UNIVERSITY OF CAPE COAST

INVESTIGATING THE INFLUENCE OF SENIOR HIGH SCHOOL STUDENTS' AFFECTIVE VARIABLES AND TEACHER-STUDENT RELATIONSHIP ON STUDENT PERFORMANCE IN MATHEMATICS IN THE CAPE COAST METROPOLIS

BY

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Thesis submitted to the Department of Mathematics and Information, Communication and Technology of the College of Education Studies, Faculty of Science and Technology, University of Cape Coast, in partial fulfilment of the requirements for the award of Doctor of Philosophy degree in Mathematics Education

JULY 2017

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:.. Date: 06/09/18

Name: Florence Christianah Awoniyi

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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ABSTRACT

A total of 3,342 Form Two students from 69 intact classes were randomly chosen along with their 57 teachers from the ten public Senior High Schools in the Cape Coast Metropolis. The students and their teachers were engaged to investigate the influence of student anxiety, student attitude, student motivation and teacher-student relationship jointly and individually. The response rates for students and teachers were 77% and 86% respectively, indicating that 2,575 students and 49 teachers participated in the study. This research followed a mixed methods design. The data collected from quantitative sources were analysed using inferential statistics and frequency counts. While those collected from interviews were analysed qualitatively and presented as narrative with some examples. Findings revealed that the variables; student anxiety, student attitude, student motivation and teacher-student relationship jointly explained 18% of the variance in achievement scores and attitude emerged as a salient predictors of student achievement in mathematics. All the variables made statistically significant contributions to predicting achievement scores. In addition, the sub constructs of the four variables collectively explained 44% of the variance in achievement scores. It is recommended that the schools should facilitate in-service training for their mathematics teachers on the impact of affective variables on student performance in mathematics. Likewise, students should be engaged in debates on the influence of affective variables on learning generally to create awareness on the effect of affective variables on the learning of mathematics in particular.

ACKNOWLEDGMENTS

I am extremely grateful to my principal supervisor, Prof. J. A. Fletcher of the School of Education and Leadership, University of Ghana, Legon, for his careful, meticulous and insightful supervision of this study. I am grateful for his patience, sacrifice, and eagle eye. I would also like to acknowledge the important contribution made by my co-supervisor, Prof. E. M. Wilmot of the College of Education Studies, University of Cape Coast, whose encouragement, mentoring, constructive comments, suggestions and wise words kept me going.

I would like to thank all the teachers of the senior high schools who agreed to be interviewed and shared with me their reflections regarding the research topic. I thank them for allowing me to observe their lessons and for their questionnaire responses. I also thank my main research participants, the students, who have contributed to the success of this thesis. I have gleaned invaluable knowledge from them.

My sincere thanks also go to Dr. E. Anane for allowing me to draw from his considerable wealth of data analysis. I am also indebted to Dr. J. Oppong, Dr. B. K. Nkansah, Dr. K. Ayebi-Arthur, for their helpful suggestions and encouragement. This thesis would not have been possible without the love and support of Rev. Sr. Priscilla Nenuwa, Dr. S. Naandam, Mrs. V. V. Wilmot and my biological family who gave me the emotional support I needed at various stages of my work. Their presence, moral support, and faith in me facilitated my work enormously.

DEDICATION

To my family

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CHAPTER ONE

INTRODUCTION

Mathematics is perceived to be the most important subject in the school curriculum of most countries. It is described as the queen and servant of the sciences by Olaniyan and Salman (2015). According to the Leitch Report (2006), in order for United Kingdom (UK) to become a world leader in skills by 2020, 95 per cent of her adults are to achieve the basic skills of functional literacy and numeracy. The message in the Report was that from age 19 to State Pension age, individuals should be able to think independently in applied and abstract ways, reason, solve problems, assess risks and take active and responsible roles in their communities. This is the requirement for the overall population in order to raise productivity (Leitch Report, 2006).

In fact, in Europe, mathematical competence has been identified as one of the key competences necessary for personal fulfilment, active citizenship, social inclusion and employability in a knowledge society (Eurydice Network, 2011). Similarly, in Africa the Kenyan government, for example, has adopted Science, Technology and Innovation (STI) as a tool for the attainment of its industrialization and vision 2030 (Government of the Republic of Kenya, 2007), implying that success in mathematics and science subjects is central to the attainment of industrialization in Kenya. In the same way, the Ghana Education Service considers the acquisition of literacy and numeracy skills to be the main priority for national development (Curriculum Research and Development Division, 2010). According to Anku (2010, p. 1), mathematics ensures the efficiency in all things that we do, especially science, engineering and technology that we need to develop our dear Ghana.

Hence, it is vital that students are encouraged and fortified through good practices at the senior high school level to 'befriend' the subject in order for them to be able to unearth the hidden treasures of the subject, such that their interest would be magnetised to it and this will invariably come to bear positively on the nation's progress.

Effective mathematics education is indeed a panacea for the production of different categories of professionals such as scientists, engineers, technologists, architects, bankers, etcetera. This involves presenting the material to students at the secondary school level as clearly as possible to enhance better understanding of the subject which invariably develops their interest in the subject beyond the secondary school level.

If the constant bombardment of change and reform in education, directed by successive governments, has not succeeded in resolving many of the persistent problems in education, then where else can we look to find solutions? The answer is, perhaps, an apparent but often unnoticed one: to find new directions for improving schools we must take as our starting point the classroom itself and explore teaching and learning through the eyes of those most closely involved – teachers and young learners. Their guidance can be used to direct our attention to the issues that need to be given precedence in planning improvement. Only in this way will teachers be enabled to develop new strategies based on a deeper knowledge and firmer understanding of the complex processes of teaching and learning.

Background to the Study

According to Curriculum Research and Development Division (CRDD, 2010), countries that are concerned about their development put a great deal of emphasis on the study of mathematics. Hence, the rationale for the senior high school mathematics syllabus is focused on attaining one crucial goal: "to enable all Ghanaian young persons to acquire the mathematical skills, insights, attitudes and values that they will need to be successful in their chosen careers and daily lives" (p. ii). Despite the broad applicability of mathematics to everyday life, it is often considered a difficult subject in schools (Mutodi & Ngirande, 2014).

Consequently, the student's aspiration and commitment in mathematics learning could affect the efforts of all sectors in achieving the Vision 2020 which envisaged the use of science and technology to rapidly address Ghana's development to improve the quality of life for all. The Curriculum Research and Development Division goal is thus far from being attained, as the teaching of mathematics is bedeviled with so many challenges (Anku, 2010). The expectation as specified in the mathematics syllabus (CRDD, 2010) that a graduate of SHS should have developed the required mathematical competence to be able to use his/her knowledge to solve real life problems and secondly, be well equipped to enter into further education and associated vocations in mathematics, science, commerce, industry and a variety of other professions is not being realized to the fullest. This is because Ghanaian students' performance in mathematics has not been desirable (Ghana Education Service, 2004; International Association for the Evaluation of Education Achievement, 2008; Ministry of Education, 2012, 2013).

The current curriculum in mathematics at the senior high school (SHS) level places emphasis on skill acquisition, creativity and the art of enquiry and problem solving. It aims at developing in the student the ability and willingness to perform investigations using various mathematical ideas and operations. In spite of government efforts, mathematics has not undergone much change in terms of its level of attractiveness to students in general. This is reflected consistently in low achievement levels in mathematics among students at both junior and senior high school levels. The high failure rate and low scores of students over the years in the West African Secondary School Certificate Examinations (WASSCE) attest to this as reported by the General Resume of Chief Examiners' report (WASSCE, 2006, 2012, 2013, 2014, 2015, 2016). The same old story repeated itself in the most recently released West Africa Secondary School Certificate Examination (WAEC) results by West Africa Examination Council which declared that only 42.73% of the candidates achieved between A1 and C6. And were thus successful in mathematics in the examination (WASSCE, 2017).

