardless of the level at which the individuals were employed, required some level of mathematical competency. Mathematical aptitude is still required for the majority of employment in the modern world (Hoyles et al., 2002), and many professionals' mathematical aptitude and competency in their field of specialization are strongly correlated (Flegg et al., 2012). Employers' requirements for mathematics skill sets are continually evolving, and employees are often anticipated to be adept in a variety of mathematics-related competencies and abilities that weren't necessary for their forebears. Since mathematics has evolved into a necessary tool in the workplace, the sort of mathematics education offered in schools should be adapted to match the expectations and needs of the society. According to Güvendir (2016), who defined extrinsic motivation as "perceptions of mathematics usefulness in daily life," students who think mathematics is relevant and beneficial perform better in mathematics than their counterparts who think otherwise.

2.3.2 Motivation in Mathematics on Students' Achievement

Mathematics is one discipline which numerous high school students struggle to understand, according to a 2007 study by Alagic et al. Many pupils are reluctant to participate in math lessons because they believe the subject to be very challenging. For instance, a large number of high school graduates in Turkey have little knowledge of the value of mathematics. According to research studies, one of the causes of this unpleasant circumstance is a lack of motivation (Alagic et al., 2007).

The forces that account for enthusiasm, choice, direction, and continuity of activity are often referred to as motivational factors Brown (2011) believed that when students are highly motivated, they will be interested in learning mathematics.

Different theories explain motivation, which highlights how challenging it is to put it into plain and straightforward terms. Most people think of motivation as an underlying desire or need that propels someone to take action to fulfill it. The word "motivation" comes from the word "motive," which is used to describe a person's needs, goals, or inclinations. According to Schiefele (2009), motivation is generally regarded as a sense of wishing to carry out a particular task in a particular circumstance. Motivation is usually associated with efforts. Some people define effort as the "total work done to achieve a particular end." Schiefele (2009) explained that if a student is more motivated to learn or to complete an assignment, they will more likely put in more effort to complete the task at hand. Personal interest and effort are frequently linked. A student will likely be more motivated to learn about a subject if they think it to be highly relevant, which will boost the amount of effort put out.

When students are highly motivated, they will be enthused and fascinated to work assiduously and persistently to achieve the goals that educational authorities have set for them. Motivation of learning therefore refers to the concerted efforts made by

students owing to the learning goals they envisage to achieve. They view achieving the goals of education as a necessity, including a desire to put learning into action, the need to see results from learning, and the need to get beyond barriers to education.

Student motivation has always been a top concern for researchers and educators because it is intimately tied to student achievement and the desired outcome (Esra and Sevilen, 2021). Numerous studies have demonstrated that increasing student motivation to learn results in higher academic achievement as well as outcomes. Teachers are obligated to employ successful teaching techniques to motivate pupils in order to increase student accomplishment.

According to Ogunmoyero and Omasheye (2012), people have an inherent desire to learn and are hence teachable and inquisitive by nature. However, in order for people to succeed in learning, motivation is frequently required. The arousal, direction, and maintenance of students' behaviors are all aspects of motivation, according to Glynn and Koballa (2006). This explains why students put in a lot of effort to succeed well in science classes, especially mathematics. It also clarifies the depth, duration, and feelings that go into such undertakings as well as the motivation behind achievement in such fields.

Different theories can be used to analyze motivation. The convictions of a person in their ability to do something, their reasons and aims for accomplishing the assignment in question, and their subjective reaction to finishing the duties all fall under the umbrella term of motivation in the discipline of education.

According to a study by Herges et al. (2017), motivating students to learn could be the solution to their mediocre performance in mathematics. Despite the fact that multiple studies have shown a direct correlation between motivation and overall academic

achievement, they claimed that there is a gap in the study for students in the high levels of education.

Internal, external, or a combination of both sources might motivate learning. In order to fulfill their future educational goals, they believe that mathematics will be essential. It will therefore serve as encouragement to continually work harder to achieve excellent grades in mathematics.

Yunos et al. (2021) concurred that students' willingness to learn mathematics was influenced by the importance they gave to the learning as a whole.

Glynn and Koballa (2006) stated that a student's commitment to giving an academic endeavor significance and value in order to gain its rewards is referred to as "motivation to learn." Students need to be motivated and inspired in order to arouse and sustain their interest in mathematics learning. This is required because mathematical operations are abstract and complicated. However, motivation results from the desire to achieve a goal. As an essential field of study for everyone in school, mathematics aims to help students understand the complex world around them, enhance their ability to think critically and solve problems, broaden a conceptual worldview, and give them the skills that they will need in the workplace. There are three things to keep in mind concerning education, according to Terrel Bell, a former US Secretary of Education, who underlined the significance of motivation. The initial one is motivation. Motivation is the second factor. Motivation is the third (Covington, 2000).

According to Terrel Bell, motivation is the core of education and is therefore crucial to it. Students are motivated to learn what they are motivated to learn. Students are motivated to achieve whatever they do for a variety of reasons. Therefore, it is the responsibility of mathematics instructor to inspire a strong passion for mathematics among their students.

Researchers believe that among the factors that affect students' learning, motivation is a highly crucial component in describing the reason students achieve varying degrees of a successful outcome. Motivation is one of the most crucial aspects that affects the probability of success or failure of a student, according to Qin et al., (2002). Students who are really motivated naturally will be encouraged to work meticulously and relentlessly toward the goals that teachers and administrators have set for them. Therefore, the term "motivation of learning" refers to students' focused efforts motivated by the learning objectives they want to accomplish. The need to put learning into action, the need to see benefits from learning, and the need to get beyond learning obstacles are what they see as being necessary for this achievement of learning goals. Teachers are supposed to motivate pupils through successful teaching tactics in order to increase student accomplishment.

Extrinsic and intrinsic motivation are the two categories of motivation recognized by the Self-Determination Theory (SDT). Extrinsic motivation, according to Ryan and Deci (2000), is "a construct that pertains whenever a task is done in order to attain some separable outcome." Intrinsic motivation, on the other hand, is "the doing of an endeavor for its fundamental delights rather than for some distinguishable consequence." According to Schiefele (2009), interest is a type of antecedent to motivation. Interest can be distinguished from other motivational constructs by its basis specificity because it is one of several motivational concepts such as self-concepts or focus on objectives (Krapp,1999).

Learners who are motivated to do things they wouldn't normally do might be thought of as having an active driving force that pushes and forces them to do so. Motivation is what spurs pupils to participate in tasks they see as challenging. McDonald et al.'s (1959) assertion that motivation is the energy shift in a person that is anticipated by a

reaction to the presence of a purpose and marked by the appearance of "feeling" buttresses the point. One may say that motivation is a reaction to an action, which is the desired outcome. According to Brown et al. (2011), students that are highly motivated would be able to complete their task thoroughly and consistently in order to meet the objectives of learning imposed on the course of study. According to (Eccles J.S & Wigfield A. 2002, Rosenzweig et al., (2019), the expectancy-value hypothesis proposes that a course of action's value and a student's anticipation determine how motivated they are toward finishing it. The intrinsic, achievement, and utilitarian value components make up the value component in the system in question. An individual's delight of a task is termed as intrinsic value Ryan & Deci (2000), which is related to intrinsic motivation in some respects. The utility value component corresponds to carrying out something due to the fact that is in line with one's intentions, such as acquiring mathematical knowledge to land a job in the field (career motivation). The utility value is likened to the internal urges a person has in this regard Ryan & Deci (2000), more precisely to the SDT notion of recognized regulation, which is the extrinsic incentive that is most autonomous. Expectancy and value also influence the activities which the learners to select to undertake.

Studies on students' mathematical achievement and enthusiasm to learn the subject have produced erratic or perhaps findings that are conflicting. These research works suggest that the relationship depends on the definition and measurement of motivation. Intrinsic motivation is linked to mathematical accomplishment, according to studies that define intrinsic and extrinsic motivation as a two-dimensional phenomenon. Results for extrinsic motivation, however, have been found to be less consistent. Notwithstanding the fact that it has been discovered by a number of studies a negative correlation

between extrinsic motivation and mathematical achievement, other studies have found a favorable correlation.

The ongoing dedication of students to mathematics includes their motivation to learn the subject, their conviction in their capacity for it, and their sentiments about it on an emotional level. A major factor when it comes to developing mathematics knowledge and skills is the dedication of students to the subject, an assertion by Education Matters (2015). Investigations into beliefs about mathematics has a particular emphasis on motivation. According to Goldin et al., (2016), who analyzed motivation as it pertains to individual intends and interest of students stressed that motivation can take various shapes. Motivating students is the deliberate act of coming up with objective and being interested in mathematics

Under-participation and poor performance in math are frequently attributed to a lack of motivation as well as involvement, but a significant amount of research has found that motivation and engagement have a positive relationship with student academic performance (Martin, 2007; Stipek, Salmon, Givvin, Kazemi, Saxe, & MacGyvers, 1998). A compelling body of research demonstrates that student motivation improves their mathematical performance, contrary to the theory put up by Wigfield & Meece (1988) that academic achievement in mathematics is inhibited by anxiety.

Schukajlow and Rakoczy's study (2016), they talked about how motivation and emotions influence acquisition of knowledge and achievement in school. The self-determination theory Ryan & Deci (2000) is used by the authors to explain classroom motivation. According to the self-determination theory, people have a need to be competent, independent, and accepted. Humans experience happy emotions when these needs are met, which results in positive experiences and great drive for an activity.

According to their research, motivation is increased by buoyant emotions and an optimistic outlook.

We consider that motivation is a component of a much wider balance of beliefs, feelings, actions, knowledge, and lifetime experiences. For instance, Moore (2007) noted that academic issues among students in developmental education frequently result from motivational inadequacies as opposed to purely cognitive or knowledge deficits and that these motivational components are also intricately linked to other personal influences and qualities. The overall lackluster achievement of developmental students in mathematics entails more than simply "the math," as well as their beliefs, routines, and general wellbeing as students. He further posited that there are a number of motivation-related characteristics that affect students' achievement, including locus of control, self-efficacy, self-regulation, and effort regulation.

Using a successful method for motivating students is essential to raising their performance Bataineh (2014). When students are motivated, doing mathematics comes naturally to them and brings them tremendous happiness. According to Hafizul et al. (2017), if educators want their pupils to succeed in all they study in school, they must pay urgent attention to motivation as a few of the crucial components. As a result, learning will become more motivating once it is assumed to be necessary. Success and learning both depend on motivation. In the context of higher education, motivation is considered as having a structure that is multidimensional and tied to learning and motivation for study.

Researchers demonstrated that motivation should be taken into consideration as a critical aspect in order to increase the interest of learners in learning mathematics. Yeh et al.'s (2019) assertion that low motivation causes low interest in learning mathematics

and thus low accomplishment is a single instance. This claim then validates the causal link between the students' academic achievement and their interest.

It is important to understand that teaching mathematics entails exceedingly mere provision of computational knowledge of the subject. The goal of mathematics instruction is to communicate mathematical concepts and terminology to students at a level at which they can comprehend and apply them. It is obvious how difficult it is to teach and learn mathematics, and many different things affect whether pupils learn the subject well or not. Any endeavor to guarantee the quality of mathematics teaching and learning must take into consideration the nature and quality of materials used for instruction, the presentation of content, the pedagogical abilities of the instructor, the learning environment, and the motivation of the learners in question.

A creative approach to instruction helps to improve the standard of educational institutions. The use of novel concepts and techniques is the definition of innovation. Students are inspired by the educational system to learn effectively in the real world. As a result, the use of creative teaching techniques in the classroom has a big impact on how engaged students are in their studies. Active learning, individualized project-oriented instruction, tutoring by peers, problem-driven teaching, blended learning, etc. are a few of the cutting-edge teaching techniques that will aid in the development of the learning categories.

Students' disregard for their academics is likely to be a reflection of an absence of academic interest and motivation. The previous 20 years have seen a steady fall in the academic motivation of adolescents, according to research. According to a study by Harackiewicz et al. (2018), children's interests and attitudes toward school in general and toward particular subject areas like mathematics, art, and science tend to decline as they become older. Otoo et al. (2018) mentioned this study.

The employment of creative teaching techniques to inspire, captivate, and maintain the interest of learners greatly aids in making math engaging for learners because math has historically been the bane of the majority of pupils. According to Dijkstra (2020), "There should be no such thing as boring mathematics." students are better able to remember what they have learned when teachers employ novel methods of instruction because it assists students understand mathematical concepts. When Young (2019) remarked, "It is clear that the chief end of mathematical study must be to make the students think," he absolutely agreed that one of the purposes of learning mathematics is to encourage students in the development of analytical thinking. No wonder, Bacon (2012) emphatically said that "Mathematics is the gate and key to science."

According to Theobald (2006), motivation improves learning and helps students develop and maintain an interest in mathematics. Due to the link between student motivation and performance, particularly boosting motivation for learners in the mathematics classroom is an essential issue for instructors and researchers. Instructors must take into account the challenging yet essential part of teaching known as student motivation. Teachers must remember that a variety of factors influence student motivation to learn, though. Utilizing cutting-edge teaching techniques in our technologically advanced society gives pupils the motivation they need to be interested in acquiring the supposedly challenging material. In theory, students should be actively involved in their education, however this depends on the teacher's external support. Although students' learning may be influenced by outside variables like prizes or incentives, it can also grow as a result of their own intrinsic motivation to perform or complete a task Theobald (2006). This implies that the teacher's contribution to students' learning is critically important.

The creation of an encouraging learning atmosphere is just one aspect of the teacher's responsibility for motivation. Learning motivation is increased by the teacher's role in promoting autonomy, relevance, and connection between the subject matter and the students' lives. Additionally, a key element influencing students' motivation to learn is the teacher's capacity to foster their competence, interest in the subject matter, and sense of self-efficacy.

Smith et al. (2012) discovered that motivation ignites students' interests in a variety of academic fields and consequently results in improvement performance, particularly in mathematics. Ryan and Deci (2017) saw motivation as a resource that offers the energy needed to persevere through difficulties and accomplish tasks successfully. It follows that motivation for learning mathematics enhances the interest of learners in the topic. Among other things, Zhang and Wang (2020) found that students' love for mathematics had a direct and positive impact on their achievement in the discipline.

Lin (2012) maintains that motivation manifests as natural demands that take place in a private context or that are repeated there when learning and mastering new material. Students who are motivated to learn mathematics pay attention to what they are learning, participate actively in class discussions, learn extensively to attain the goals they have set, and demonstrate a willingness to learn both when the teacher is present and when they are not. Additionally, they attend all of the math classes because they see how important math is to other subjects.

2.3.3 Interest in Mathematics on Students' Achievement

It is a common belief among mathematics researchers that with regards to learning, one of the most crucial components is interest in the learning of mathematics. "Interest in mathematics is as natural as growth" (Kolpas, 1972). Every human being is born and

raised in a world where objects are measured, tallied, and compared; as a result, he acquires both knowledge of and skills for applying numbers and every other type of language. In reality, no child is naturally opposed to mathematics; learning dislikes are learned traits that are not hereditary.