The General Resume of Chief Examiners' Reports (WASSCE, 2015), declared that conceptual understanding of basic mathematical concepts and their real life applications seemed to be lacking, students were unable to translate story problems into mathematical statements (i.e. could not apply the concepts in real life problems) and they were unable to solve problems involving partial variations. Consequently, the chief examiners recommended that teachers should help students understand basic mathematical concepts and their applications.

In this technological advancement era, inability of young citizens to apply mathematics to the real life situation may collapse the economy as well as the personal and individual growth and development because as stated by Mefor (2014), mathematics relates to everything in the universe from the smallest to the largest. This explains why the poor and deteriorating performance among students in mathematics poses a challenge to educational practitioners and researchers alike to find the factors that influence such performance. Therefore, the desire to understand and identify factors that may have meaningful and consistent relationships with mathematics performance has been shared among national policy makers and well-meaning educators around the world.

Ajila and Olutola (2000) and Roberts, Edgerton, and Peter (2008) categorise problems responsible for students' poor performance in mathematics as their teaching and learning environment, which include availability of suitable learning environment, adequacy of educational infrastructures like textbooks and society at large among others. Mbugua, Kibet, Muthaa, and Nkonke (2012), in their study concluded that the factors contributing to poor performance include under staffing, inadequate teaching/learning materials, lack of motivation, poor attitudes by both teachers and students, and retrogressive practices. Awoniyi and Fletcher (2013) claimed that the poor performance of students in mathematics could be due to the way teaching and learning of mathematics is carried out in schools as well as interest level in mathematics among students and attitude of teachers toward assessment practices. According to them, students' test scores are yet to be seen by the majority of the mathematics teachers as a means of identifying the strengths and weaknesses of the students and for remedial teaching.

Similarly, Umar Sa'ad Umar Sa'ad, Adamu, and Sadiq (2014) in their study concluded that students' negative attitude toward mathematics, anxiety and fear of mathematics, inadequate qualified teachers, poor teaching methods, inadequate teaching materials, overcrowded classes were some of the causes of poor performance in mathematics. Research works have hinted, among other things, on the influence of human resources, curriculum and material resources as well as school building structure and facilities on the students' performance in the subject (Adeyemi, 2010; Kimani, Kara, & Njagi, 2013; Musasia, Nakhunu, & Wekesa, 2012; Onderi & Makori, 2013). Oguntuase, Awe, and Ajayi (2013) recognise that availability and adequacy of teaching and learning resources support the efficacy of schools as these are the basic things that can activate good academic performance in the students. Some studies have considered teaching and learning resources as tools and materials used in the classroom for teaching (Klaus, 2010; Tamakloe, Amdahel, & Atta, 2005), while some researchers like Maicibi (2003) see them to encompass both human and non-human. According to Maicibi all institutions or organizations are made up of human beings (workers) and non-human resources which can be manipulated to realise set objectives.

Nevertheless, the human resource is the first port of call in terms of resources for mathematics education. In the view of Wöbmann (2004), the teacher as an input is the most important factor in the education provision and this affects the quality of education considerably. Teachers are indispensable resources in mathematics teaching and learning. Regardless of how well a curriculum is designed, it has little value outside of its implementation in classrooms if the teacher is not well trained to implement the curriculum. Afe (as cited in Kimani et al., 2013), reports that it has been proved that teachers as resources have an important influence on students' academic performance. In other words, teachers' role has been recognized as indispensable to the delivery as well as to the quality of education. Notwithstanding, Yara and Otieno (2010) concluded in their study that availability of teaching/learning resources, (teachers inclusive) in the schools do not alone account for students' performance in mathematics. The study was corroborated by Oguntuase et al. (2013).

In summary, the problem of students' performance in mathematics could be related to so many factors. Some of the factors could be school-based such as student/teacher ratio or class size, supervision and so on; teacher factors which may include attitudes and beliefs, commitment, content and pedagogical knowledge, experience, qualification et cetera; student factors which may include intelligence and interest, gender, early childhood learning and so on; parental factors such as race, ethnicity, social class and so on; policy makers' factors such as inadequacy or lack of textbooks, assessment practices, under staffing, curriculum and so on (Ali, 2013; Enu, Agyman, & Nkum, 2015; Gardner, 2010; Mbugua et al., 2012; Roberts et al., 2008). Nonetheless, there is a need to specifically investigate the influence of student affective variables in teaching and learning environments.

Given that many important determinants of effective learning are beyond systematic control, it has become important that school divisions optimise the effects that they can control. One of such effects is intelligence, which according to Gardner (1999) is "a bio-psychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture" (Gardner, 1999, pp. 33-34).

Gardner proposed the notion that human beings have not just one type of intelligence, but several. He made two fundamental claims about multiple intelligences; that the theory accounts for the full range of human cognition, and each individual has a unique blend of the various intelligences that contribute to his/her personal predilections and abilities. One of the main challenges for educators and individuals is for each person to develop his/her intelligences to the fullest. The intelligences are Linguistic/Verbal, Logical-mathematical, Musical, Bodily-kinesthetic, Spatial, Intrapersonal, Naturalist, Spiritual, Existential and Interpersonal. The intrapersonal and interpersonal intelligences are some of the factors that the school can optimise because it has to do with the relationship of the learner with self, peers and the teacher. Other effects are attitude, motivation, anxiety et cetera which are equally based on relationship between teachers and students. The teacher–student relationship is viewed as integral to successful teaching and learning. The school environment creates the context for a variety of emotional experiences that have the potential to influence teaching, learning, and motivational processes (Goldstein, 1999; A. Hargreaves, 1998; Hargreaves, 2001; Sutton, 2004; Zembylas, 2005) and until teachers come to this awareness, achieving improved student performance can be elusive.

The classroom today, according to Flutter and Rudduck (2004), is like a football stadium, surrounded by an eager crowd of politicians, parents and employers, who enthusiastically observe, examine, assess and openly debate what happens inside the classroom. 'Targets' and 'goals', 'performance' and 'league tables' are the banners waved excitedly by education policy makers and the media. Just like football teams, teachers and pupils find their performance criticised when public anticipations do not seem to have been met. The public have been fascinated by the language and style of this winner-takes-all culture.

Yet, while notions of 'competition', 'improvement' and 'reward' are in themselves meaningful and appropriate within certain contexts, it must be recognised that learning is far more significant, multifaceted and challenging than any game. According to Flutter and Rudduck (2004), while it is obvious that much remains to be done to ensure that our educational system matches up to the demands of the twenty-first century, this political impetus for higher standards and greater accountability has not necessarily supported schools effectively in meeting the challenges. As national statistics continue to confirm, too many young people leave school without the prerequisite and skills they need for thriving and fulfilling adult lives (Anku, 2010).

Where the objective of the investigation is to improve teaching and learning, then it is only the testimony of pupils most especially and teachers themselves that can provide essential, first-hand evidence (Flutter & Rudduck, 2004). Of course, there are other 'expert witnesses' from a range of fields that may also make important contributions to the consultation but, unlike teachers and pupils, these experts cannot offer perspectives based on direct experience. When teachers and pupils are invited to give their accounts of teaching and learning, we are interested in more than 'factual' testimony in the legal sense because we also want to discover more about their perceptions of, and attitudes towards, their experiences in classrooms and schools. Whilst these perceptions might not constitute admissible evidence in a court of law, in the context of an investigation aimed at improving teaching and learning, such evidence is a vital resource. Hence, for this study, the teacher-student relationship and students' affective variables were delved into to proffer evidences that are possibly responsible for poor student performance in mathematics.

Statement of the Problem

Observations and reports from examining bodies have revealed that a high percentage of senior high school students continue to perform poorly in mathematics examinations. This poor performance continues to generate much concern among parents, teachers, students and other stakeholders in the education business. The failure is more noticeable in the problem-solving or application of knowledge to real life situations (WASSCE, 2015). One cannot tell precisely what factors are (mostly) responsible for the persistent failure in mathematics but in my view, there is a gap between where we should be and where we are at present in relation to performance of students in mathematics. Following the trend in the past, it looks like the future is bleak because in 2012, 49.9% of school candidates achieved between A1 and C6, in 2013, 36.8% achieved this, while 32.4% was recorded in 2014. In 2015, the figure was 25.04%, followed by 32.83% in 2016 and the current year (2017) the figure is 42.73%. From the foregoing, one can see that if time is not taken to discover the problems affecting the students in mathematics, then in the near future, the performance of the students could be devastating and this would not augur well for both individual and national development.

There are many studies that have sought to unearth the possible problems or challenges in respect of teaching, learning and outcomes of mathematics in senior high schools but they focused more on the cognitive aspects. The few that considered the affective aspects were carried out in developed countries and they did so in isolation, that is, anxiety or motivation or attitude with performance and there had been little research on the extent to which these factors collectively affect students' performance in mathematics (e.g. Ashcraft & Kirk, 2001). Yet, there is a need to ascertain, in such a way that captures the peculiarities of developing countries, the level of impact teacher-student relationship and these affective variables, jointly or individually have on student performance in mathematics.

Purpose of the Study

The purpose of this study was to investigate the influence of teacher-student relationship and students' affective variables on performance in mathematics.

Research Questions

The study was guided by the following research questions:

1. What are students' and teachers' views on teacher-student relationship in the mathematics classroom?
2. What teacher-student relationship exists in the mathematics classroom and the effect of the relationship on students' achievement?
3. What are the levels of mathematics-related affect (anxiety, attitude and motivation) in students and their effect on students' achievement?
4. Which of the sub-constructs of affective variables and teacher-student relationship predicts student performance in mathematics?

Research Hypothesis

The study was guided by the following null hypothesis:

H_0: There is no significant influence of anxiety, attitude, motivation and teacher-student relationship either individually or collectively on performance of students in mathematics.

Significance of the Study

Students' disposition, attitude and motivation are indispensable to the teaching profession because they tend to be authentic sources. As teachers, students experience and encounter our classrooms directly. When teachers pay attention to students' actions and reactions, they energise students not only to feel more engaged but also to be more inclined to take responsibility for their learning because it is no longer something being done to them but rather something they do. Thus the study could help both practitioners and researchers in education to understand how students think, feel and are motivated, thereby providing information which could help to improve teacher-student relationship. The study could provide a sense of direction for teachers of mathematics to plan towards the enhancement of students' mathematics-related affect alongside the planning, delivery and teaching of mathematics. This could be made possible by making the teaching and learning of mathematics fun, meaningful and inspiring, and by avoiding those practices that promote fear in students and make mathematics more applicable to students' lives.

Delimitation

The study was carried out in the ten public senior high schools in the Cape Coast Metropolis. Furthermore, senior high school (SHS) Form Two students and their mathematics teachers were selected for the study. The selected teachers had taught the students for at least one year. The SHS Form Two students were selected because they had covered most of the necessary topics at the time of the research to allow the same achievement test to be given across the ten schools.

Limitations

Seven hundred and sixty seven (767) out of the 3,342 students discontinued from the study and eight out of 57 mathematics teachers in the senior high schools sampled for the study did not participate in the study. This was responsible for obtaining response rates of 77% and 86% respectively. One of the reasons for the discontinuity by the participants was due to the problem of sustaining participants' interest, especially the students, in the study for a period of seven months. This gave room to weariness by the students many of whom expressed the fact that they were used to one shot research. Other reasons were due to irregularities in students' attendance in the schools due to their being sacked for school fees and some teachers were not frequent in school due to their involvement in some programmes or extra teaching at some private schools in the neighbourhood. The research questions and instruments ignore various other influencing factors that may impact mathematics anxiety, attitudes, motivation and teacher-student relationship. They do not take into account parental influences and socioeconomic factors. Some of these factors might have affected the quality of the data.

Operational Definition

Words and phrases have got different meanings in the contexts in which they are used. It is, therefore, necessary to take the following operational definitions as they are expected to be interpreted in this study:

Performance/Achievement: The two words are used interchangeably, it means succeeding in doing very good and difficult activity or how well a person does a piece of activity. In this study an achievement test was used to generate achievement score which measured students' performance in mathematics.

Relationship: Means the way in which two or more people feel or behave towards each other.

Confidence: The quality of being certain of your abilities to succeed in a given task.

Sample size required: The sample that is necessary for the study based on Krejcie and Morgan table of sample sizes

Sample size selected: The sample sizes selected based on the possibility of some respondents discontinuing after awhile.

Sample size persevered: The sample sizes of respondents that started the study and continued till the study was finished.

Respondent/Participant/Student/Teacher: The four pronouns were used interchangeably to mean the individual who participated in the study. Students were sometimes referred to as participants or respondents, in the same way that teachers were mentioned as respondents or participants. However, there were always notifications to clarify which of the two groups of participants were being referred to at any point in time. For example, students from School A was coded as StuA1, StuA2 etc. and the teacher TA1, while from School B was coded as StuB1, StuB2. and the teacher TB1. The same was done for the rest of the schools.

Organisation of the study

Chapter Two reviewed the literature related to the study. The review involved empirical studies, theoretical and conceptual frameworks.

The third chapter described the methodology used for the study. This involved the research design, population, sample and sampling procedure, the research instrument, the piloting procedure, the procedure for data collection and the data analysis.

Chapter Four discussed the results while Chapter five summarized the findings, drew conclusions and made recommendations that could be beneficial to policy makers, educational authorities, students and teachers.

CHAPTER TWO

LITERATURE REVIEW

The purpose of this study was to investigate the influence of teacher-student relationship and students' affective variables on student performance in mathematics in the Cape Coast Metropolis. This chapter reviewed literature in relation to the topic under study and the research questions/hypothesis formulated for the study. The discussion in this chapter is sub-divided into five sections. The first section deals with motivation while the second deals with anxiety, the third deals with attitude and the fourth deals with teacher-student relationship. The last section covers the conceptual framework of the study.

It is universally recognised that students' affective dispositions influence their learning of mathematics, for better or for worse (DeBellis & Goldin, 2006; Hannula, 2006, 2015; Lim & Chapman, 2013a; Ma, 2011; Ma & Kishor, 1997b; Ma, Kishor, & Kisor, 2014; McLeod, 1992, 1994; Tighezza, Tighezza, & M'hamed, 2014; Valentine, DuBois, & Cooper, 2004). Such acknowledgement brought about extensive body of research on the relationships between different affective variables and performance in mathematics (Ball, 1977; McLeod, 1994; Samuelsson & Granstrom, 2007). Amongst these studies, motivation, attitudes and anxiety are three broad affective domains that have been reported to associate very strongly with mathematics performance (Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007). Several reasons were mentioned to explain these strong correlations. Students who have good attitudes towards mathematics or are motivated to do mathematics have a propensity to spend more time on the subject and for this reason perform better. Conversely, students who are nervous about mathematics may not do tasks assigned to them at all, or tend to have pessimistic feelings and ruminations which interrupt their thinking processes when they are working on mathematics problems. These interruptions of their thinking processes cause poor mathematics performance (Ashcraft, 2002; Maloney & Beilock, 2012). Sometimes, the feeling of uneasiness by the students could be so intense that it might result in math-phobia which Olaniyan and Salman (2015) claimed is caused by student-teacher relationship, non-conducive environment for mathematics class among others. Therefore, this review explored how these four factors: motivation, attitude, anxiety and teacher-student relationship relate to the performance of student in mathematics by following the conceptual framework as a guide. The first section deals with motivation while the second deals with anxiety and then the third deals with attitude. The last section covers teacher-student relationship.