Kolpas (1972) continued to state however that, by the time a student first enrolls in a junior high school, his innate interest in mathematics has all too often faded and died, leaving a mathemaphobic student who, undoubtedly choosing success to failure, interest to boredom, and anonymity to prestige, chooses to close his thought, his feeling, and his imagination when confronted with mathematics. That is to say, a lot of students have such high levels of nervousness from traumatic events in the lower grades that by the time they are in high school, they are fundamentally petrified in the subject of mathematics.

As a result, the senior high mathematics teacher would benefit immensely by comprehending the genesis of his students' abnormal hatred towards mathematics. Having this knowledge, he will be able to make an extra effort to boost these students' self-esteem, investigate their problem areas, and, using particular motivational approaches, instill in them the "drive" required to succeed in the field of mathematics and its related fields.

Hidi and Renninger (2006) defined interest as a psychological state characterized by involvement in or a propensity to continue involvement with a given piece of content across time. Their research divided interests into two categories: situational interests and individual interests. when students are motivated by a variety of circumstances or specific environmental elements. Such an interest is categorized as situational interest. Personal interest, on the other hand, is an interest that develops through time because of a sustained interest in a subject or activity.

According to Arthur et al. (2014), students naturally gravitate toward deeper study about a subject when they are interested in it. Their theory is that pupils are motivated to learn even when their teacher is not present because of their interests.

It is important to keep in mind that during the adolescent years, learning-related activities get harder and call for more concentrated devotion and effort, which may risk that sense of success. This suggests that there is substantial but possibly probable, Kahu et al., (2017).

The definition of interest given by Harackiewicz et al. (2016) was "an individual's momentary experience of being captivated by an object and more lasting feelings that the object is enjoyable and worth further exploration." When something attracts someone's interest and inspires them to act or pursue it, they are said to have that interest.

Wong & Wong (2019) described interest in the context of learning as the act of involving students in mathematics instruction while they are having fun. In this study, interest is defined as the state in which students feel comfortable and unrestricted in communicating with teachers and peers about learning mathematics while demonstrating a keen interest in and appreciation of their educational experience.

According to Emefa et al., (2020), interest is also a psychological state that includes readiness, concentration, focus, and a positive attitude regarding a certain subject or activity that emerges during a person's contact with it.

The literature is replete with examples of how academic accomplishment and interest of students are positively correlated. Notably, students who exhibit higher levels of the belief in themselves and interest in mathematics and those who place a higher value on the subject perform better. Learning is a change in behavior induced by circumstances of activity, practice, and experience. According to Oyeniran (2003), learning is the

process of gaining knowledge, developing a skill, improving oneself, or moving forward. Interest is a prerequisite for knowledge of any kind to have an impact on character. The data that must be processed by the mind must become ingrained in and uniquely its own. This implies that learning requires interest, which is a necessary prerequisite. Interest is a highly important aspect in mathematics instructions, according to Obodo (1997). The researcher added that the type of interest learners build for the subject greatly influences the degree and direction of attitude toward mathematics.

Singh et al. (2002) stated that one of the attitudes and influential variables that predict academic achievement of students in studying mathematics or avoidance of it is interest. They affirmed unequivocally that low achievement in mathematics is caused by an absence of interest in the subject. This implies that any instructor who is able to pique and maintain his students' enthusiasm in their mathematics education would witness success among his students.

Mathematics, according to Yeh et al. (2019), is a discipline that is rife with abstraction. The majority of students are uninterested in mathematics because it is an abstract topic. Low achievement is the result of this loss of interest in the subject. In addition to students' lack of interest in mathematics due to its abstraction, Summer (2020) emphasized that their nervousness related to learning mathematics has also played a role in their dislike of the subject. There is also the problem of mismatch between grades and knowledge/skills which turns to not only discourage students, but demotivate them as well. The situation becomes worse if a student perceives that the school mathematics is something that is simply uninteresting. He starts exhibiting what is termed as mathematics avoidance and displays a negative attitude toward school and learning as a result.

Increased attention, efforts, effects, and experience were mentioned as some of the fundamental qualities of interest in the study done by Toli et al., (2021). To increase students' interest in learning science, their study used a situational interest growth approach. In the end, it became clear that there is a positive correlation between students' interest and their educational outcomes or performance. In other words, it was found that how students do is influenced by their level of interest.

Eshun (2000) explained that a person's attitude toward mathematics as "a disposition toward a particular the aspect of mathematics that he has acquired through his beliefs and exposure, but that has the potency to change as time goes on."

In a similar vein, a negative attitude toward mathematics is related to a negative emotional disposition (Zan & Martino, 2008). A positive attitude toward mathematics indicates a positive psychological disposition in respect to the subject at hand. These psychological characteristics affect how people behave because they are more likely to succeed in a subject that they love, have interest in, or find valuable. Kihwele (2022) examined the pattern of students' bad math scores and came to the conclusion that their absence of interest for the subject is to blame for their appalling output. He found that pupils don't seem to be interested in mathematics at all since they believe it to be uninteresting.

Heinze et al., (2005) conducted a study involving 500 German seventh- and eighth-graders to examine their ability for and keen interest in mathematics and to investigate the relationships between the factors. In his study, he came to the conclusion that one way to predict students' success in mathematics is to gauge their interest in the subject area (Heinze et al., 2005). Another study was done on 511 secondary students in Nigeria. According to the study's findings (Kpolovie, Joe, & Okoto, 2014), academic success and motivation in learning are significantly correlated. A researcher, Sauer

(2012), found that a student cannot be successful in a subject without taking into account their interest for pursuing the subject at hand.

Trying to cultivate interest in students to enable them to learn mathematics should be a deliberate effort and not a spontaneous decision teachers take in the course of mathematics instructions since interest plays a pivotal role in students' academic success. This assumes that academic interventions and tactics must be given top attention in the classroom. (Brophy, 2008; Eccles et al., (1993) held that high school students' interests in disciplines like science, technology, engineering, and mathematics (STEM) steadily wane. It is the role of the mathematics teacher to utilize motivational interventions to pique their interest in these crucial areas.

Nothing about interest interference is universal. In other words, it may not be possible to adapt an approach that works for one group of kids to another. Judith et al. (2016) hypothesized that two intervention strategies are informed by interest theory:

1. Create and sustain situational interest: Give students tasks that use structural elements to keep their attention and engage them, such as issues, challenges, and surprises.
2. Develop newly discovered and established personal interests by offering material and academic assignments that make it easy to combine academic subjects with pre-existing passions.

Evidently, if our learners have not yet understood the essence of the value of mathematics, for which reason, they have to study and become successful in the subject, they will still exhibit the lack of interest attitude towards the subject. They will be unable to discover the link that their school mathematics has and real-life. When this happens, it will then be unsurprising to find out that students' interest towards the subject being in a declining trend. Azmidar et al. (2017), one of the most significant

aspects influencing students' performance is their interest in studying. They came to the conclusion that students who show a high level of interest in learning mathematics perform well in the subject, and the opposite is also true. Reeve et al. (2015) claim that students' passion in mathematics propels them to want knowledge in the subject, which ultimately boosts their achievement in the subject. According to a recent study by Luzano (2023), student's decreased interest in mathematics instruction may also be a contributing factor to their poor mathematics performance. (Betz, 1978; Singh, Granville, & Dika, 2002) state that the drive of students to gain the skills necessary to do daily chores and their involvement in the STEM fields, particularly among female students, are directly impacted by their lack of interest in mathematics. Less interest in taking challenging mathematics courses before enrolling in tertiary (Nosek et al., 2002), less interest in pursuing a career in STEM-related fields (Usher, 2009), and lower grades in mathematics are all closely related to lower interest, with females being more vulnerable (Betz, 1978). When compared to other topics, mathematics shows a rather strong correlation between interest and achievement (Schiefele, Krapp, & Winteler: 1992).

Hidi and Renninger's (2006) model states that a person's formation of interests is influenced by a sense of good passion for an action, as well as judgments of worth and the gain of expertise in a field. Additionally, they proposed four stages for interest growth. An external stimulation may cause a person to become momentarily interested in an activity (phase one of situational interest triggering), and over the course of time, that interest may expand (phase two of situational interest maintaining). If situational interest is maintained and a person continues to engage in the activity and see value in it, individual interest may begin to form (emerging individual interest: Phase 3). in relation to the action. Consistent participation in the activity over a period of time,

information gained, and positive emotions can all help to develop a continuous interest in it (developed individual interest: Phase 4). Therefore, the level of value, positive affect, and knowledge associated with the activity impacts the interest that arises or intensifies in a certain circumstance.

As one strategy for stirring interest, provide educational activities that grab students' attention. According to Dewey (1913), learning experiences should awaken and stimulate a person's current needs. Berlyne (1970) highlighted task parameters as having an effect on attention as well as focus as collective elements. He carried out several studies where he changed the novelty, complexity, surprise, and contradiction of the visual stimuli, and found that each of these multifaceted qualities increased interest, arousal, and attention. These ideas serve as the theoretical foundation for many initiatives that try to promote situational interest in learning spaces, or what Renninger and Hidi (2016) refer to as "triggers for interest."

According to research by Tsoto et al. (2016), students' interests may help them succeed in mathematics and have been shown to enhance students' motivation to study the subject, which in turn affects their academic performance.

2.3.4 Achievement in Mathematics

A student's achievement is determined by how much of a course material or topic they have learned. What a student has accomplished in the past serves as the foundation for his potential in the future, Aiken (1985). Most researchers are of the opinion that the achievement of students in mathematics has continuously been appalling. One of such researchers is Ale (1989). For example, many times, students struggle to understand the mathematical concepts that their teachers are trying to teach them, which results in a general lack of success in examinations that are internal as well as external.

We should be concerned as a country and as a society because our schools have a sizable proportion of low-achieving children. Both the public and private spheres of the education system have been extremely concerned about student's overall mathematics performance, which has been continuously low for a very long time (Bekoe et al., 2022). Every classroom has heterogeneous students. which means that each student has significantly varied learning styles and consequently exhibits a range of academic accomplishments, Yeh et al., (2019).

It is clear from the existing research that student performance in mathematics is quite low. The academic performance of students in mathematics has always been subpar, despite how crucial mathematics is to one's career or the country as its entirety. Academic performance is undoubtedly a major problem for educational scholars because students' lives become unpredictable and depressing when they perform poorly on national exams. It should be emphasized that a student's success or failure in senior high school plays a significant impact in whether or not they will continue their education at the postsecondary level, and mathematics plays a significant role in this regard. Numerous research has examined how gender affected math proficiency. The scholastic achievement of girls in mathematics was comparable to that of boys in the primary grades, but it decreased in middle school, according to Morgade and Bonder's (1995) research. Furthermore, investigation conducted by Fennema and Sherman (1977) found that girls' arithmetic abilities tend to be on par with boys in the early primary school years but tend to deteriorate in high school. The TIMSS findings revealed that there is no disparity in the standard level of mathematical knowledge among male and female students across all of the examined countries (Ismail, 2009). According to research conducted in Africa by some academics, such as Tilaye and Bedru (2006), there is a discernible gender disparity in mathematical and scientific

ability in favor of male pupils in relation to that of female students. Janson (1996) also discovered that female students' mathematical proficiency was lower in comparison to that of their male peers.

A study by Wang (2004) equally highlighted how family variables and motivation impact on ability in mathematics. Despite the fact that most characteristics were highly correlated with mathematical proficiency for both countries, the results showed that Chinese students outscored those from the United States in this subject. The results of earlier studies (Ai, 2002; Ma & Kishor, 1997) showed a strong and favorable link between attitudes toward mathematics and mathematical achievement.

The influences on students' mathematical achievement were covered in a number of research. For example, according to research by (Demir et al., 2009), factors such as student background, self-related mathematics cognition, learning styles, and school environment have an enormous impact on students' success. According to Hammouri (2004), while success attributing to hard work, beliefs about mathematics, and optimism regarding a person's ability to succeed in mathematics all have significant positive overall effects on mathematics achievement, success attributing to luck and friends' perceptions of the importance of mathematics have negative direct and overall effects.

There has been a significant percentage of mathematics failure among students in Ghana's senior high schools, according to various examination bodies over the years. The importance of mathematics in daily life and the workplace is well known, but student performance has been appallingly low for a while (Butakor, 2016). Only 49% of students who took the West African Examination Council (WAEC) test in June 2012 who took the mathematics core subject managed to pass with at least a credit (C6 and higher), according to one case. Every high school graduate must achieve a C6 in

mathematics in order to be qualified for a university education. This implies that in 2012, more than half of candidates were rejected for admission to a higher education program. The issue grew worse during the next years. In 2013, just 36.8% of applicants received at least a C6. The percentage of students passing with a grade of C6 or higher varied from 32.4% in 2014 to 25.04% in 2018 and from 32.83% to 42.73% in 2017. The percentage of candidates who received a Grade C6 or higher decreased from 42.73% in 2017 to 38.33% in 2018. As a result, more than 61% of test takers for the 2018 school certificate exam were unable to continue on with their study. There has never been an exceptional performance in the last 20 years, despite the fact that the last three years' performances—65.31%, 65.71%, and 54.11% for 2019, 2020, and 2021, respectively—are above average. Math achievement is the level of proficiency that the student demonstrates in the subject. It results from the learner gaining information, understanding, abilities, and procedures in a certain field. It is a component of the math achievement test (Pandey, 2017).

Mathematical achievement has a direct bearing on job options available for students in future, affects how much of a students' broad spectrum of expertise they have learned, and constitutes an appropriate standard for classifying students into scientific or literary streams. Competence regarding mathematics can also lead to profitable employment and high-status positions, according to Khair et al. (2012). Therefore, pupils at all grade levels struggle with mathematics, as observed by educators, parents, and researchers. According to Satwant (2013), a student's success in mathematics is crucial to achieving the ideal of a harmonic development. She makes the case that mathematics has taken on such importance in today's rapidly advancing world and with the development of science and technology that every parent now sets high expectations for their children to be successful. Thus, success refers to all the behavioral modifications that occur in a

person as a result of diverse learning experiences. The level of accomplishment or proficiency gained in a particular field of mathematics is referred to as mathematics achievement. Achievement is typically used to describe a student's performance on an annual test. According to Crow et al. (1956), achievement is the degree to which a learner is benefiting from lessons in a particular subject area. An exam that evaluates students' understanding of a few academic subjects is called an accomplishment test. Students' mathematical skills might increase due to the teacher's numerical proficiency, dedication to their job, and continual focus on professional advancement. Science-phobic students attribute their disinterest and substandard academic performance to the teachers' methods of instruction (Bature, 2005). Such students tend to do poorly in mathematics because teachers are unable to explain the subject at their level of understanding.

To achieve the ambitions of both the individual student and Nigeria as a whole, secondary school mathematics education in Nigeria requires constant improvement. According to research by Akinsola (2013), poor performance in mathematics external tests is becoming more prevalent. This might be because some individuals are unaware of how important the subject is to everyday life, especially for people who aspire to become business people and for the country as a whole.