Motivation

The debate about the falling standards of students' performance in mathematics has produced increasing attention among researchers, parents and educational authorities because of the importance of mathematics in all realms of life (Iskandar et al., 2014; Mefor, 2014). There exists a consensus that motivation promotes academic performance in students (Schick & Phillipson, 2009) and experimental evidence has demonstrated that academic motivation tends to be an effective predictor of school performance (Deci, Vallerand, Pelletier, & Ryan, 1991; Fortier, Vallerand, & Guay, 1995; Komarraju, Karau, & Schmeck, 2009). Andrew (2003) conceptualises motivation as students' energy and drive to learn, work effectively, and achieve to their potential at school and the behaviours that follow from this energy and drive. According to him, motivation plays a large part in students' interest in and enjoyment of school and study. In other words, motivation is the driving force, impetus, desire or an urge that drives us to achieve our goals. To be fastened to an activity requires glue or hook, motivation appears to be that magnet that attracts and maintain student's interest to various learning adventure. This attraction can be internal or external, depending on the underlining factor(s).

Students could take up challenges or do some things simply because it interests them or because they think it is good or enjoyable. They experience happiness in carrying out the activity and have a propensity to develop inner satisfaction, confidence and are successful. This is what is called intrinsic motivation which have been linked to the construct of individual interest, enjoyment and liking (e.g. Gaspard, Dicke, Flunger, Schreier, & Hafner, 2015). Intrinsic motivation is best summed up by Ryan and Deci (2000a, p. 56) as "the doing of an activity for its inherent satisfaction rather than for some separable consequence". However, extrinsic motivation is the force behind doing something for some consequence separate from the immediate action (Wigfield & Cambria, 2010). It is thus a means to an end rather than an end in itself. Extrinsic motivation is seen to be driven by external forces such as rewards, praises and approval by peers, which can end in the absence of a reward or a gift. Extrinsic motivation refers to the stimulation that depends on external incentive to initiate actions towards a set goal. A student, who is extrinsically motivated, learns because he/she wants good grades, marks, honour or respect and the joy for studying the subject does not matter.

Furthermore, some studies have demonstrated that in the mathematics classroom specifically, the separation of motivation into two extremes is insufficient (e.g. Walter & Hart, 2009). Over time, the initial distinction made between intrinsic motivation and extrinsic motivation as adaptive and mal-adaptive drives, respectively, turned out to be less compelling than originally expected (Matthews, Hoessler, Jonker, & Stockley, 2013). These could be due to the considerable overlap between extrinsic and intrinsic motivation (Cokley, 2000).

Some researchers have used motivational approaches, such as self-efficacy theory (e.g. Zimmerman, Bandura, & Martinez-Pons, 1992), goal theory (Meece & Holt, 1993), investment theory (Horn, 1982), socio-cognitive theory (Bandura, 1977), and expectancy-value theory (Eccles[Parsons] et al., 1983) to examine the relationship between academic motivation and academic performance. Another viewpoint that seems promising and applicable for the study of academic performance is Deci and Ryan's (Deci & Ryan, 1985; Deci & Ryan, 1991, 2000a) motivational approach: the Self-Determination Theory (SDT). This theoretical outlook has generated an extensive amount of research in the field of education (Deci et al., 1991).

Self-Determination Theory

Self-determination is any effort to be in control of our actions, thoughts and feelings and make alterations when judged necessary (Deci & Ryan, 1985).

The essential nature of self-determination is of one action over-riding another, in terms of stopping, starting or changing behaviour. It has to do with the ability or power to make decisions for self. Self-determination theory (SDT) was propounded by Deci and Ryan (1985) and has proven to be an all-inclusive and valuable theory to explain students' learning strategies, performance, personal experience, and perseverance in the educational setting (Ryan & Deci, 2000a). SDT is "an approach to human motivation that highlights people's inner motivational resources in explaining healthy personality development and autonomous self-regulation" (Reeve, Deci, & Ryan, 2004, p. 33).

SDT offers a sound argument for systematically linking the environmental factors that influence motivation and personal well-being within the socio-cultural context (Reeve et al., 2004). SDT assumes that motivation can be classified into three categories: intrinsic motivation, extrinsic motivation, and amotivation (Deci & Ryan, 1985) but further divided extrinsic motivation into four sub-constructs: (i) external regulation, (ii) introjection, (iii) identification, (iv) integrated regulation motivation. Studies have reported that each sub-construct measures distinct aspects of motivation (Fairchild, Horst, Finney, & Barron, 2005; Lim & Chapman, 2014; Vallerand & Bissonnette, 1992) and exist on a continuum, according to the level of control that individuals have over their actions or behaviours (Deci & Ryan, 2000a).

As mentioned earlier, intrinsic motivation is defined as participation in an activity for the pleasure and satisfaction from that participation (Deci & Ryan, 1985; Vallerand et al., 1992). In other words, students who are intrinsically motivated study not only to pass their examinations, but also to gain knowledge for its sake. Vallerand and Bissonnette (1992) suggest that students who had a higher intrinsic motivation for academic activities persisted longer and finished the course. Fortier et al. (1995) conducted a study whose evidence also showed that intrinsic motivation has a positive relationship with college GPA, which was partially mediated by assiduousness, such as willpower, organisation, class attendance, and efficient study (Komarraju et al., 2009).

Students who have high intrinsic motivation might achieve academic success by attending higher levels of conscientious behaviours. Both field and laboratory studies have shown a connection between autonomous forms of motivation and better school performance (e.g. Fortier et al., 1995). In some cases, intrinsic motivation has been shown to predict performance in many expressions (Fennema & Sherman, 1976; Meyer, 1985; Ryan & Deci, 2000a, 2002). Similar results have been documented for intrinsic motivation and mathematics learning (Aiken, 1970; Middleton & Spanias, 1999).

Vallerand et al. (1992) further classified intrinsic motivation into three types: intrinsic motivation to know, intrinsic motivation toward accomplishments, and intrinsic motivation to experience stimulation. There are slight distinctions in these intrinsic motivations which are as a result of different motivational perspectives in research. According to Vallerand et al. (1992, p. 1005), 'To know' is defined as "the fact of performing an activity for the pleasure and the satisfaction that one experiences while learning, exploring, or trying to understand something new". 'To accomplish' is "the fact of engaging in an activity for the pleasure and satisfaction experienced when one attempts to accomplish or create something".

It is necessary to note that the difference is identified in the outcome: understanding in 'To know' and accomplishing in 'To accomplish'. 'Toward stimulation' occurs when one engages in an activity for the stimulation or excitement derived from that engagement. Spinath and Steinmayr (2012) corroborated Vallerand et al. (1992) by stating that intrinsic task-values denote the degree of positive affective evaluation of an activity that includes liking, enjoyment, for reasons that lie within the activity itself, rather than its consequences. They furthermore indicated that intrinsic task-values were not the only reason for learning, task enjoyment can be considered as the most desirable state for learners, because learning comes as a by-product of engaging in a pleasurable activity. This focus is consistent with the view that learners are active, constructive participants in the learning process. Intrinsic motivation plays a critical role in SDT, but extrinsic motivation is also necessary in the educational setting (Reeve et al., 2004).

Extrinsic motivation can be defined as engaging in an activity as a means to an end but not for its intrinsic value (Deci & Ryan, 1985) and its categorisation can be ordered on a continuum from the lowest to highest level of self-determination (Vallerand et al., 1992). The different stages reflect the degree to which the value of the behaviour is internalised and can be differentiated by the degree of autonomy in the regulation of behaviour.