Abdullahi (2018) posited that in order to receive appropriate therapy in the classroom, students fear of mathematics has been recognized as learning ailment, but people are yet to discover the virus that is responsible for it. However, when mathematics is taught and learned in class, the signs of this ailment are constantly visible on the faces of the students. Students who abhor mathematics refuse to increase their interest in the subject in secondary school, and this attitude is carried over to higher educational institutions.

Students are known to leave the classroom early or during mathematics classes under the illusion of taking a break.

The fundamental objective of mathematics is to find remedies for puzzles. All opinions are based on questions like what and how these questions are best answered by putting every assertion into a mathematical statement before seeking for a solution. The depth of a person's mathematical knowledge affected the degree of correctness of their conclusion. This implies that in order to function properly in society, especially in the 21st century, a person must understand or have a good grasp of mathematics. Technology development is firmly rooted in the field of mathematics.

In the view of Okebukola (1992), mathematics is the core academic field of the contemporary technical community. Kerlinger (1985) asserted that mathematics is a language of science. However, according to Aminu (1990), mathematics is not just the language of the sciences but also a fundamental component of reflection, logical analysis, and growth. By pointing out opportunities for improvement, mathematics both frees the mind and offers an assessment of one's ability to think critically. He concluded by saying that mathematics was the basis for all sciences and innovations, and consequently for all human pursuits. The application of mathematics is pervasive across human understanding. Despite the fact that mathematics has a wide range of applications and is quite valuable, many students and young children continue to struggle with the subject due to their repeated failure.

It is accurate to say that the aforementioned elements play a role in why pupils struggle with their math proficiency. The performance of students is still largely influenced by teacher-related factors, notably in mathematics where there are many abstractions. Even if all the other elements still exist, a good math instructor can still assist students by

offering adequate motivational techniques to inspire a love of mathematics in them. Teachers have a crucial role to play in the mathematics curriculum.

As a result, it is feasible to view teachers as being the most important component of mathematical instruction. Teachers are the catalyst and important player in the drive for advancement in our educational system, according to Adesokan (2000). Any effort to teach mathematics relies on them. Any educational system's ability to succeed is primarily dependent on the caliber of teachers that it has access to. Because of this, it is both a requirement and a mark of a successful mathematics teacher to be able to place your students at a level where they can recognize the importance of mathematics and become intrigued and driven to pursue it. Much is expected of instructors because how well students perform in this crucial area primarily depends on the educational techniques, approaches, and encounters they use in the classroom.

Being successful in mathematics is closely related to professional options in the future, influences how much of a student's broad understanding they have learned, and serves as a valid criterion for classifying students into scientific or literary streams. Additionally, mathematical accomplishment can open doors to lucrative careers and high-status positions. Tentama & Abdillah (2019), reported that, according to studies, students who have outstanding educational achievements and accomplishments typically have more options for employment, a higher pay, opportunities for professional development, and better employment perks.

2.4 Conceptual Framework

The relationship between your variables, or the characteristics or features you want to research, is expressed by a conceptual framework, in accordance with Bas Swaen and Tegan George (2022). A conceptual framework is essentially a written or visual product

that outlines the main topics under investigation, key variables, structures, or components, and any presumptive links between them. It acts as a guide for your research, identifying the topics to be investigated and providing guidance on how the data should be arranged and analyzed. A conceptual framework is useful for several things when conducting research. It aids in refining the research questions, makes the study's purpose and issue clear, and guides the procedure for gathering and analyzing data. It serves as the instrument that integrates all aspects of the study so that the researcher and readers can understand it more thoroughly.

Figure 1 displays the conceptual framework for this study. Usefulness of mathematics, interest in mathematics, motivation in mathematics, and achievement in mathematics are the variables in this study. Achievement in mathematics is the dependent variable, while the usefulness of mathematics and mathematical interest are the independent factors. The study's mediator is motivation in mathematics. Our comprehension of the relationships between the independent and dependent variables is enhanced by the connection made by the mediating factor.

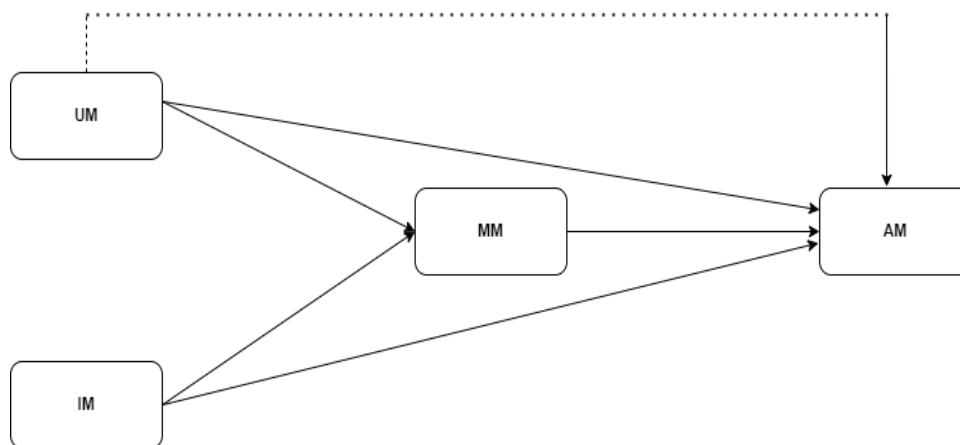


Figure 1: Conceptual Framework

MM: Motivation in Mathematics

IM: Interest in Mathematics

UM: Usefulness of Mathematics

AM: Achievement in Mathematics

CHAPTER THREE

METHODOLOGY

3.1 Overview

In Chapter 3, we will examine the research methodology used. When there is a deficiency in the current data for which reason, it cannot be used to find a solution to a problem under consideration, then research methods are used to obtain fresh data (Kothari 2004). Again, in this chapter, the tools and instruments which the researcher intends to use in the data gathering will be thoroughly examined. Moreover, the population, sample and sampling techniques and procedures will be given a special attention in this chapter. Furthermore, the statistical methods used to establish correlations between collected data and unknown variables within the sample group that will be involved in our research will be examined.

3.2 Research Design

Kirti (2022), wrote that the word "research" is made from of the terms "Re" and "search." Recall that "search" indicates to thoroughly examine or carefully look over anything in order to locate something, while "re" denotes repetition. In many fields of knowledge, new facts, hypotheses, and ideas are established and/or proven through study, according to Kirti (2022). A research design, which McCombes (2019) defines as a research strategy, is a plan or framework used to obtain an answer to a set of predetermined questions. He goes on to say that a study design is an organizational structure that includes the steps and strategies for gathering, analyzing, and interpreting data. The research design for this particular research is descriptive research design. Gathering data in a methodical manner to characterize a circumstance, a phenomenon, or a population is the goal of the descriptive research design. There is no control or manipulation of any of the variables by the researcher while employing this method known as descriptive design.

3.3 Research Paradigm

The term paradigm refers to a collection of guiding principles, beliefs, and assumptions that direct and guide a researcher in his study. The positivist paradigm, which is the focus of this study, is based on the fundamental belief that knowledge can be obtained through objective observation and measurement. Positivism presupposes that answers can be found through thorough measurement and analysis of data, especially numerical data.

3.4 Research Approach

A research approach is defined as the procedure that the researcher chooses to gather, analyze and interpret data. The research approach considered for this study is quantitative. The quantitative research approach is used when the aim of the researcher is to establish cause and effect relationship. It involves gathering and analyzing numerical data.

3.5 Population

In statistics, a population is a group of individuals that are statistically sampled for research. Thus, any selection of individuals grouped together by a common characteristic can be considered a population (Osikhotsali, 2023). The population for the research were all the form three students in Senior High School in the Kumasi Metropolis in the Ashanti region. The form three students would be used since they are more exposed to mathematics and have more experience in mathematical concepts compared to those in form one and form two.

3.6 Sample

The total population of the form three students in the three schools under consideration was 3650. A sample of 120 students was selected from each of the three schools which were used to gather data for this research. This made a total sample of 360 students. This figure was arrived at by using the Yamene's formula for sample determination. Using confidence interval of 95% with 5% (0.05) margin of error, the Yamene's formular was used to calculate the sample size is illustrated below:

$$n = \frac{N}{1+Ne^2}$$

$$n = \frac{3650}{1+3650 \times 0.05^2}$$

$$n = 360.49$$

$$n \approx 360$$

3.7 Sample and sampling procedure

To determine how many students to be sampled from each of the three schools, the population of each school was expressed as a fraction of the population of the three schools (3650) multiplied by the total sample (360). Prempeh College=1020/3650 x 360=100 Kumasi Girls' SHS=1109/3650 x 360=110 and Armed Forces SHS=1521/3650 x 360=150. Since there were five departments, namely: General Science, General Arts, Home Economics, Business and Virtual Art, the sample to be selected from each department was found by dividing the total sample by five.

Cluster random sampling was first used to select clusters from each department. In each school, the classes under each department were put into clusters. For each of these departments, the class representatives were invited to participate in a simple ballot to select their class as a cluster or otherwise for the study. This was done by using cards, some bearing "Yes" and others bearing "No." If a class representative picked "Yes," it

means his or her class would be included in the research. Nonetheless, if a class representative picked “No,” it means his or her class would be excluded from the data collection exercise. The researcher arrived at the classes from each of the departments for the study. To ensure that each students had the same likelihood of being chosen, a simple random sampling method was adopted. In all, the required 360 students were selected for the study.

3.8 Research Instrument

A questionnaire was used by the researcher to collect data for the study since it is effective at swiftly obtaining information from a large number of respondents (Amedahe & Asamoah-Gyimah, 2014). The questionnaire was consisted of two sections, Section A and Section B. In Section A, students were largely asked for demographic data, and in Section B, they were asked for their open opinions on the four main variables under examination. These four variables were interest in mathematics, the usefulness of mathematics, the motivation in mathematics and the achievement in mathematics. This research used one dependent variable, that is performance in mathematics, one mediator, that is motivation in mathematics, and two independent variables, which are usefulness of mathematics and interest in mathematics. The performance of students in mathematics measurement items were adapted from Zhou et al. (2020); students’ interest in mathematics measurement item were developed from Zhang and Wang (2020); those of the usefulness of mathematics were drafted from Fennema (1976) and those of motivation in mathematics were developed from Prast et al., (2018).

There were a total of 40 items on the questionnaire, 10 items for each of the four variables. Although the measurement items were chosen from earlier research, they

were amended in order to suit the current study's primary focus on Usefulness of Mathematics, Interest in Mathematics, Motivation in Mathematics and Achievement in Mathematics.

A sample statement under Usefulness of Mathematics was “Learning mathematics helps me learn other subjects;” that of Motivation in Mathematics was “My teacher motivates me to do mathematics;” that of Interest in Mathematics was “I wish mathematics lessons never end whenever we are learning mathematics;” and that of Achievement in Mathematics was “I score higher grades in mathematics than in other subjects.” The questionnaire was made up of predominantly close ended items and the statements had 5-point Likert scale responses (1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree, and 5=Strongly Disagree) asking students to tick in the box indicating the response they deem suitable to the item being considered. Three mathematics education professionals with over ten years of experience in teaching were given the tool for review and scrutiny. Their approval and management were based on their suggestions for improvement.

3.9 Data Collection Procedure

The researcher obtained an introduction letter from the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development's mathematics department. The introductory letter was sent to the three schools where the data were to be collected. This was to seek the consent and permission of the school authorities concerned ahead of time. It was also to notify the mathematics departments of the schools to ensure they offer their assistance during the collection process. With consent from the authorities of the schools and assistance from the mathematics teachers in the schools under consideration, the questionnaires were administered to students and

collected after thirty minutes. All the 360 questionnaires were received from the participants indicating an 100% return rate.

All the 360 questionnaires received were used for the data analysis since they were all completely and appropriately responded to by the students. This indicates a 100% valid response rate.

3.10 Reliability of the Questionnaire

The questionnaire did not elicit any information that required participants to identify themselves in order to guarantee students' privacy and freedom from disclosure. Once more, the researcher made sure that the instruments were pre-tested to ensure that they were reliable. Significantly, this action helped the researcher to identify and clarify any potential ambiguous questions. Additionally, any other threats and challenges which could mar the success of the study were identified and subsequently addressed. Cronbach's alpha (CA) was also used to evaluate the observed variables' internal consistency. The CA of the retained items of the various variables under study was calculated using SPSS (v.23). It should be noted that when the CA score is at least 0.7, there is an achievement of the reliability of the observed variables. Table 6 presents the reliability analysis. In the said analysis, the CA of all the latent variables were above 0.7 which is an indicative of the achievement of internal consistency. The CA score of Usefulness of Mathematics was 0.953, the CA score of Mathematics Motivation was 0.927, the CA of Mathematics Interest was 0.974 and that of Mathematics Achievement was 0.984.

3.11 Validity of the Questionnaire

The instrument was given to the supervisor, a subject-matter expert, to determine validity. Then the supervisor painstakingly cross-checked if the items were well constructed. It was after this, that the supervisor gave the researcher the final approval to go and administer the questionnaire.

3.12 Data Analysis Procedure

In order to analyze the study's data, quantitative approaches were used. Quantitative data was coded and entered into the computer programs SPSS (version 23) and AMOS (version 23) to facilitate research analysis. Then, quantitative data was analyzed via the Structural Equation Model (SEM). In order to apply generalization and forecast the outcomes, the analysis of the collected data was carried out in order to highlight the essential traits and connections between the data.

3.13 Ethical consideration

The researcher saw that all research ethics were strictly followed. Following the respondents' assent to take part in the study, the data was managed with extreme confidentiality while preserving anonymity. The goal and scope of the research were explained to the respondents by the researcher. The explanation provided persuaded the participants, who unhesitatingly provided their consent. All those who responded were shielded by the researcher from danger of any kind, including political, psychological, and bodily injury. The data the researcher gathered and provided did not in any manner reveal participants' identities, ensuring the confidentiality of the participants.

CHAPTER FOUR

ANALYSIS AND DISCUSSION OF RESULTS

4.1 Overview

The analysis and discussion of the study's findings are covered in detail in this chapter.

This chapter contains the answers to all of the research questions that were posed for the study.

4.2 Demographic Characteristics of Respondents

Table 1: Demographic Characteristics of Respondents

<i>Demographics</i>	<i>Frequency (N)</i>	<i>Percentage (%)</i>
<i>Gender</i>	<i>360</i>	<i>100.0</i>
Male	190	52.8
Female	170	47.2
<i>Age</i>	<i>360</i>	<i>100.0</i>
14 – 16 years	66	18.3
17-19 years	284	78.9
20 years and above	10	2.8
<i>Programme of Study</i>	<i>360</i>	<i>100.0</i>
General Arts	72	20.0
Science	95	26.4
Business	64	17.8
Visual Arts	63	17.5
Home Economics	66	18.3
<i>Track</i>	<i>360</i>	<i>100.0</i>
Green	268	74.4
Gold	92	25.6

Demographics Frequency (N) Percentages (%) Gender Male 190 52.8 Female 170 47.2 Total 360 From table 1, out of three hundred and sixty respondents, 52.8% were males and 47.2% were females. 18.3% were at the age range from fourteen (14) to sixteen (16), 78.9% were at the age range from seventeen (17) to nineteen (19), and 2.8% were above twenty (20) years or above. 20% were General Arts students, 26.4% were science students, 17.8% were Business students, 17.5% were Visual Art students' and 18.3% were Home Economics students. 47% of the students were green track students and 25.6% of the students were gold track students.