External regulation is the least autonomous; it is performed because of external demand or possible reward (Deci, 1972; Vallerand et al., 1992). Individuals would only take action in order to obtain a reward or an outcome and not just for fun. It is dictated by the desire to satisfy external pressures such as parents and teachers. For example, the fear of punishment by the teacher or being confined by the parents might push a child to do his/her assignment.

Extrinsic motivation that is driven by introjected regulation is driven by ego, wherein a failure to perform well or to study hard results in a sense of guilt or anxiety. It is meant to maintain self-esteem or pride or to avoid guilt or anxiety. Extrinsic motivation that is driven by introjections regulation describes taking on regulations to behaviour but not fully accepting said regulations as your own. Deci and Ryan (1995) claim such behaviour normally represents regulation by contingent self-esteem, citing ego involvement as a classic form of introjections. This is the kind of behaviour where people feel motivated to demonstrate ability to maintain self-worth. While this is internally driven, Ryan and Deci (2000b) claim introjected behaviour is an externally perceived locus of control because they are not perceived as part of self. Introjected behaviour are not fully accepted as part of oneself, for instance the rules are adopted but not incorporated into the sense of self. This indicates that people go along with a task because they think they should, and feel guilty if they do not. Introjection sometimes takes place when individuals feel that they 'ought to' participate in an activity (Wang, Hagger, & Liu, 2009), and start to impose their own rewards or punishments (Hayamizu, 1997). Exercise, for example, may not in itself be enjoyable for some people but is seen as good for one's health and well-being and so, it is at the introjected stage.

Regulation through identification is a more autonomy driven form of extrinsic motivation. It involves consciously valuing a goal or regulation so that the said action is accepted as personally important. Extrinsic motivation driven by identified regulation is strongly associated with the student's personal goals. With identified regulation, action begins to be integrated within the student's sense of self. For example, students who do their assignments because it is valuable to them are at the identified regulation stage while those who do it just because their parents insist remain at the introjected stage. At the stage of identified regulation people see the benefits of the activity. It is still instrumental but represents an early form of autonomy. The student makes the benefit of the object his/her own, understands its rationale and experiences a sense of self-determination in acting in line with it. Although identified regulation is a self-determined form of motivation, it differs from intrinsic motivation in that it is instrumental. Identification results when individuals identify with the reasons behind their behaviour. Usually, identification is experienced by an individual who 'wants to' participate in an activity due to an unrelated consequence (Wang et al., 2009).

Integrated regulation is the most autonomous kind of extrinsic motivation, occurring when regulations are fully assimilated with self so they are included in a person's self-evaluations and beliefs on personal needs. Because of this, integrated motivations share qualities with intrinsic motivation but are still classified as extrinsic because the goals that are trying to be achieved are for reasons extrinsic to the self, rather than the inherent enjoyment or interest in the task.

Amotivation is the least self-determined motivation while intrinsic motivation represents the most self-determined motivation (Vallerand et al., 1992). Amotivation can be defined as lacking an intention to act and when amotivated, people either do not act at all or act without intent, they just go through the motions (Ryan & Deci, 2000b). Vallerand et al. (1992) explained that —individuals are amotivated when they perceive a lack of contingency between their behaviour and outcomes. Amotivated behaviours are not intrinsically or extrinsically motivated but are non-motivated (Vallerand et al., 1992), that is, it occurs in the absence of both extrinsic and intrinsic motivation. Amotivation occurs in the absence of intent to pursue an activity. It is associated with feelings of incompetence to complete a task, or the inability to see value in an activity (Fairchild et al., 2005).

In view of the review so far, it is apparent that there are different categorizations of motivation, some researchers classified it into three, four, five, seven or even eight sub-constructs. One of the reasons for these variations could be due to the fact that some researchers claim that some of the sub-constructs could be collapsed for example, external regulation and identification sub constructs, since both sets of items refer to aspirations about the future. Results from past studies on the Academic Motivation Scale (Cokley, 2000; Fairchild et al., 2005; Smith, Davy, & Rosenberg, 2010; Vallerand et al., 1993) show that they are closely related. In the same vein, identified regulation and integrated regulation seem to have academic effects more like those of intrinsic motivation (Ratelle, Guay, Vallerand, Larose, & Sen′ecal, 2007) hence could be collapsed to produce one sub-construct. Whichever categorization is adhered, the goal of motivation should be to help people reach the stage of self-determination through gradual autonomy support, giving them chances to solve their own problems and inviting them to participate in making decisions.

Autonomous motivation involves acting with a full sense of volition and choice, and it encompasses both intrinsic motivation and well-internalized or integrated extrinsic motivation (Deci & Ryan, 1985; Deci & Ryan, 2000a). It has to do with choosing to engage in an activity rather than being required to perform it in order to satisfy the expectations or demands of others. The implication is that the person would be involved in this activity, rather than other activities that he/she could equally be doing at the time. Controlled motivation, in contrast, involves acting with a sense of pressure or demand and includes regulation by external contingencies and by contingencies that are partially attributable to success, for example to gain admission to the university after senior high school one has to pass with a good grade in mathematics.

Considering the sub-constructs in motivation, amotivation and intrinsic motivation were the strongest correlates of mathematics performance (Lim & Chapman, 2015). According to them, even though other studies (e.g. Fairchild et al., 2005; Lim & Chapman, 2014; Vallerand & Bissonnette, 1992) have reported that the five motivation sub-constructs measure distinct aspects of motivation, only amotivation and intrinsic motivation were important correlates of mathematics performance. This they believe may be due to the considerate overlap between extrinsic and intrinsic motivation. Nevertheless, for the purpose of this study, Deci and Ryan (1985) categorization shall be adapted because it is an appropriate framework that adequately covered and explained the various sub-constructs of motivation. However, even though there are eight sub-constructs of motivation according to the categorisation by Deci and Ryan (1985), integration (extrinsic motivation) and the three different levels of intrinsic motivation ('to know' , 'to accomplish' and 'to experience stimulation') were not considered because they are more relevant for individuals with formed identities and not for adolescents and emerging adults who are the focus of the present study (Ratelle et al., 2007). Thus, the six motivational scale is as shown in Figure 1

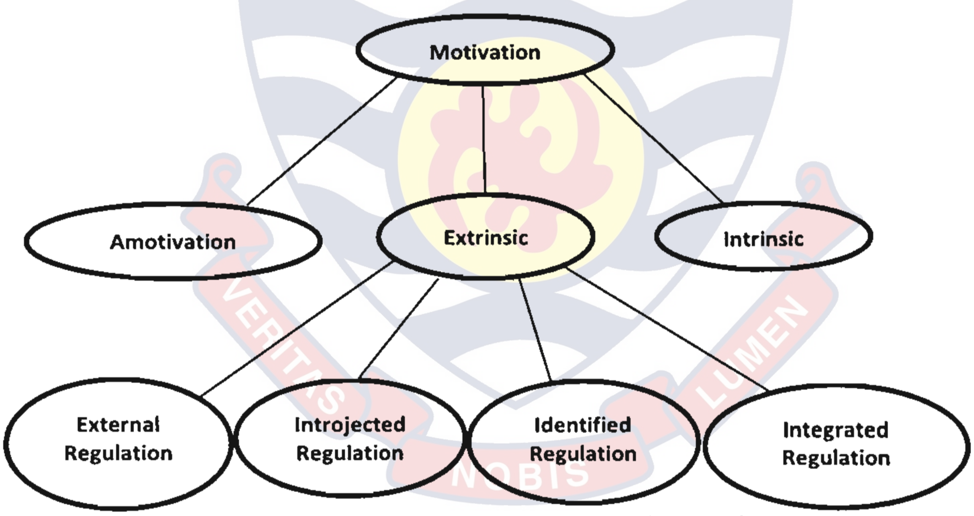

Figure 1: The six motivational sub constructs. Adapted from Deci and Ryan (1985)

Anxiety

According to Research Services (2011), many students have before now experienced mathematics anxiety in schools, for example approximately 93 percent of Americans indicate that they experience some level of mathematics anxiety. Documented story of being anxious toward mathematics include the avoidance of mathematics, dread, nervousness, associated bodily symptoms related to doing mathematics' (Fennema & Sherman, 1976) and the decline in mathematics performance or helplessness, paralysis, fright and mental incompetence that arises among students when they are required to solve a mathematical problem (Fiore, 1999). This kind of 'anxiety', according to Karimi and Venkatesan (2009) was first detected in the late 1950s. For example, Dreger and Aiken (1957) noticed undergraduate college students reacting emotionally to arithmetic and mathematics. Although the reaction appeared to be similar to test anxiety in general, they found that mathematics anxiety is unique. They have labeled it 'number anxiety', which is repeatedly assumed to be high levels of anxiety that weaken performance.