4.3 Results of Analysis

4.4 Preliminary Analysis

To determine whether the study's data were acceptable, preliminary analysis was carried out. Mean and standard deviation (to check for normality), exploratory and confirmatory factor analyses, discriminant analysis, reliability analysis, and path analysis are among the early analyses carried out for this project.

4.4.1 Exploratory Factor Analysis

The EFA was calculated using SPSS (ver. 23). In order to find out how each of the observable variables loaded on the appropriate latent variable, EFA was employed to analyze the linked factors. This was a method of reducing or eliminating some of the observed variables from the survey whose loading wasn't in the proper place relative to the latent variable. The final EFA is shown in Table 2 and shows the observed variables under their correct latent variables.

Table 2: Exploratory Factor Analysis (EFA)

Rotated Component Matrix				
<i>Measurement</i>	Component			
<i>Items</i>	1	2	3	4
<i>UM5</i>		.943		
<i>UM6</i>		.854		
<i>UM7</i>		.914		
<i>UM8</i>		.903		
<i>MM1</i>				.947
<i>MM2</i>				.938
<i>MM5</i>				.938
<i>IM1</i>			.906	
<i>IM2</i>			.917	
<i>IM3</i>			.921	
<i>AM1</i>	.939			
<i>AM2</i>	.938			
<i>AM3</i>	.912			
<i>AM4</i>	.916			
<i>AM8</i>	.922			
<i>AM9</i>	.934			
<i>AM10</i>	.930			
<i>KMO and Bartlett's Test</i>				
Total Variance Explained				87.175%
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.				.874
Bartlett's Test of Sphericity		Approx. Chi-Square		9551.761
		Df		153
		Sig.		0.000
a. Determinant				1.662E-12

The analysis in Table 2 indicates how many observed variables are loaded onto the corresponding latent variables on the right. Further data analysis employed observed

variable loading larger than 0.5 and under the right latent variable. It was identified that a number of observed variables in their right definiteness for Usefulness of Mathematics has four (4) items, Mathematics Motivation has three (3) items, mathematics interest has three (3) items, and Mathematics Achievement with seven (7) items. With a Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of 0.874, the determinant's coefficient was calculated to be 1.662E-12. The KMO provided an explanation for the observed variables loading in the right dimension on the latent variables in 87.4% of the cases. A significant p-value of 0.000 was observed by Bartlett's Test of Sphericity from a Chi-square of 9551.761 and a degree of freedom of 153. The four latent variables also showed a cumulative variance of 87.175%, in addition to the EFA. All other observed variables, nevertheless, that were not correctly positioned on the rotated component matrix were eliminated. The final EFA is shown in Table 2 and shows the observed variables next to their correct latent variables.

4.4.2 Descriptive Analysis

Descriptive analysis was also used in the study. This was used to test the questionnaire's normality using the mean and standard deviation. In table 3, the findings for each construct piece are displayed. The researcher was notified that the normality test was successful by the mean and standard deviation for each construct.

Table 3: Descriptive Analysis

Variable	Mean	Std. Deviation
<i>Usefulness of Mathematics (MATH_USE)</i>	2.1819	.61057
<i>UM5: I will pursue mathematics related course in future</i>	2.3750	1.26928
<i>UM6: Learning Mathematics helps me learn other subjects</i>	2.1722	1.18642
<i>UM7: Mathematics is the best among all the subjects I study</i>	2.3111	1.22094
<i>UM8: I will get good job in future if I learn mathematics</i>	2.4500	1.31533
<i>Mathematics Motivation (MATH_MOT)</i>	1.9593	1.02742
<i>MM1: My teacher motivates me to do mathematics</i>	1.9417	1.09159
<i>MM4: I study on my own the lesson I missed in class</i>	1.9861	1.11327
<i>MM5: I find extra time to practice mathematics</i>	1.9500	1.09583
<i>Mathematics Interest (MATH_INT)</i>	2.2175	1.09437
<i>IM1: I feel happy in solving mathematics</i>	1.8583	1.04997
<i>IM2: I enjoy learning mathematics</i>	1.8417	1.03420
<i>IM3: Mathematics is not a boring subject to me</i>	1.8417	1.03689
<i>Mathematics Achievement (MATH_ACH)</i>	2.2435	.88435
<i>AM1: I perform well in mathematics</i>	2.2028	1.1396
<i>AM2: I think I am good in mathematics</i>	2.2111	1.15143
<i>AM3: My friends think I am successful at mathematics</i>	2.2194	1.14135
<i>AM4: I see myself as successful student in mathematics</i>	2.2056	1.13539
<i>AM8: I am able to solve questions without my teacher's assistance</i>	2.2861	1.13630
<i>AM9: I am able to answer questions during mathematics lessons</i>	2.2111	1.13191
<i>AM10: I get good grades in mathematics exams</i>	2.1861	1.17605

Table 3 explains how the descriptive statistics for each of the latent variables were analyzed. usefulness of mathematics, mathematics motivation, mathematics interest and achievement using their mean scores and each corresponding standard deviation.

From table 3, the total mean score of student Mathematics Achievement was reported as 2.2435 and a standard deviation of .88435.

Among each of the observed items which loaded under Mathematics Achievement, the lowest mean score was obtained for the question item 10 “I get good grades in mathematics exams” (M= 2.1861, SD= 1.17605) while its highest mean value was identified on the item 8 “” (M= 2.2861, SD= 1.13630). It was identified that the item 3 “My friends think I am successful at mathematics” showed a mean of 2.2194 and a standard deviation of 1.14135 as the second highest mean. These mean scores lied within 2.1 to 2.3

Descriptive analysis of mathematics motivation had a total mean score of (M= 1.9593, SD = 1.02742). The mean score of item 1 “My teacher motivates me to do mathematics” had a mean of 1.9417 and a standard deviation of 1.09159. This is seen to be the lowest score of the mean while item 4 “I study on my own the lesson I missed in class.” (M= 1.9861, SD= 1.11327) showed the highest mean score among all the items under teaching quality. Item 5 “I find extra time to practice mathematics” (M= 1.9500, SD= 1.09583) was reported as the second highest among the other observed variables. These mean scores lied within 1.9 to 2.0.

Descriptive analysis of mathematics interest had a total mean score of (M= 2.2175, SD= 1.09437). The mean score of item 1 “I feel happy in solving mathematics” had a mean of 1.9417 and a standard deviation of 1.09159. This is seen to be the lowest score of the mean while item 3 “Mathematics is not a boring subject to me.” (M= 1.8417, SD= 11.03689) showed the highest mean score among all the items under teaching quality. Item 2 “I enjoy learning mathematics” (M= 1.8417, SD= 1.03420) was reported as the second highest among the other observed variables. These mean scores lied within 1.9 to 2.1.

Lastly, the descriptive analysis of usefulness of mathematics has a total mean of 2.1819 with a standard deviation of .61057. The range of mean of the observed item was within 2.1 to 2.5. The highest item has a mean of 2.4500 and a standard deviation of 1.31533 for 8 “I will get good job in future if I learn mathematics” while the least mean of the observed item was 6 “” (M = 2.1722, SD = 1.18642).

4.4.3 Confirmatory Factor Analysis Results

Amos (ver. 23) was used to calculate CFA. The CFA is used to estimate various statistical tests, which indicates that it has more applications than other statistical analysis (Arthur et al., 2022). The CFA analysis is defined in Table 3. The observed variables from the rotated components were used to examine the CFA following the EFA. The CFA was examined using factor loading larger than 0.4, and observable variables from the EFA with weak factor loading below 0.5 were eliminated. Table 3 shows that there were four variables for Mathematics Usefulness, three for Mathematics Motivation, three for Mathematics Interest, and seven for Mathematics Achievement. Variables eliminated under each construct had inadequate factor loading, which was evident from the EFA results.

Table 4: Confirmatory Factor Analysis (CFA)

Model Fit Indices: CMIN = 210.258; DF = 97; CMIN/DF = 2.168 ; Factor
TLI = .983; CFI = .988 ; RAMSEA = .057; SRMR = ; PClose = .132 Loadings

Usefulness of Mathematics (MATH_USE): CA = .953; CR = .964;
AVE = .871;

<i>UM5: I will pursue mathematics related course in future</i>	<i>.988</i>
<i>UM6: Learning Mathematics helps me learn other subjects</i>	<i>.906</i>
<i>UM7: Mathematics is the best among all the subjects I study</i>	<i>.924</i>
<i>UM8: I will get good job in future if I learn mathematics</i>	<i>.912</i>

Mathematics Motivation (MATH_MOT) : CA = .927; CR = .931;
AVE = .819;

<i>MM1: My teacher motivates me to do mathematics</i>	<i>.951</i>
<i>MM4: I study on my own the lesson I missed in class</i>	<i>.788</i>
<i>MM5: I find extra time to practice mathematics</i>	<i>.965</i>

Mathematics Interest (MATH_INT) : CA = .974; CR = .975; AVE
= .928;

<i>IM1: I feel happy in solving mathematics</i>	<i>.923</i>
<i>IM2: I enjoy learning mathematics</i>	<i>.976</i>
<i>IM3: Mathematics is not a boring subject to me</i>	<i>.990</i>

Mathematics Achievement (MATH_ACH) : CA = .984; CR = .983;
AVE = .895;

<i>AM1: I perform well in mathematics</i>	<i>.966</i>
<i>AM2: I think I am good in mathematics</i>	<i>.951</i>
<i>AM3: My friends think I am successful at mathematics</i>	<i>.934</i>
<i>AM4: I see myself as successful student at mathematics</i>	<i>.934</i>
<i>AM8: I am able to solve questions without my teacher's assistance</i>	<i>.933</i>
<i>AM9: I am able to answer questions during mathematics lessons</i>	<i>.957</i>
<i>AM10: I get good grades in mathematics exams</i>	<i>.946</i>

Amoako et al. (2022) discussed the certainty of the fit of the model of the CFA in Table 4 analysis, stating that the values of CMIN/DF (chi-square value over the degree of freedom), RMR (Root mean square residual), and RMSEA (Root mean square Error of

Approximation) should be less than 3, 0.08 for the root mean square error of approximation, and at least 0.9 for the Tukey Lewis Index and comparative fit index. According to Amoako et al. (2022), CMIN makes sure that there is at least a discrepancy value, while RMR and RMSEA define the complete fit index by calculating the model's departure from the numerous hypotheses put forth. The TLI and CFI values, on the contrary hand, are created in parts of the normal theory on continuous data that predicted the line of reference fit of the model. The diagram of the confirmatory factor analysis was displayed in Figure 2 below.

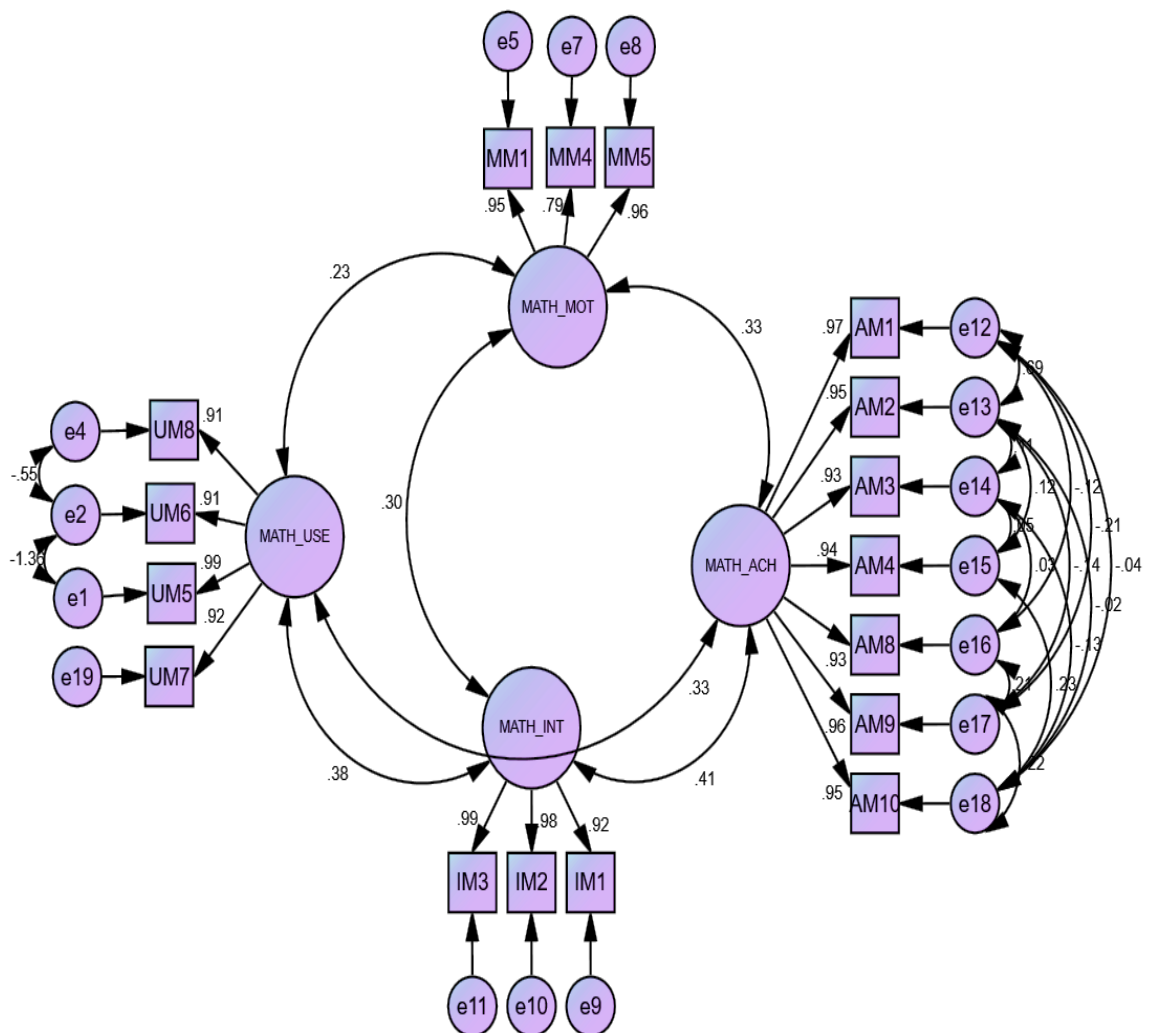


Figure 2: Confirmatory Factor Analysis
 Source: Field Survey (2023)

4.4.4 Discriminant Validity

To assess the convergent validity and reliability of the resulting observed variables that estimated the CFA, the average variance extracted (AVE) and composite reliability (CR) were determined. Convergent validity assesses how strongly each observed item correlates with the other observed variables on the same construct (dos Santos & Cirillo, 2021). It is recommended that the AVE and CR have expected values of at least 0.5 and 0.7, respectively. The AVE and CR were calculated for further analysis of the study and to achieve convergence validity. The results confirm at least AVE =.819 and CR =.931, which satisfies the criteria for AVE and CR by Dogbe et al., (2020). The technique of other researchers, such as Arthur (2022), who explained that discriminant validity is acquired when AVE has a value above the correlation coefficient, which the coefficient values were derived from the CFA output using the covariance, was used to evaluate the discriminant validity. Table 5 compares the \sqrt{AVE} and associated latent variable association.

Table 5: Discriminant Validity

Variable	<i>MATH_USE</i>	<i>MATH_INT</i>	<i>MATH_MOT</i>	<i>MATH_ACH</i>
<i>MATH_USE</i>	.933			
<i>MATH_INT</i>	.376***	.963		
<i>MATH_MOT</i>	.232***	.298***	.905	
<i>MATH_ACH</i>	.329***	.407***	.326***	.946

Note: *** ~P-value Sig. at 1% ; \sqrt{AVE} are in italics.

According to Table 5, where the lowest AVE value is .905 and the greatest correlation coefficient is .407, the least AVE value is bigger than the highest value for correlation of the latent variables. It is clear from this why discriminant validity is attained.

4.4.5 Reliability Analysis

Using Cronbach's alpha, reliability analysis was computed using SPSS (version 23). The study was performed to examine the latent variables' internal consistency. Table 6 includes a summary of the reliability analysis. The coefficients for the usefulness of mathematics, motivation in math, interest in mathematics, and achievement in mathematics are displayed as .953, .927, .974, and .984 correspondingly. In conclusion, the reliability coefficients for the four constructs used in the current study are higher than the 0.7 minimal requirement.

Table 6: Reliability Analysis

<i>Variables</i>	<i>Number of items</i>	<i>Cronbach's Alpha Value</i>
Usefulness of Mathematics	4	.953
Mathematics Motivation	3	.927
Mathematics Interest	3	.974
Mathematics Achievement	7	.984

4.5 Path Estimates

Table 7 analyzes the course of the numerous direct effects on the study's hypothesis. The path analysis provides a method of separating the association between the different independent variables and the dependent variables, which confirms the hypotheses put forth by previous scholars. The Structured Equation Model (SEM) from Amos (ver. 23) was used to examine this. Table 7 shows the impact of the independent (latent) factors (usefulness of mathematics, mathematics motivation, and mathematics interest) and the control variables (gender, age, program, and track) on the dependent variable (mathematics achievement).

Table 7: Direct Path

<i>Direct Path</i>	<i>Std. Estimate</i>	<i>S.E</i>	<i>C.R</i>	<i>P-Value</i>
<i>Gender</i> → <i>MATH_ACH</i>	<i>-.100</i>	<i>.102</i>	<i>-.978</i>	<i>.328</i>
<i>Age</i> → <i>MATH_ACH</i>	<i>.039</i>	<i>.118</i>	<i>.328</i>	<i>.743</i>
<i>Programme</i> → <i>MATH_ACH</i>	<i>.040</i>	<i>.036</i>	<i>1.101</i>	<i>.271</i>
<i>Track</i> → <i>MATH_ACH</i>	<i>.282</i>	<i>.117</i>	<i>2.414</i>	<i>.016</i>
<i>MATH_MOT</i> → <i>MATH_ACH</i>	<i>.215</i>	<i>.053</i>	<i>4.021</i>	<i>.000</i>
<i>MATH_INT</i> → <i>MATH_ACH</i>	<i>.302</i>	<i>.059</i>	<i>5.082</i>	<i>.000</i>
<i>MATH_USE</i> → <i>MATH_ACH</i>	<i>.174</i>	<i>.044</i>	<i>3.938</i>	<i>.000</i>
<i>MATH_USE</i> → <i>MATH_MOT</i>	<i>.193</i>	<i>.043</i>	<i>4.445</i>	<i>.000</i>
<i>MATH_USE</i> → <i>MATH_INT</i>	<i>.251</i>	<i>.038</i>	<i>6.524</i>	<i>.000</i>
<i>MATH_MOT</i> → <i>MATH_INT</i>	<i>.208</i>	<i>.047</i>	<i>4.388</i>	<i>.000</i>

From table 7, with a p-value $>.050$ ($\beta = -1.00$; C.R = $-.978$), it can be seen that gender has a detrimental effect on students' math proficiency but is statistically insignificant. Additionally, with a p-value $>.05$ ($\beta = .039$; C.R = $.328$), age of respondents has a favorable influence and is statistically insignificant on students' math achievement. Additionally, the course of study has a favorable impact on students' math achievement while being statistically unimportant (p-value > 0.05 ($\beta = .040$; C. R = 1.101)). Finally, the school's track program has a favorable effect and is statistically significant on students' achievement in mathematics, with a p-value $<.05$ ($.282$; C.R = 2.414).

4.5.1 Research Question One: What is the impact of usefulness of mathematics on students' mathematics achievement?

The first research question sought to find the impact of usefulness of mathematics on students' mathematics achievement. This was answered by the direct effect analysis (*MATH_USE* → *MATH_ACH*) from table 7. Usefulness of mathematics has a direct positive effect on mathematics achievement as a predictor with a p-value < 0.01 . The

results of the analysis showed that relationship between usefulness of mathematics and mathematics achievement had a p-value of 0.000 which was statistically significant at 1%. Results on the hypothesized paths indicate that usefulness of mathematics had a direct positive impact on mathematics achievement among senior high school students ($\beta = 0.174$; C.R. = 3.938). This means that about 17.4% of the improvement in the mathematics achievement of high school students is experienced, when students know the usefulness of mathematics.

4.5.2 Research Question Two: What is the effect of mathematics motivation on students' mathematics interest?

The second research question sought to find the effect of mathematics motivation on students' mathematics interest. This was answered by the direct effect analysis (MATH_MOTI→MATH_INT) from table 7. Mathematics motivation has a direct positive effect on students' mathematics interest as a predictor with a p-value < 0.01. The results of the analysis showed that relationship between mathematics motivation and mathematics interest had a p-value of .000 which was statistically significant at 1%. Results on the hypothesized paths indicate that mathematics motivation had a direct positive impact on students' mathematics interest ($\beta = .208$; C.R. = 4.388).

4.5.3 Research Question three: What is the impact of interest of mathematics on students' mathematics achievement.

The third research question sought to find the impact of mathematics interest on students' mathematics achievement. This was answered by the direct effect analysis (MATH_INT→MATH_ACH) from table 7. Mathematics interest has a direct positive effect on mathematics achievement as a predictor with a p-value < 0.01. The results of

the analysis showed that relationship between mathematics interest and mathematics achievement had a p-value of 0.000 which was statistically significant at 1%. Results on the hypothesized paths indicate that mathematics interest had a direct positive impact on mathematics achievement among senior high school students ($\beta = 0.302$; C.R. = 5.082). This means that about 30.2% of the improvement in students' mathematics achievement of high school students is experienced, when their mathematics interest is enhanced.

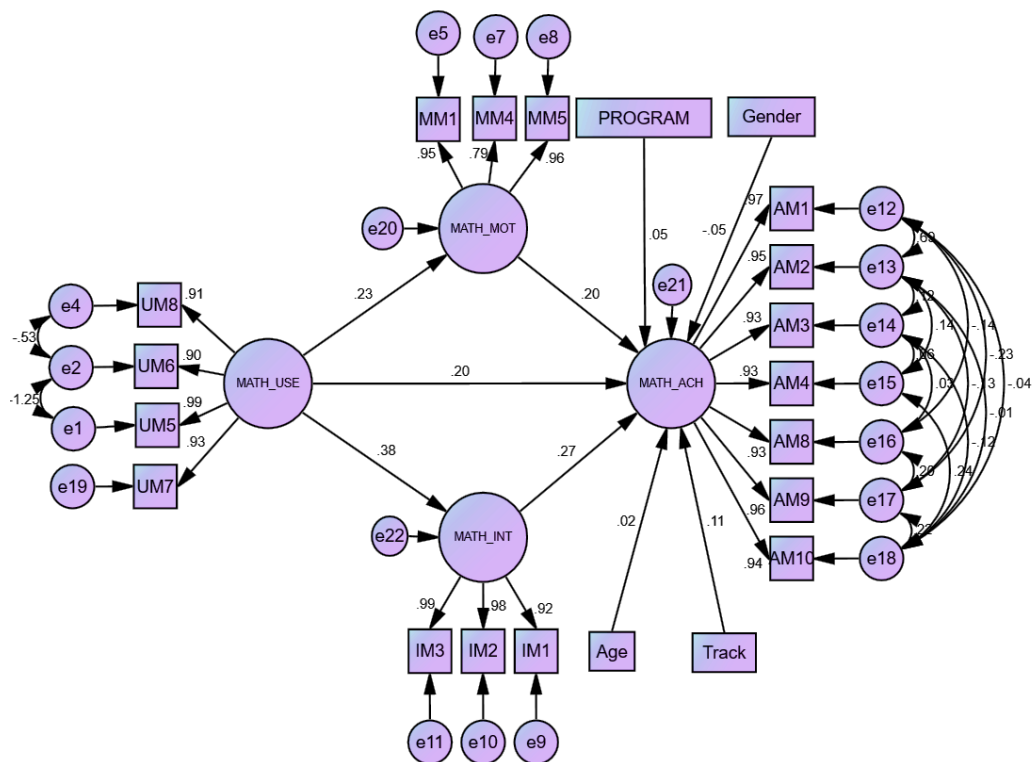


Figure 3: Path Analysis
 Source: Field Survey (2023)

4.5.4 Research Question Four: What is the mediating effect of mathematics motivation between usefulness of mathematics and mathematics achievement?

Table 8: Indirect Path

<i>Path effect</i>	<i>Std. Estimate</i>	<i>S.E</i>	<i>C.R</i>	<i>P-Value</i>
<i>MATH_USE</i> → <i>MATH_ACH</i>	.235	.044	5.366	.000
<i>MATH_USE</i> → <i>MATH_MOT</i>	.192	.043	4.435	.000
<i>MATH_MOT</i> → <i>MATH_ACH</i>	.280	.054	5.143	.000
<i>Indirect effect</i>	<i>Std. Estimate</i>	<i>Lower BC</i>	<i>Upper BC</i>	<i>P-Value</i>
<i>MATH_USE</i> → <i>MATH_MOT</i> → <i>MATH_ACH</i>	.118	.037	.288	.001

From table 8, usefulness of mathematics has a direct positive impact and statistically significant on mathematics achievement with p-value less than 1% ($\beta = .450$; C.R = 3.595). This means that, 45% improvement of students' mathematics achievement is by usefulness of mathematics. Moreover, Usefulness of mathematics has a positive effect and statistically significant on students' mathematics motivation with p-value < 1% ($\beta = .319$; C.R = 4.029). Also, Mathematics motivation has a positive effect and statistically significant on students' mathematics achievement with p-value < 1% ($\beta = .796$; C.R = 4.125). The indirect effect size of .118 was statistically significant with p-value less than 1%, as shown in Table 8 (zero does not lie within the range of the lower bound =.037 and the upper bound =.288). This means that, mathematics motivation partially mediates the relationship between usefulness of mathematics and students' mathematics achievement. The study further explains that, without the mediating variable (mathematics motivation), usefulness of mathematics has a positive effect and statistically significant on students' achievement in mathematics.

4.6 Discussion of Results

This section focuses on the results obtained from the study. The interpretations with respect to analysis of previous studies are given a special attention in this section. The discussion is organized under the study's objectives as follows:

1. The impact of usefulness of mathematics on students' mathematics achievement.
2. The effect of mathematics motivation on students' mathematics interest
3. The impact of students' mathematics interest on mathematics achievement.
4. The mediating effect of mathematics motivation between usefulness of mathematics and mathematics achievement

4. 6.1 Relationship Between usefulness of mathematics and students' achievement

Evidently, the knowledge of how useful something is catapults people to invest their time and other resources in it, and this is the view of some practitioners and some researchers. The usefulness of mathematics is a very important attribute in mathematics achievement. According to the study's analysis, usefulness of mathematics has a direct positive effect on mathematics achievement. The results of the analysis showed that the relationship between usefulness of mathematics and mathematics achievement was statistically significant, which support a number of writings and literature works of many researchers. For instance, Guy et al., (2015) conducted a study to ascertain the correlation between mathematics usefulness and mathematics success. They came to the conclusion that mathematics usefulness is a positive predictor of success. According to Adelson et al., (2011) the perceived usefulness is the opinion students have regarding the applicability or significance of mathematics in both the present and the future. They also stated that learners' broad views about the subject, mathematics which will

ultimately improve their academic success in the subject, are directly influenced by how they view the important nature of mathematics. The work of Eccles & Harold (1991), clearly supports the findings of this research. In their work, they intimated that, discovering a meaning and significance in one's task may additionally promote participation on the part of students, their growth of competence, an improvement in performance. Similarly, the conclusion made by Güvendir (2016) attests to the fact that the usefulness of mathematics leads to academic achievement. He defined extrinsic motivation as "perceptions of mathematics usefulness in daily life," and then stated that students who think mathematics is relevant and beneficial perform better in mathematics than their counterparts who think otherwise. This study showed that there is 17.4% of the improvement in the mathematics achievement of high school students is experienced, when students know the usefulness of mathematics.

4.6.2 Relationship between mathematics motivation and students' mathematics interest

The study found out that there exists a direct positive effect on mathematics motivation and students' mathematics interest. In other words, mathematics motivation has a direct positive effect on students' mathematics interest. The findings of this study also revealed a statistically significant correlation between mathematics motivation and students' mathematics interest. There are a lot of writings that support this finding of the study. Various researchers have uncovered this positive correlation between these two variables. These researchers believe that in order to enhance the interest of students in learning mathematics, motivation should be regarded as a crucial factor. For example, Yeh et al., (2019) asserted that a low level of motivation results in low interest in learning mathematics and hence low achievement. Admittedly, from the work of

these researchers, a high level of motivation will arouse and sustain the interest of students in learning mathematics which will result in a better performance of students.

This assertion then confirms that the students' interest and their academic achievements are correlated.

Again, the findings of Smith et al., (2012) discovered that motivation ignites students' interests in a variety of academic fields and consequently results in improvement performance, particularly in mathematics. This means that, the higher the motivation, the more interested students become in learning mathematics.