A reasonable amount of anxiety may actually aid performance but beyond a certain degree, anxiety impedes performance particularly in the case of higher mental activities and conceptual process (Newstead, 1995). Psychological literature provides a number of conceptualizations of mathematics anxiety. Suinn (1988) had described mathematics anxiety in terms of its incapacitating effect on mathematical performance. Such incapacitation effect is exhibited in the feeling of tension and apprehension that meddles with handling and answering mathematical questions in a wide variety of ordinary life and academic situations.

Many students who suffer from mathematics anxiety have little confidence in their ability to do mathematics and are likely to take the minimum numbers of required mathematics courses (in higher institutions), which has greatly limited their career choice options (Garry, 2005). Mathematics anxiety is the outcome of low self-esteem and the fear of failure. It causes problems for processing the incoming information as well as the previously learned information for problem solving, which is why some researchers, according to Mutodi and Ngirande (2014) argue that it is an intellectual problem since it interferes with the student's ability to learn mathematics. Such students avoid mathematics whenever or wherever possible (Daane, Judy, & Tina, 1986). Karimi and Venkatesan (2009) found a negatively significant correlation between mathematics anxiety and academic performance. Their claim corroborated the findings of Ashcraft and Kirk (2001). That is, students who have a high level of mathematics anxiety have lower levels of mathematics performance and reduction in anxiety is consistently associated with improvement in performance.

Several researchers such as Geist (2010), Hellum-Alexander (2010) and Ashcraft (2002) have pointed out different reasons for mathematics anxiety in students. They posit that when a teacher's pedagogy does not match with the student's learning, it can become a major factor in developing mathematics anxiety in students. Such anxiety can cause one to lose ones' self-confidence (Tobias, 1993) which may result in slips, errors or misconceptions culminating in poor performances of senior high school students in mathematics. For example, Makonye (2011) indicated that poor performance in mathematics is correlated to learner errors and misconceptions. This position is confirmed by Sarwadi and Shahrill (2014). Ertekin, Dilmac, and Yazici (2009) agreed that mathematics anxiety is not innate but acquired.

Mathematics anxiety has been described to involve cognitive and affective domains of learning. Harper and Daane (1998); Hembree (1990); Sloan, Daane, and Judy Giesen (2002) described the construct as related to personality characteristics, negative attitudes toward mathematics, mathematics avoidance, poor mathematics background, poor teaching behaviour, achievement levels, lack of confidence and negative experiences in school.

Olaniyan and Salman (2015) in their research in Nigeria described mathematics anxiety as a form of *phobia* that is present among students and that mathematics teachers identified mathematics phobia as a problem to mathematics learning in their schools and were able to provide a list of 'math-phobic' students in their class. According to them, mathematics phobia is characterized by feverish feelings in mathematics class, difficulty in understanding mathematics problem, failure to ask or answer/contribute in mathematics class, truancy in mathematics class, student's refusal to do their mathematics assignment and students showing no interest in mathematics class. Some of these findings were in agreement with Smith (1997) and Wilson (2012) who had earlier found out that mathematics phobia among students is characterised in a number of ways ranging from uneasiness when asked to perform mathematical task, to avoidance, feeling of physical illness, and panic in mathematics class. While Traxler (2013) was of the opinion that there are three intertwined variables that are principal causes of mathematics anxiety: beliefs, learning environment, and an anticipatory response, for Olaniyan and Salman (2015) causes of mathematics phobia include teacher-student relationship and non-conducive environment for mathematics class among others.

Anxiety towards mathematics is measured by two opposite sub-constructs: (i) anxiety, which measures level of discomfort with mathematics; and (ii) ease, which measures level of comfort with mathematics (Lim & Chapman, 2013a; Pajares & Urdan, 1996). In the analyses within anxiety sub-constructs, Lim and Chapman (2015) in their study, discover that both 'ease' with mathematics and mathematics 'anxiety' were significant correlates of mathematics performance. Students' choices to pursue advanced mathematics courses or mathematics-related careers are affected by these two sub-constructs (Ashcraft, 2002; Chipman, Krantz, & Silver, 1992; Schwarzer, Seipp, & Schwarzer, 1989).

In other words, there is a significant correlation between the two sub constructs and mathematics performance. It means that students who have high mathematics anxiety (not at ease with mathematics) or avoid mathematics, tend to attain low score in mathematics performance and those who have low mathematics anxiety (at ease with mathematics) tended to achieve high score in mathematics (Clute, 1984; Hembree, 1990; Karimi & Venkatesan, 2009; Lee, 1996). Mathematics anxiety is reported to correlate robustly with mathematics performance (Hembree, 1990; Ma, 1999; Richardson & Suinn, 1972; Wigfield & Meece, 1988; Zakaria & Nordin, 2008) and with mathematics avoidance.

Almost all studies reviewed have shown that anxiety was found to be significantly and negatively correlated with achievement, whereby higher levels of mathematics anxiety relate to lower mathematics achievement. Nevertheless, some literatures suggest that there is a positive correlation between anxiety and academic achievement. This means that the more anxiety students have the higher scores they achieve (Ho et al., 2000; Lee, 2009; Wigfield & Meece, 1988). For example, students from Asian countries, especially Korea, Japan, and Thailand, who though demonstrated high mathematics anxiety on the Programme for International Student Assessment (PISA) 2003 mathematics assessment (Lee, 2009) were consistently among the top performers on international large-scale assessments (Mullis, Martin, Foy, & Arora, 2012; Organization for Economic Co-Operation and Development, 2004, 2010).

"The familial and societal pressures placed on Asian students to achieve academically and the importance placed on mathematics achievement may yield high levels of math anxiety" (Ho et al., 2000, p. 365), which may act as a motivational construct to set high goals and achieve a high level of academic performance. This claimed was corroborated by Siebers (2015) in his study where female students outperformed male students in achievement test despite the fact that the female students had higher levels of mathematics anxiety than the male students. Figure 2 shows the sub-constructs of anxiety as construed by Lim and Chapman (2013a).

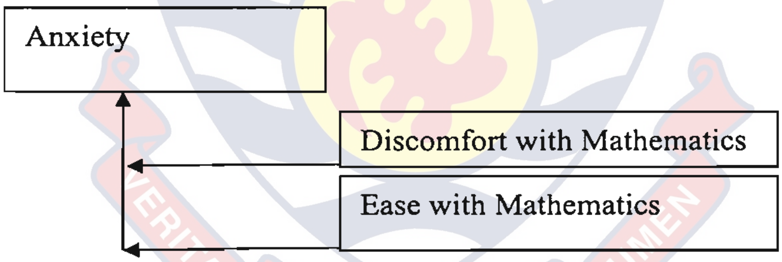

Figure 2: Sub-constructs of anxiety

Attitude

As far back as 1969, Neale (p. 632), defined attitude towards mathematics as an aggregated measure of "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics and a belief that mathematics is useful or useless". It is the feeling or opinion of students about mathematics or mathematics related discipline.