4.6.3 Relationship between students' interest in mathematics and students' achievement

The study's findings showed that there was a statistically significant correlation between students' mathematics interest and mathematics achievement, something that can be supported by a lot of assertions by various researchers and educators. It can be reported from the findings of the study that mathematics interest has a direct positive effect on mathematics achievement.

Singh et al., (2002) studied interest as one of the attitudinal and influential variables that are predictors of students' achievement in learning or avoidance of learning mathematics. They stated categorically that lack of interest in learning mathematics results in low achievement. This then presupposes that any teacher who is able to arouse and sustain the interest of his students in their mathematics education will see his students do well. Yeh et al., (2019) asserted that the abstract nature of mathematics makes it difficult for students to have interest in the subject. Consequently, this loss of interest in the subject leads to low achievement. Conversely, high interest in mathematics leads to high achievement. Summer (2020) reiterated that apart from an

abstraction of mathematics causing low interest in students, having disaffection for mathematics is a recipe for low performance about learning mathematics also has contributed to disliking the subject. The study conducted by Toli et al., (2021) studied the basic characteristics of interest, which they identified as increased attention, efforts, effects and experience. In the end, it came too light that students' interest and their learning outcomes or performance are positively correlated. In other words, they discovered that interest influences students' performance. The study of Azmidar et al., (2017) highlighted student interest as one important factor that affect their performance. Their conclusion, which was students who exhibit a high level of interest in learning mathematics do well in the subject and vice versa really supports this research finding. Again, the findings of this present study are also in accordance with the study of Reeve et al., (2015), which posited that interest students have in learning mathematics catapults them to crave for having mathematical knowledge eventually promotes their achievement in mathematics. Similarly, according to Luzano (2023), students' reduced interest in learning mathematics may be another factor that contributes to low success in mathematics. This presupposes that reduced interest leads low academic achievement, whereas increased interest fosters high academic achievement. Furthermore, the research by Tsoto et al., (2016) is in support of the findings of this current research. In their research, they concluded that the idea that the interests of students foster their accomplishments in mathematics and that these interests have been proven to increase the drive of learners to study mathematics and have a bearing on their academic performance.

Additionally, the work of Nosek et al., (2002), to ascertain what influences students' choices when it comes to mathematics-related courses at the tertiary level supports the findings of this current study. They concluded in their study that lower interest is closely

related to lower performance on math-related achievement tests and lower grades in mathematics, less interest in taking rigorous mathematics curricula before enrolling in tertiary (Nosek et al., 2002). Also, Zhang and Wang (2020) discovered that, students' interests in mathematics directly and positively affect their performance in mathematics.

4.6.4 The mediating effect of mathematics motivation between usefulness of mathematics and mathematics achievement

The mediating analysis (indirect path) was the main focus of this present study. Motivation in mathematics was used as a mediator between usefulness of mathematics and mathematics achievement. This means that, mathematics motivation partially mediates the relationship between usefulness of mathematics and students' mathematics achievement. The study further explains that, without the mediating variable (mathematics motivation), usefulness of mathematics has a positive effect and statistically significant on students' achievement in mathematics.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the major findings from the study based on the data analysis. From the findings of the study, conclusions and recommendations will also be made in this chapter.

5.2 Summary

This study is purposely designed to find out whether usefulness of mathematics and interest enhance the achievement of students in mathematics in Senior High Schools in the Kumasi Metropolis in the Ashanti Region using motivation as a mediator. Students from three schools, namely Prempeh College, Kumasi Girls' Senior High School and Armed Forces Senior High School were used as respondents for the questionnaire designed for the study. The study employed quantitative design which was a descriptive survey approach. In all, three hundred and sixty (360) students were selected through a random simple random technique. The items on the questionnaire for collecting data were all adapted from previous research work. However, the items were modified to suit the variables under study as far as this study was concerned. Structural Equation Model (SEM) from Amos (version 23) was used for the data analysis. The analysis made in this study included the following: Exploratory Factor Analysis, Confirmatory Factor Analysis, Direct Path Effect, Discriminant Validity and Indirect Effect Analysis. Based on the study's data analysis, the following findings were made.

1. With respect to the demographic information, gender has a negative effect and statistically insignificant on mathematics achievement of the students. Moreover, age of the respondents has a positive effect and statistically

insignificant on student's mathematics achievement. Also, program of study has a positive effect and statistically insignificant on student's mathematics achievement. Finally, track system of the school has a positive impact and statistically significant on student's mathematics achievement.

2. Usefulness of mathematics has a direct positive effect on mathematics achievement and is seen to be statistically significant.
3. Knowledge of the usefulness of mathematics improved the achievement of high school students by 17.4%.
4. Mathematics motivation and students' mathematics interest were positively, statistically and significantly correlated.
5. Students' mathematics interest was seen to have a direct impact on their mathematics achievement.
6. The relationship between mathematics motivation and mathematics interest was reported as significant at 1%.
7. Mathematics motivation partially mediated the relationship between usefulness of mathematics and students' mathematics achievement.

5.3 Conclusions

The researcher would like to make the following conclusions which are based on the study's findings.

First, it can be concluded that students' knowledge of the usefulness of mathematics enhances their achievement. The study's data shows 17.4% improvement in the mathematics achievement of students in the three selected schools when students know the usefulness of mathematics in both their daily life and career. It is therefore the

responsibility of mathematics teachers to not only teach students to be mathematically competent, but to also create awareness of the usefulness and relevance of mathematics. Second, the findings of the study revealed to the researcher that mathematics motivation has the potency of positively influencing students' interest in learning the subject. This means that the more the stakeholders of education, that is government, parents, teachers and what have you motivate students to learn mathematics, there more students become interested to learn this all-important subject.

Third, it can be concluded based on the findings of the study that, students' mathematics interest is an extremely important factor in enhancing the achievement of students in mathematics. This was evidenced in the fact that students' mathematics interest was statistically significant with achievement. The data of the study indicates 30.2% improvement in students' mathematics achievement in high school students in the schools under consideration when their mathematics interest is enhanced.

Fourth, the results obtained from the data analysis revealed that mathematics motivation partially mediated the relationship between usefulness of mathematics and students' mathematics achievement.

5.4 Recommendations

The following recommendations were made based on the available results of this study.

1. It was recommended that all the stakeholders of education, government, teachers, parents and so on must intrinsically and extrinsically motivate students when it comes to the study of mathematics.
2. The management of the school must periodically organize workshops and seminars to sensitize students on the usefulness of mathematics in both their daily lives and future.

3. Teachers must professionally upgrade themselves from time to time in order to become abreast with the new motivational teaching strategies in our technologically-oriented world.
4. Teachers must use teaching methods and strategies that will make mathematics interesting and practical to students to alleviate students' level of mathematics phobia associated with their study of mathematics.
5. The school management and mathematics educators must endeavor to unravel the usefulness of mathematics to one's career and daily life to students to encourage them to vigorously and assiduously study mathematics.
6. It was recommended that further studies be carried out in other parts of the country to investigate the mediating role of motivation on the usefulness of mathematics and the interest of students owing to the fact that this present study focused on only three schools in the Kumasi metropolis of the Ashanti region.

REFERENCES

- Abd Algani, Y.M. (2022). Role, need and benefits of mathematics in the development of society. *Journal for the Mathematics Education and Teaching Practices*, 3(1), 23-29.
- Abdullahi, A. D. (2018). Meeting the needs of sustainable development in Africa through engineering research and innovation in mathematics education: students' attitude as a predictor of academic achievement. *World Educators Forum*, Vol. 10 No. 1, Issn: 2350-2401.
- Adelson, J. L., & McCoach, D. B. (2011). Development and psychometric properties of the math and me survey: measuring third through sixth graders' attitudes toward mathematics. *measurement and evaluation in counselling and development*, 44(4), 225-247. Retrieved from https://journals.sagepub.com/doi/pdf/10.1177/0748175611418522?casa_token.
- Ai, X. (2002). Gender differences in growth in mathematics achievement: Three-Level longitudinal and multilevel analyses of individual, home, and school influences. *Mathematical thinking and learning*, 4(1), 1-22.
- Aiken, L. R. (1985). *Psychological testing and assessment*. London: *Allyn and Bacon, Inc.*
- Ajani, T. O., & Popoola, B. A. (2013). Effect of emotional intelligence mathematics teaching anxiety and self-concept of pre-service teachers' achievement in mathematics. *Proceedings of September 2013 Annual National Conference, MAN*
- Akinsola, M. K., & Olowojaiye, F. B. (2008). *Teacher instructional methods: Students attitudes towards mathematics*, volume 3,1.

- Akinsola, M. O. (2013). Helping teacher time underachievement in mathematics the attitude dimension. *Paper* presented at the honouring ceremony of fellows of the mathematical association of Nigeria (FMAN), Oyo State Branch.
- Alagic, M. (2007). Innovations in mathematics education via the arts BIRS - Workshop 07w5062 22–26. *Journal of mathematics and the arts*, 1(3), 203. doi:10.1080/17513470701585977.
- Ale, S. O. (1989). School mathematics in the 1990's some major problems for developing countries: *International journal of mathematics educational in science and technology* 20 (5), 655-659.
- Ali, N., Jusof, K., Ali, S., Mokhtar, N., & Salamat, A. S. A. (2009). The Factors Influencing Students' Performance at Universiti Teknologi Mara Kedah, Malaysia. *Management Science and Engineering*, 3(4), 81-90.
- Aliyu, R. T. & Akinoso, S. O. (2017). Detecting the differential item functioning of mathematics multiple choice items using Rasch Model. *Journal of educational thought*, 6 (1) 15-33.
- Alzahrani, K. S. (2022). Away from the textbook. Metacognitive strategies in mathematics: A qualitative study on saudi students' motivation to learn mathematics. *EURASIA journal of mathematics, science and technology education*, 18(1), em2070. <https://doi.org/10.29333/ejmste/11507>.
- Amedahe, F. K. & Asamoah-Gyimah, K. (2014). Introduction to research methods in education. Unpublished. Cape Coast: University Press 392.
- Aminu, J. (1990). Address by the Honourable Minister of Education. *Abacus* 20 (1), 22-29.
- Amoako, T., Sheng, Z. H., Dogbe, C. S. K., & Pomegbe, W. W. K. (2022). Assessing

the moderation role of ict in the relationship between supply chain integration and sme performance. *Journal of industrial integration and management*, 7(2), 203–233.

<https://doi.org/10.1142/S2424862221500160>.

Amponsah, John (2010). when will Ghana get represented at the international mathematical olympiad? (ghanaweb.com).

Arthur, Y. D. (2017). Connecting mathematics to real life problem using instructor quality and availability, mathematics facility and teacher motivation for prediction. 312.

Arthur, Y. D. (2022). Modeling student’s interest in mathematics : Role of history of mathematics , peer- assisted learning , and student ’ s perception. 18(10).

Arthur, Y. D., Oduro, F. T., & Boadi, R. K. (2014). Statistical analysis of Ghanaian students’ attitude and interest towards learning mathematics. *International Journal of Education and Research*. 2(6) 661-670.

Awofala, A. O. (2014). Examining personalisation of instruction, attitudes toward and achievement in mathematics word problems among Nigerian senior secondary school students. *International Journal of Education in Mathematics, Science and Technology*, 2(4), 10-12.

Awofala, A. O. (2017). Assessing senior secondary school students’ mathematical proficiency as related to gender and performance in mathematics in Nigeria. *International Journal of Research in Education and Science (IJRES)*, 3(2), 488-502. doi: 10.21890.

Awofala, A. O. A., & Odogwu, H. N. (2017). Assessing preservice teachers’ mathematics cognitive failures as related to mathematics anxiety and

- performance in undergraduate calculus. *Acta Didactica Napocensia*, 10(2), 81 – 97.
- Awofala, A. O. A., Lawani, A. O., & Adeyemi, O. A. (2020). Increasing mathematics achievement of senior secondary school students through differentiated instruction. *Journal of Educational Sciences*, 4(1), 318-333
- Aysun, N. E. (2017). Students' attitudes towards mathematics and the impacts of mathematics teachers' approaches on it volume 10, (2).
- Azmidar, A. Darhim, D., & Dahlan, J. A. (2017). Enhancing students interest through mathematics learning. *Journal of Physics: Conference Series*, 895 (1) doi: 10.1088/1742-6596/895/1/012072.
- Bank, C., & Finlapson, W. (1980). Successful motivation of students in academic activities in McClelland D.C.Appleton–Century–Crafts International Journal of Scientific and Research Publications, 7 (5), 2250-3153.
- Bargh, J. A., & Ferguson, M. J. (2000). Beyond behaviorism: on the automaticity of higher mental processes. *Psychological bulletin*, 126(6), 925.
- Bas, S. and Tegan, G. (2022). What is a conceptual framework? Tips & examples
- Bataineh, A. M. T. (2014). *International journal of arts & sciences*. 07, 347–59.
- Berlyne, D. E. (1970). Novelty, complexity, and hedonic value. *Perception & Psychophysics*. 1970;8:279–286. doi: 10.3758/BF03212593.
- Betz, N. E. (1978). Prevalence, distribution, and correlates of math anxiety in college students. *Journal of Counseling Psychology*, 25(5), 441–448.
- Boaler, J. (2016). *Mathematical Mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. San Francisco, CA: John Wiley & Sons.

- Bodinet, J.C. (2016), Pedagogies of the futures: shifting the educational paradigms, *European Journal of Futures Research*, 4(21), 1-11, doi: 10.1007/s40309-016-0106-0.
- Boekaerts, M. (2002). Motivaton to learn. *Educational practises series*, 10(1), 1-27.
- Borko, H., Eisenhart, M., Brown, C. A., Underhill, R. G., Jones, D., & Agard, P. C. (1992). Learning to teach hard mathematics: Do novice teachers and their instructors give up too easily? *Journal for Research in Mathematics Education*, 23(3), 194–222. doi: 10.2307/749118
- Brophy, J. (2008). Developing students’ appreciation for what is taught in school. *Educational psychologist*. 43:132–141. doi: 10.1080/00461520701756511
- Brown, H. D., & Principles, T. B. (2011). An interactive approach to language pedagogy vol 3 *San Francisco: Pearson Longman*, 64.
- Butakor, P. K. (2016). Hierarchical linear modeling of the relationship between attitudinal and instructional variables and mathematics achievement. *International Journal of Research in Education Methodology*, 7(5), 1328-1336. doi:0.24297/ijrem.v7i5.4342.
- Chelliah, A., & Branavan, A. (2017). The impact of academic motivation on student’s academic achievement and learning outcomes in mathematics among secondary school students in paddiruppu educational zone in the Batticaloa District, Sri Lanka.
- Chief Examiners’ Report, WASSCE (2007). The West African Examinations Council, 2007. Accra: WAEC.
- Chief Examiners’ Report, WASSCE (2012). The West African Examinations Council, 2012. Accra: WAEC.