Similarly, Hart (1989) considers attitude towards mathematics from multidimensional perspectives and defined an individual's attitude towards mathematics as a more complex phenomenon characterised by the emotions that he/she associates with mathematics, his/her beliefs about mathematics and how he/she behaves towards mathematics.

Zimbardo and Leippe (1991) defined attitude as favourable or unfavourable evaluative reasons whether exhibited in beliefs, feelings, or inclinations to act towards mathematics. According to Myers (1996), attitude is commonly referred to as beliefs and feelings related to a person or event and their resulting behaviour. This means that when individuals have to respond quickly to something, the feeling can guide the way they react. Teachers and other mathematics educators generally believe that children learn more effectively when they are interested in what they learn and that they will achieve better in mathematics if they like it. This is supported by the finding of Adebowale (2000) who said that, students' lack of interest in mathematics makes it difficult for teachers to impart pertinent knowledge to them on the subject. In my opinion, attitude is a way of behaving towards an activity or object, which is caused by a feeling or an opinion about the activity or the object.

Attitude towards mathematics plays a crucial role in the teaching and learning processes of mathematics because it influences the participation rate of learners. In fact, there is a general consensus among researchers that students' success in mathematics depends upon attitude towards mathematics (Farooq & Shah, 2008), and Schenkel (2009) demonstrates a strong and significant relationship between mathematics attitude and mathematics achievement. That is, the more positive the attitude, the higher the level of performance in the student. Some other studies also find that student beliefs and attitudes have the ability to either facilitate or hinder learning (Mata, Monteiro, & Peixoto, 2012; Minato & Yanase, 1984; Randhawa & Beamer, 1992).

Bandura (1977) states that attitude is often used in conjunction with motivation to achieve. It is how well people judge themselves to perform a task successfully. Moreover, extensive evidence and documentation were provided for the conclusion that attitude is a key factor in the extent to which people can bring about significant outcomes in their lives. The relationship between attitude and academic achievement is expressed by Bandura that the evidence is relatively consistent in showing that attitude contribute significantly to level of motivation and academic achievement. Williams (2004) found significant relationships between attitude to a subject and performance in that subject. In other words, knowing people's attitude is to envisage their actions.

Research has repeatedly suggested that mathematics attitude is a critical construct related to learning. Attitudes towards mathematics are positively and significantly associated with mathematics achievement in several countries: students with positive attitudes tend to achieve higher (Else-Quest, Hyde, & Linn, 2010; House, 2006; Shen & Tam, 2008; Singh, Granville, & Dika, 2002; Winheller, Hattie, & Brown, 2013). Although this variable is multidimensional, some researchers have come out with three clearly separated constructs namely academic self-concept, enjoyment of mathematics and perceived value of mathematics (Vandecandelaere, Speybroeck, Vanlaar, De Fraine, & Van Damme, 2012).

Mathematics academic self-concept concerns the students' perceptions of his/her capability to master the subject matter and to do well in mathematics. Enjoyment of mathematics (like learning mathematics) contains the extent to which the student enjoys mathematics lessons and subject matter itself. Perceived value of mathematics (perceived importance of mathematics) finally refers to the beliefs the student holds about the importance of mathematics in every day and later life. A substantial body of research during the last three decades demonstrates that all these aspects of mathematics attitude have emerged as salient predictors of achievement in mathematics (Chiu & Klassen, 2010; Kupari, 2006; Marsh & Hau, 2004; Singh et al., 2002; Wilkins, 2004; Williams & Williams, 2010).

According to Odufuye (1985), the attitude of a learner towards mathematics will determine the measure of the learner's attractiveness or repulsiveness to mathematics. Steinkamp (1982); Olaosebikan (1985); Cheung (1988) and Lawal (1993) in their different studies on attitude of students towards mathematics stated that attitudes are related to the achievement and enrolment in the subject. For example, a study by Dulton (2004) indicated that high achievers have more positive attitude towards mathematics than the under-achievers. According to Dulton (2004), when students were asked to list their subjects in the order of preference, the high achievers gave mathematics a significantly high ranking than their other counterparts.

Attitude is one of the psychological constructs that cut across different philosophical orientations. Different schools of thought approached attitude based on viewpoints about their learning theories. The behaviourists, interactionists or social-constructivists, Vygotkians, et cetera have written about attitude based on the learning ideology of those who propounded their theories, such as Skinner, Piaget, Dewey, Vygotsky, Gardner, Bandura and so on.

Nonetheless, experts in the field of mathematics education have not been able to come up with unambiguous definitions of concepts such as attitudes and beliefs, as acknowledged in the literature (e.g. Furinghetti & Pehkonen, 2002). According to McLeod (1992, p. 590), "a major difficulty is that research on affect has not usually been grounded in a strong theoretical foundation", and more recently Cretchley (2008, p. 147) supported this assertion: "this neglect is easy to understand, given the difficulties researchers face in this new field: theories not yet well-developed, terminology used differently and ambiguously, and varying research instruments, some untested, make the literature difficult to interpret, and leave researchers open to criticism."

Consequently, there are various categorizations of the sub-constructs of attitude. For example, Ashby (2009) on one hand opine that factors that influence attitude towards mathematics are confidence, beliefs in the importance of mathematics and its utility in practice and mathematical anxiety. On the other hand, Lim and Chapman (2013b) claim that attitudes towards mathematics can be categorised into three sub-constructs: (i) enjoyment of mathematics; (ii) self-confidence in mathematics and (iii) value of mathematics. However, the modified

Fennema-Sherman attitudes scales (FSMAS-R) confirmed the eight different thematic categories of attitude. These are: value, enjoyment, perseverance, interest, perceived personal ability, confidence, social influence and gender.

If some of the sub-constructs are merged or collapsed, for example, perseverance and interest could produce attention; personal ability and confidence could produce self-confidence, then, the various categorisations will all converge at the same point. In that case, the enjoyment sub-construct has to do with 'the degree to which students enjoy (Tapia & Marsh, 2000, p. 17), the satisfaction, equity, natural and positive consequences they experience by working mathematics. The self-confidence sub-construct deals with 'students' confidence and self-concept of (their) performance in mathematics' (Tapia & Marsh, 2000, p. 17), the learning requirement, success opportunities, personal control or ability for working mathematics. Attention sub-construct deals with the interest, perpetual arousal, inquiry arousal and variability of students working mathematics.

According to self-determination theory, two important predictors of intrinsic motivation are the self-selection of activities and the competence that individuals feel while engaging in them. The proponents of this theory (Deci & Ryan, 1985) claim that when activities are perceived as chosen rather than required, that is, acting with a full sense of volition and choice, and when people believe they would be successful in carrying out the activities, there is a high possibility that intrinsic motivation is experienced in the form of interest.

Finally, the value sub-construct measures 'students' beliefs on the usefulness, relevance and worth of mathematics to their lives' (Tapia & Marsh, 2000, p. 17), goal orientation, motive matching and familiarity for working mathematics. Students' usefulness of mathematics is related to the confidence they express in their achievements. Utility value is the degree to which students value mathematics for its usefulness in a future endeavour. Eccles and Wigfield (1995) found that students' choice to participate in a mathematics task related to their valuing of mathematics. This means that if a student chooses to study mathematics or spend more time on presumably difficult question in mathematics other than another subject, this demonstrates the student's way of saying that mathematics is useful.

However, there are some controversies over the description of the sub constructs of attitude. To some researchers, the crux of attitude is that when individuals believe they have the capability to succeed at different activities they will be more likely to engage in them, persist in the face of difficulties, and do well on those activities (Bandura, 1997; Graham & Williams, 2009; Schunk & Pajares, 2009; Weiner, 1992). On the other hand, some researchers maintained that if individuals see little purpose or reason for doing an activity (such as math homework) they probably would not, even if they believe they can do the activity (Elliot, 2005; Wigfield & Eccles, 1992; Wigfield, Tonks, & Klauda, 2009).