- Chief Examiners' Report, WASSCE (2013). The West African Examinations Council, 2013. Accra: WAEC.
- Chief Examiners' Report, WASSCE (2014). The West African Examinations Council, 2014. Accra: WAEC.
- Chief Examiners' Report, WASSCE (2015). The West African Examinations Council, 2015. Accra: WAEC.
- Chief Examiners' Report, WASSCE (2016). The West African Examinations Council, 2016. Accra: WAEC.
- Chief Examiners' Report, WASSCE (2017). The West African Examinations Council, 2017. Accra: WAEC.
- Chief Examiners' Report, WASSCE (2018). The West African Examinations Council, 2018. Accra: WAEC.
- Chief Examiners' Report, WASSCE (2019). The West African Examinations Council, 2019. Accra: WAEC.
- Chief Examiners' Report, WASSCE (2020). The West African Examinations Council, 2020. Accra: WAEC.
- Chief Examiners' Report, WASSCE (2021). The West African Examinations Council, 2021. Accra: WAEC.
- Cieslik, K., Barford, A., & Vira, B. (2021). Young people not in employment, education or training (NEET) in Sub-Saharan Africa: Sustainable development target 8.6 missed and reset. *J. Youth Stud.* 2021;1-22.
- Covington, M. V. (2000). Goal theory, motivation and school achievement: An integrative review. *Annual Review Psychology*, 51, 171–200.
- Crow, L. D. (1956). *Understanding our behavior*, New York: *Alfred A. Knopf Publishers*.

- Das, K., Mondal, R., Chowdhury, R., & Boral, D. (2019). Applications of mathematical knowledge in history, geography, fine-arts & physical education subjects in two-year B.Ed. Programme: Indian Context. *Journal of Emerging Technology and Innovative Research*, 6(6), 8-15.
- Demir, I., Serpil, K., & Ozer, D. (2009). Factors affecting Turkish students' achievement in mathematics. *US-China Education Review*, 6(6), 47-52.
- Dewey J. (1913). *Interest and effort in education*. Boston, MA: *Houghton Mifflin*
- Dijkstra, E. (2021). https://www.brainyquote.com/quotes/edsgger_dijkstra_204343
- Dogbe, C. S. K., Tian, H. Y., Pomegbe, W. W. K., Sarsah, S. A. T. O., & Otoo, C. O. A. (2020). Market orientation and new product superiority among small and medium-sized enterprises (smes): The moderating role of innovation capability. *International Journal of Innovation Management*, 24(5). <https://doi.org/10.1142/S1363919620500437>.
- dos Santos, P. M., & Cirillo, M. Â. (2021). Construction of the average variance extracted index for construct validation in structural equation models with adaptive regressions. *Communications in statistics: Simulation and computation*, 0(0), 1–13. <https://doi.org/10.1080/03610918.2021.1888122>.
- Eccles, J. S., & Harold, R. D. (1991). Gender differences in sport involvement: Applying the Eccles expectancy–value model. *Journal of Applied Sport Psychology*, 3, 1533–1571.
- Eccles J. S., Midgley, C., Wigfield, A., Buchanan, C. M, Reuman, D., Flanagan, C., & Mac, I. D. (1993). Development during adolescence: The impact of stage-environment fit on

- young adolescents' experiences in schools and families. *American Psychologist*. 48:90–101. doi: 10.1037/0003-066X.48.2.90.
- Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annu. Rev. Psychol.* 109-132, [10.1146/annurev.psych.53.100901.135153](https://doi.org/10.1146/annurev.psych.53.100901.135153).
- Education Matters (2008). Student achievement in mathematics – the roles of attitudes, perceptions and family background. Retrieved 26 June 2010 from Education Matters.
- Emefa, A.J., Miima, F. A., & Bwire, A. M. (2020). Education impact of motivation on junior high school students' interest in reading comprehension in Hohoe Municipality: A literature based review. *African Journal of Emerging Issues (AJOEI)*, Vol. 2(8), 1-16. performance in some selected colleges of education in Ghana.
- English L. D., & Gainsburg, J. (2015). Problem solving in A 21th century mathematics curriculum. In L.D. English & D. Kirshner (Eds.), *Handbook of international research in mathematics education*. 313–330. New York, NY: *Routledge*.
- Enu, J. A, Agyeman O. K., & Nkum D. (2015). Factors influencing students' mathematics performance in some selected colleges of education in Ghana. *Int J Edu Learn Develop* 3(3):68–74.
- Eshun, B. A. (1999). The pattern of mathematical achievement of secondary school students in Ghana. *Journal of Science and Mathematics*. 2, 22-33.
- Eshun, B. A. (2000) 'Sex-Differences in Attitude of Students Towards Mathematics in Secondary Schools'. *Journal of the Mathematical Association of Ghana*.13, 1-14.
- Esra. M., & Sevilen, Ç. (2021). Factors influencing EFL students' motivation in online learning: A qualitative case study. *J. Educ. Technol. Online Learn*. 4, 11–22.

- Fatima, M. (2013). Mathematics achievements among high school students in Afghanistan. Gender difference in math achievements- performance.
- Fennema, E. (1976). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education*, 7(5), 324-326.
- Fennema, E., & Sherman, J. (1977). Sex-related differences in mathematics achievement, spatial visualization and effective factors. *American Educational Research Journal*, 14(7), 57-71.
- Flegg, J., Mallet, D., & Lupton, M. (2012). Students' perceptions of the relevance of mathematics in engineering. *International Journal of Mathematical Education in Science and Technology*, 43(6), 717-732.
<https://doi.org/10.1080/0020739X.2011.644333>
- Fraser, W., & Killian, R. (2005). The perceptions of students and lecturers of factors influencing academic performance at two South African universities. *Perspectives in Education*, 23, 25-40.
- Gbollie, C. (2017). Student academic performance: The role of motivation, strategies, and perceived factors hindering Liberian junior and senior high school students learning. *Education Research International*:1-11 doi:[10.1155/2017/1789084](https://doi.org/10.1155/2017/1789084).
- Ghimire, R. (2022). Mathematics teachers' perception on their profession. 1&6.
- Glynn, S. M., & Koballa, T. R. (2006). Motivation to learn college science. Joel, J. M. & William J. L. (Eds). *Handbook of College Science Teaching*, 25 – 32, Arlighton, VA: National Teachers Association Press.
- Güvendir, M. A. (2016). Students' extrinsic and intrinsic motivation level and its relationship with their mathematics achievement *Int. J. Math. Teach. Learn.*, 17.
- Guy, G. M., Cornick, J., & Beckford, I. (2015). More than math: On the affective domain in developmental mathematics. *International Journal for the*

- Scholarship of Teaching and Learning, 9 (2). Retrieved from <https://files.eric.ed.gov/fulltext/EJ1134636.pdf>
- Hafizul, F. H., Che, S. S., Mohd, H. W., Khairulanuar, S. (2017). Materials science and engineering 226, 7(1).
- Hall, J. F. (1989). Learning and Memory (2nd Edition) Massachusetts; *Allyn and Bacon*.
- Hammouri, H. (2004). Attitudinal and motivational variables related to mathematics achievement in Jordan: Findings from the third international mathematics and science study (TIMSS). *Educational Research*, 46(3), 241-257.
- Harackiewicz, J. M., Smith, J. L. & Priniski, S. J. (2016), Interest matters: the importance of promoting interest in education, Policy insights from the behavioral and brain sciences. 3(2), 220-227, doi: 10.1177/2372732216655542.
- Harackiewicz, J. M., and S, Hidi. (2018). Motivating the academically unmotivated: a critical issue for the 21st century, *Review of educational research*. 70 (2), 151–179.
- Heinze, A., Reiss, K., & Franziska, R. (2005). Mathematics achievement and interest in mathematics from a differential perspective. *Zentralblatt fuer Didaktik der Mathematik*, 37(3), 212–220. <https://doi.org/10.1007/s11858-005-0011-7>.
- Herges. R. M., Duffield S. Martin, W., & Wageman, J. (2017). Motivation and achievement of middle school mathematics students. *The Mathematics Educator*. 26(1), 83–106.
- Hidi, S. & Renninger, K. A. (2006). The four-phase model of interest development. *Education Psychologist*. 41(2), 111-127.
- Holland, J. G. (1978). Behaviorism: Part of the problem or part of the solution? *Journal of Applied Behavior Analysis*, 11(1), 163-174.

- Hoyles, C., Wolf, A., Molyneux-Hodgson, S., & Kent, P. (2002). *Mathematical skills in the workplace final report to the science, technology and mathematics council*. London: University of London and Science, Technology and Mathematics Council.
- Hurst, C. (2008). Engagement and connection in mathematical learning. In J. Vincent, R. Pierce & J. Dowsey (Eds), *Connected mathematics: Proceedings of the 45th annual conference of the Mathematical Association of Victoria*.139–147. Brunswick, Victoria: Mathematical Association of Victoria.
- Ismail, N. A. (2009). Understanding the gap in mathematics achievement of Malaysian students. *The Journal of Educational Research*, 102(5), 389-394.
- Janson, S. (1996). The contribution of large-scale assessment programs to research on gender differences. *Educational Research*.
- Kahu, R.E., Nelson, K., & Picton, C (2017). Student interest as a key driver of engagement for first year students *Student Success* 8(2):55. doi:10.5204/ssj.v8i2.379
- Kerlinger, F. N. (1985). *Foundation of behavioural research*. *Rinehart Holt and Winston*
- Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International
- Krapp, A. (1999). Interest, motivation, and learning: An educational-psychological Perspective *European Journal of Psychology of Education*, 14, 23-40. doi:10.1007/BF03173109
- Jain, S., & Dowson, M. (2009). Mathematics anxiety as a function of multidimensional self-regulated and self-efficacy. *Contempo. Educ. Psychol.* 34, 240–249, doi:10.1016/j.cedpsych.2009.05.004.

- Jansen, B. R. J., Louwse, J., Straatemeier, M., Van der Ven, S. H. G., Klinkenberg, S., & Van der Maas, H. L. J. (2013). The influence of experiencing success in math on math anxiety, perceived math competence, and math performance. *Learn. Individ. Differ.* 24, 190–197. doi: 10.1016/j.lindif.2012.12.014.
- John Wesley Young (2019). <https://www.prodigygame.com › main-en › blog › ma>.
- Johnston, S. (1994). Choosing mathematics. ‘You need it even if you don’t want to do it’ *Australian Journal of Education*, 38(3), 233-249.
<https://doi.org/10.1177/000494419403800304>
- Judith, M., Harackiewicz, J., Smith, I., & Stacy, J. P., (2016). Interest Matters: The Importance of Promoting Interest in Education. *Policy Insights Behav Brain Sci.* 3(2): 220-227. doi; 10.1177/237273221665542.
- Kihwele, J. E. (2022). Promoting students’ interest and achievement in mathematics through “King and Queen of Mathematics” initiative, 165.
- Kirti, S. (2022). Research: Definition, types, process, importance & nature
- Khair, T. M., Ali M., Ahmad, Z. K., Elrofai, T. A. (2012). Level of students' achievement in mathematics at the end of elementary education in Yemen *Online Submission, US-China Education Review A* 6, 588-593.
- Kpolovie, P. J., Joe, A.I. & Okoto, T. (2014) Role of Interest in Learning and Attitude towards School
- Liebeck, P. (1984). *How children learn mathematics: A guide for parents and teachers:* London: Penguin.
- Lin, L. C. (2012). Measuring adult learners’ foreign language anxiety, motivational factors, and achievement expectations: A comparative study between Chinese as a second-language students and English as a second language students [Unpublished doctoral dissertation]. Cleveland State University.

<https://engagedscholarship.csuohio.edu/etdarchive>

- Luzano, J. F. (2020). Development and validation of strategic intervention materials (SIMs) of the selected topics in trigonometry of precalculus discipline in senior high school. *Journal of Mathematics and Statistics Studies*, 1(2), 26–37
- Ma, X., & Kishor. N. (1997). Assessing the relationship between attitude toward Mathematics and achievement in mathematics: A meta-analysis. *Journal for Research in Mathematics Education*, 28(1), 26-47.
- Maria, A., & Bacabac, A. (2017)-. *American Journal of Educational Research*. 5(8), 843-847. doi: 10.12691/education-5-8-<https://en.wikipedia.org>
- Martin, A. J. (2007). Examining a multidimensional model of student motivation and engagement using a construct validation approach. *British Journal of Educational Psychology*, 77(2), 413-440.
- Mazana, M.Y., Montero, C. S. and Casmir, R.O. (2020). Assessing students' performance in mathematics in Tanzania: the teacher's perspective”, *International Electronic Journal of Mathematics Education*, 15(3), 1-28, doi: 10.29333/iejme/7994
- Mbugua, Z., Kibet, K., Muthaa, G. and Nkonke, G. (2012). Factors contributing to students' poor performance in mathematics at Kenya certificate of secondary education in Kenya: a case of Baringo county, Kenya”, *American International Journal of Contemporary Research*, Vol. 2 No. 6, pp. 87-91, available at: <https://kerd.ku.ac.ke/handle/123456789/1013>
- McCombes, S. (2019). *Research design: types, methods, and examples*.
- McDonald, F. J. and Morgan, D. (1959) *J. Educational Psychology* (San Francisco: Wadsworth Publishing.

- Michaelides, M. P., Gavin, T. L. Brown., Eklöf, H. & Papanastasiou, C. E. (2019). The relationship of motivation with achievement in mathematics BT - Motivational Profiles in TIMSS Mathematics: Exploring student clusters across countries and time, *Springer International Publishing, Cham*, 9-23, [10.1007/978-3-030-26183-2_2](https://doi.org/10.1007/978-3-030-26183-2_2)
- Moore, R. (2007). Course performance, locus of control, and academic motivation among developmental education students. *Research and Teaching in Developmental Education*, 24 (1), 46-62.
- Morgade, G., & Bonder, G. (1995). Women, mathematics and natural science. In R. Clair (Ed.), *The scientific education of girls: Education beyond reproach?* Paris: UNESCO.
- Musto, G. (2008). Showing you're working: A project using former pupils' experiences to engage current mathematics students. *Teaching Mathematics and its Applications*, 27(4), 210–217. doi: 10.1093/teamat/hrn014
- Ndume, V., Songoro, M. and Kisanga, D. (2020). Enriching performance of mathematics in secondary schools using mobile learning. *International Journal of Education and Development Using Information and Communication Technology*, 16(2), 223-241.
- Niss, M. (1994). Mathematics in society. In R. Biehler et al (Eds.), *Didactics of mathematics as a scientific discipline*, 67-378. Dordrecht: *Kluwer Academic Publishers*.
- Niss, M. (1996). Goals of mathematics teaching. In: A. J. Bishop, K. Clements, C. Keitel, J.

- Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math = male, me = female, therefore math \neq me. *Journal of Personality and Social Psychology*, 83(1), 44–59
- Obodo, G. C. (1997). *Principle and practice of mathematics education in Nigeria*. Enugu: General studies Division, Enugu State University of Science and Technology, Enugu.
- Obuba, E. M. (2013). *The role of school and motivational factors in mathematics achievement and self-efficacy: A multi-level analysis* Cleveland State University
- Ochieng, I. (2022). *Importance of learning mathematics*.
- Ogunmoyero, S. A. & Omasheye, G. O. (2012). Repositioning teaching and learning of mathematics and science to enhance technological advancement, *Journal of Teacher Perspective*, 6(2), 393–401.
- Okebukola, P. A. O. (1992). Can good concept Mappers be good problem solvers? *Education Psychology*, 12(2), 113-119.
- Okereke, S. C. (2006). Effects of prior knowledge of implications of mathematical tasks /concepts to career types and gender on students' achievement, interest and retention. In U. Nzewi (Ed) *STAN procedures of the 47th Annual conference*, 253-259.
- Onion, A. (2004). What use is maths to me? A report on the outcomes from student focus groups. *Teaching Mathematics and its Applications*, 23(4), 189–194. doi: 10.1093/teamat/23.4.189.
- Osikhotsali, M. (2023). *Population, definition in statistics and how to measure it*.
- Otoo, D., Wahab A. I., Kessie, A. J., & Larbi, E. (2018). Structural model of students' interest and self-motivation to learning mathematics. *Hindawi education*

- Oyeniran, J. O. (2003). An introduction to Principles and methods of Teaching. In O. Oluokun (Ed.). Lagos: SIBIS ventures.
- Pandey, B. D. (2017). A Study of mathematical achievement of secondary school students. *International Journal of Advanced Research* 5(12):1951-1954
doi:10.21474/IJAR01/6165
- Papanastasiou, C., & Papanastasiou, E. C. (2004). Major influences on attitudes towards science, *Educational Research and Evaluation*, 10, 3, 239–257.
- Peteros, E., Gamboa, A., Etcuban, J. O., Dinuanao, A., Sito, R. and Arcadio, R. (2020). Factors affecting mathematics performance of junior high school Students. *International Electronic Journal of Mathematics Education*, Vol. 15 No. 1, pp. 1-13, doi: 10.29333/iejme/5938.
- Prast, E. J., Van de Weijer-Bergsma, E., Miočević, M., Kroesbergen, E. H., & Van Luit, J. E. (2018). Relations between performance in mathematics and motivation in students of diverse achievement levels. *Contemporary Educational Psychology*, 55, 84- 96. ; 105 doi: 10.1007/978-981-16-4099-5_6.
<https://doi.org/10.1016/j.cedpsych.2018.08.002>
- Qin, X., & Wen, Q. (2002). Internal structure of EFL motivation at the tertiary level in China. *Foreign Language Teaching and Research*, 51-58.
- Reeve, J., Lee, W., & Won, S. (2015). Interest as emotion, as affect, as schema. In K. A. Renninger, M. Nieswandt, & S. Hidi (Eds.), *Interest in mathematics and science Learning*. American Educational Research Association, 79-92.
https://doi.org/10.3102/978-0-935302-42-4_5

- Renninger, K. A. & Hidi, S. (2016). The power of interest for motivation and engagement. New York, N. Y: Routlssssedge.
- Richards, P. (1982). Difficulty in learning mathematics: Teaching mathematics. *CROOM HELM, London and Canverra*,112-140
- Rosenzweig, E. Q., Wigfield, A. & Eccles J. S. (2019). Expectancy-value theory and its relevance for student motivation and learning
- Roshan, R. (2021). Factors affecting the students' achievement in mathematics: a case study, 2-3
- Russell, B. (1901). Recent Work on the Principles of Mathematics. *The International Monthly* 4(1): 83–101.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being.
- Ryan, R. M. & Deci, E. L. (2000). Intrinsic and extrinsic motivations: classic definitions and new directions *Contemp. Educ. Psychol.*, 25, 54-67, [10.1006/ceps.1999.1020](https://doi.org/10.1006/ceps.1999.1020)
- Ryan, R. M., & Deci, E. L. (2017). Self-determination theory: Basic psychological needs in motivation, development, and wellness. *Guilford Publications*. <https://doi.org/10.1521/978.14625/28806>
- Sa'ad, T. U., Adamu, A, and Sadiq, A. M. (2014). The causes of poor performance in mathematics among public senior secondary school students in Azare metropolis of Bauchi State, Nigeria. *J Res Method Edu.* 4(6):32. doi:10.9790/7388-04633240
- Sauer, K. (2012). The impact of student interest and instructor effectiveness on student performance. St. John Fisher College: Education Masters Retrieved from https://fisherpub.sjfc.edu/cgi/viewcontent.cgi?article=1244&context=education_ETD_masters.

- Satwant, K. (2013). Computer based instruction and its effectiveness on achievement of students in mathematics
- Schiefele, U. (2009): Situational and individual interest. K. Wentzel (Ed.), *Handbook of motivation at school*, Routledge, New York 197-222.
- Schiefele, U., Krapp, A., & Winteler, A. (1992). Interest as a predictor of academic achievement: A meta-analysis of research. In K. A. Renninger, S. Hidi, & A. Krapp (Eds.), *The role of interest in learning and development*. 183-212. Hillsdale, NJ: Erl
- Schraw, G., Flowerday, T., & Lehman, S. (2001). Increasing situational interest in the classroom. *Educational Psychology Review*, 13(3), 211–2.
- Schukajlow, S., & Rakoczy, K. (2016). The power of emotions: Can enjoyment and boredom explain the impact of individual preconditions and teaching methods on interest and performance in mathematics? *Learning and Instruction*, 44, 117-127
- Serhat, K. (2022). Constructivism, key terms, history, theorists, criticisms and implications for teaching.
- Shikalepo, E. E., & Hautemo, A. M. (2021). Open education and self-directed learning in adult, professional and vocational education in Africa. In: *Radical solutions for education in Africa*. Springer.
- Singh, K., Granville, M. and Dika, S. (2002). Mathematics and science achievement: effects of motivation, interest, and academic engagement. *Journal of Educational Research*, 95 (6),323-332, doi: 10.1080/00220670209596607.
- Smith, J. K., Smith, L. F., Gilmore, A., & Jameson, M. (2012). Students' self-perception of reading ability, enjoyment of reading and reading achievement. *Learning and*

individual differences, 22(2), 202-206.

<https://doi.org/10.1016/j.lindif.2011.04.010>

Solano, L., Cabrera, P., Ulehlova, E. and Espinoz, V. (2017). Exploring the use of educational technology in efl teaching: A case study of primary education in the south region of Ecuador

Steinmayr, R., Weidinger, A. F., Schwinger, M. & Birgit S, B. (2019). The Importance of Students' Motivation for Their Academic Achievement – Replicating and Extending Previous Findings. Sec. Personality and Social Psychology. Volume 10. <https://doi.org/10.3389/fpsyg.2019.01730>

Suleiman, Y., and Hamed, A. ((2019). Perceived causes of students' failure in mathematics in Kwara state junior secondary schools: implication for educational managers. *Int J Educ Stud Math.* 6(1):19–33.

Stemhagen, K. (2008). Dewey, democracy, and mathematics education: reconceptualizing the last bastion of curricular certainty. *Education and Culture* 24(2) doi:[10.1353/eac.0.0023](https://doi.org/10.1353/eac.0.0023)

Stipek, D., Salmon, J. M., Givvin, K. B., Kazemi, E., Saxe, G., & MacGyvers, V. L. (1998). The value (and convergence) of practices suggested by motivation research and promoted by mathematics education reformers. *Journal for Research in Mathematics Education*, 29(4), 465-488

Syyeda, F. (2016). Understanding attitudes towards mathematics (atm) using a multimodal modal model: an exploratory case study with secondary school children in England. *Cambridge Open-Review Educational Research e-Journal*, 3, 32-62. Retrieved from http://corerj.soc.srcf.net/?page_id=224

Tentama, F., & Abdillah, M. H. (2019). Student employability examined from academic achievement and self-concept. *International Journal of Evaluation and*

Research in Education, 8 (2), 243–248. <https://doi.org/10.11591/ijere.v8i2.18>

128

Theobald, M. A. (2006). Increasing student motivation: Strategies for middle and high school teachers. *Corwin Press*.

Tilaye, K., & Bedru, K. (2006). Girl's performance in mathematics in upper primary schools of Addis Ababa. *Indian Journal of Gender Studies*, 13, 401-424.

Toli, G. and Kallery, M. (2021). Enhancing student interest to promote learning in science: the case of the concept of energy. *Education Sciences*, 11 (5), 1-15, doi:10.3390/educsci11050220.

Tsoto, M. G., Asbury, K., Mazzocco, M. M., Petrill, S. A., & Kovas, Y. (2016). From classroom environment to performance in mathematics: The mediating role of self-perceived ability and subject interest. *Learning and Individual Differences*, 50, 260-269. <https://doi.org/10.1016/j.lindif.2016.07.009>

Usher, E. L. (2009). Sources of middle school students' self-efficacy in mathematics: A qualitative investigation. *American Educational Research Journal*, 46(1), 275–314

Vinz, S. (2022). What is a theoretical framework? Guide to organizing

Vygotsky, L. S. (1994). The socialist alteration of man. In R. van de Veer and J. Valsiner (Eds) *The Vygotsky Reader*. *Blackwell Publishers*

Wang, D. B. (2004). Family background factors and mathematics success: A comparison of Chinese and US students. *International Journal of Educational Research*, 41(1), 40-54

Wigfield, A. & Meece J. L. (1988). Math anxiety in elementary and secondary school students *J. Educ. Psychol.*, 80, p. 210

- Willis, J. (2010). Learning to love math: Teaching strategies that change student attitudes and get results. Alexandria, Va: Assoc. for supervision and curriculum development.
- Witte, J. (2022). It takes a society to raise a family: The multidimensional family sphere. SSRN Journal 2022:13-39. doi: 10.2139/ssrn.4133866.
- Wong, S. L. and Wong, S. L. (2019). Relationship between interest and mathematics performance in a technology-enhanced learning context in Malaysia”, research and practice in technology enhanced learning, Vol. 14 No. 21, pp. 1-13. doi: 10.1186/s41039-019-0114-3.
- Woolfolk, A. (2008). Motivation in learning and teaching; Psychology in Education, pages 80-93.
- Yeh, C. Y. C., Cheng, H. N. H., Chen, Z. H., Liao, C. C. Y. and Chan, T. W. (2019). “Enhancing achievement and interest in mathematics learning through Math-Island”, Research and Practice in Technology Enhanced Learning, 14 (5), 1-19, doi: 10.1186/s41039-019-0100-9.
- Yunos, N. M., Thangal, T. B. T., Sharif, N. F. M., Rashid, N. R. A., & Rahmat, N. H. (2021). Exploring motivation to learn mathematics through Vroom’s theory. European Journal of Education Studies, 8(11). <http://dx.doi.org/10.46827/ejes.v8i11.3976>.
- Yunos, N. M., Thangal, T. B. T., Rahmat, N. H., Sharif, N. F. M., Ahmad, S. N., & Latif, N. A. (2022). Motivation for learning mathematics: A study across disciplines. International Journal of Academic Research in Business and Social Sciences, 12(9), 1135 – 1154.
- Zan, R., & Di Martino, P. (2008). Attitude toward mathematics: Overcoming the positive/negative dichotomy. in B. Sriraman (Ed.), beliefs and mathematics:

Festschrift in honor of guenter toerner's 60th Birthday, 197-214. Missoula, MT:
Information Publishing Age Publishing.

Zhang, D., & Wang, C. (2020). The relationship between mathematics interest and performance in mathematics: mediating roles of self-efficacy and mathematics anxiety. *International Journal of Educational Research*, 104, 101648. [https://doi.org/ 10.1016/j.ijer.2020.101648](https://doi.org/10.1016/j.ijer.2020.101648)

Zhou, D., Liu, J., & Liu, J. (2020). The effect of problematic Internet use on performance in mathematics: The mediating role of self-efficacy and the moderating role of teacher-student relationships. *Children and Youth Services Review*, 118, 105372. [https://doi.org/10.1016/j.chilyouth.2020.10537](https://doi.org/10.1016/j.chilyouth.2020.105372)

APPENDIX
QUESTIONNAIRE

Dear students,

Kindly spend few minutes of your time in responding to this questionnaire. The study is about *“Enhancing Students’ Achievement in Mathematics Through the Usefulness of Mathematics and Interest: The Mediating Role of Motivation.”* This is purely an academic exercise. Therefore, your confidentiality is guaranteed. There is no right or wrong answers. All you are required to do is to tick [√] the responses which are applicable to your circumstance.

Section A: Demographics

1. Program /Course: General Arts [] Science [] Business [] Visual Arts [] Home Economics []
2. Gender: Male [] Female []
3. Age: 14-16 [] 17-19 [] 20-Above []
4. Form/Year: Form 1 [] Form 2 [] Form 3 []
5. Track: Green [] Gold []

Section B: Various Variables

Please tick [√] the correct response from the options given.

SA = STRONGLY AGREE A = AGREE N = NEUTRAL D = DISAGREE

SD = STRONGLY DISAGREE

Usefulness of Mathematics

S/N	STATEMENT	SA	A	N	D	SD
1	I will need Mathematics in my daily life					
2	Mathematics is of no relevance to me					
3	I will need Mathematics at the tertiary level of education					
4	Learning Mathematics is a waste of time					
5	I will pursue mathematics related course in future					
6	Learning Mathematics helps me learn other subjects					
7	Mathematics is the best among all the subjects I study					
8	I will get good job in future if I learn mathematics					
9	I think I will not remove mathematics if it were optional					
10	I study mathematics because I know how useful it is					

Motivation in Mathematics

S/N	STATEMENT	SA	A	N	D	SD
1	My teacher motivates me to do mathematics					
2	I pay close attention when the teacher is teaching mathematics					
3	I do my assignments regularly					
4	I study on my own the lesson I missed in class					
5	I find extra time to practise mathematics					
6	Mathematics is not easy subject to me					
7	I have enough confidence to solve mathematics related questions					
8	I complete my mathematics assignments on time					
9	My parents reward me for doing well in mathematics					
10	My teacher gives me little gifts when I do well in examination					

Interest in Mathematics

S/N	STATEMENT	SA	A	N	D	SD
1	I feel happy in solving mathematics					
2	I enjoy learning mathematics					
3	Mathematics is not a boring subject to me					
4	I find learning math interesting					
5	I make myself prepared for the mathematics lesson					
6	I wish mathematics lessons never end whenever we are learning mathematics					
7	I actively participate in mathematics lessons					
8	I will choose mathematics over other subjects					
9	I do not give up when solving challenging mathematics questions					
10	I work hard to get good grades					

Achievement in Mathematics

S/N	STATEMENT	SA	A	N	D	SD
1	I perform well in mathematics					
2	I think I am good in mathematics					
3	My friends think I am successful at mathematics					
4	I see myself as successful student in mathematics					
5	I am not a model student in mathematics					
6	I would be proud to be the outstanding student in my class					
7	I score higher grades in mathematics than in other subjects					
8	I am able to solve questions without my teacher's assistance					
9	I am able to answer questions during mathematics lessons					
10	I get good grades in mathematics exams					