Nevertheless, the study of Lim and Chapman (2015), discover that within the construct of attitudes, self-confidence was the strongest correlate. This strong correlation between self-confidence and achievement concurred with past findings (e.g. Goldberg & Cornell, 1998; Ma & Kishor, 1997a) and suggested the importance of self-confidence to obtain better mathematics results, both in the short and longer terms. This view is important for this study because, one of its objectives was to find out which of the sub-constructs of attitude best predicts performance in mathematics. Thus, an in-depth exploration of confidence might help to understand its important role in improving the performance of students in mathematics. Figure 3 shows the sub-constructs of Attitude.

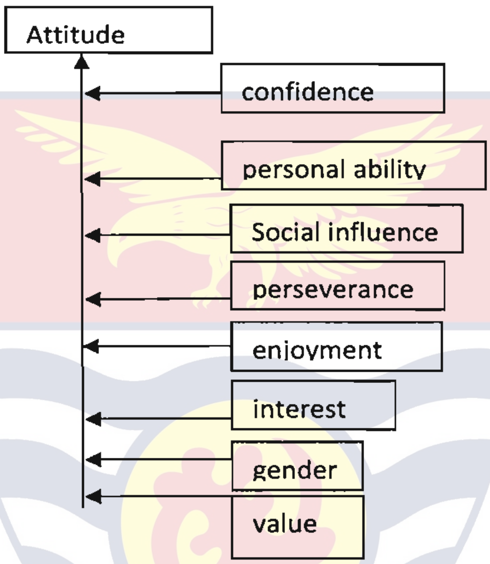

Figure 3: Sub-constructs of Attitude. Adapted from Lim and Chapman (2015)

Confidence

The most important psychological factor related to mathematics achievement is mathematics self-confidence (Iskandar et al., 2014). According to Bandura (1977), self-confidence is ‘not a measure of the skills one has, but a belief about what one can do under different sets of conditions with whatever skills one possesses’.

A student who lacks confidence in mathematics would not study hard, not take the initiative, and always lose interest in the subject (Guangming, Huimin, & Yanyun, 2009). Students with low confidence level may have negative self-perception and this may result in low level of performance (Dekrefflin, 2003). This may be one of the factors responsible for ever declining performance in mathematics of senior high school students in Ghana over the years.

Stankov, Lee, Luo, and Hogan (2012) measured confidence, self-belief, self-efficacy, self-concept and anxiety in students aged 15 from Singapore and established that a different confidence factor exists in the domains of Mathematics and English. Their focus on confidence was taken to mean a state of being certain about the success of a particular behavioural act. Furthermore, Stankov (1999) situated confidence between cognitive abilities and personality and plotted confidence against success in cognitive abilities and personality and the results signified that confidence is important to success in mathematics. Hence, Lim and Chapman (2015) finding corroborates the earlier assertion of Stankov et al. (2012) and Stankov (1999). Although Iskandar et al. (2014) claim that the level of confidence is the first step to success in mathematics, it could not be determined whether students' self-confidence came from their general success in mathematics or if their success in mathematics built their self-confidence, it is much like the "Chicken and the Egg" debate. Morony, Kleitman, Lee, and Stankov (2013) predicted achievement by measuring confidence against self-efficacy, anxiety and self-concept in Confucian Asia and Europe and declared that confidence is a relatively new measure of self-belief, but is the single most important predictor of mathematics accuracy.

In order words, the relationship between self-confidence and academic achievement is likely to be reciprocal, that is, prior academic achievement affects subsequent academic self-confidence and prior academic self-confidence also affects academic achievement. It follows therefore, that if an individual has a negative attitude towards a particular subject, as a result of low self-confidence, the individual will have low level of confidence to study the subject. The perception of one's self-confidence has been found to influence the attitude, learning and performance in a subject. Students with low self-confidence maintain a low level of confidence, negative self-perception and low level of performance (Dekrefflin, 2003).

Researchers have demonstrated the value of self-confidence in predicting a student's performance in mathematics. For example, Bandura (1977) postulated that self-confidence, as a person's belief concerning his/her ability to successfully perform a given task or behaviour, is a major determinant of whether a person will attempt at a given task and the amount of effort and persistence produced in pursuing the task. It was also demonstrated that based on the social cognitive theory, students' beliefs in the judgment of confidence in performing academic tasks or succeeding in academic activities will determine their subsequent capability to accomplish such tasks or succeed in the activity (Bandura, 1986).

Meanwhile, the research by Campbell and Hackett (1986) found that students' belief in their ability in mathematics is an important factor that will contribute toward their achievement in mathematics. Also, research findings by Hackett and Betz (1989) found a moderately strong relationship between mathematics self-confidence and mathematics performance. Believing in self-confidence, influences many aspects of life such as choosing goals, making decision, level of continuity and stability and encountering challenging problems.

When student confidence which is an internal factor is negative, it is otherwise referred to as learned helplessness by some scholars (Slavin, 2003). This has to do with students having doubt about their ability to learn or do well in mathematics. If such students achieve academic success on certain mathematics examinations, it would be attributed to instability factors, such as luck. Student without confidence in mathematics would not study hard, not take the initiative, and always losing interest (Guangming et al., 2009). The student's self-concept (perceptions of his/her capability to master the subject matter and to do well) in mathematics was found to have a particularly strong (reciprocal) association with achievement (Kupari & Nissinen, 2013).

In Lim and Chapman (2014) study of an investigation of the Fennema-Sherman Mathematics Anxiety Subscale, mathematics performance had a stronger relationship with self-confidence in mathematics than with mathematics anxiety and ease with mathematics. That result suggested that self-confidence in mathematics is a more important correlate of mathematics performance than mathematics anxiety and ease with mathematics.

A confidence score was compared to the percentage of correct answers in a test in order to assess the realism of the confidence judgements (Moore & Healy, 2008; Stankov, 2000). The result was that confidence is indeed required for success, but high confidence and low accuracy is a problematic combination. Just as students who repeatedly underestimate their performance can lose motivation for learning, due to a lack of self-confidence, in the same way, students who over estimate their performance may be at a disadvantage as their over confidence may hinder their motivation to learn new procedures (Stankov, Morony, & Lee, 2014). In addition, Huang (2011), in quoting Marsh and Craven, noted that if practitioners improve performance without also promoting participants' self-beliefs in their ability, then the performance gains are not likely to be long lasting.

Teacher-Student Relationship

Teachers play an important role in the trajectory of students throughout the formal schooling experience (Baker, Grant, & Morlock, 2008). Although most research regarding teacher-student relationships investigate the elementary years of schooling, teachers have the unique opportunity to support students' academic and social development at all levels of schooling (Baker et al., 2008; Bronfenbrenner, 1979; Bronfenbrenner & Morris, 1998; McCormick, O'Connor, Cappella, & McClowry, 2013). Aligned with attachment theory (Ainsworth, 1982; Bowlby, 1969), positive teacher-student relationship enables students to feel safe and secure in their learning environments and provide scaffolding for important social and academic skills (Baker et al., 2008; O'Connor, Dearing, & Collins, 2011; Silver, Measelle, Armstrong, & Essex, 2005). The quality of the relationship between a student and the teacher will result in a greater degree of learning in the classroom, according to Downey (2008), and may be one of the most important environmental factors in changing a child's educational path.

Teachers who support students in the learning environment can positively impact their social and academic outcomes, which are important for the long-term trajectory of school and eventually employment (Baker et al., 2008; O'Connor et al., 2011; Silver et al., 2005). When teachers form positive bonds with students, classrooms become supportive spaces in which students can engage in academically and socially productive ways (Hamre & Pianta, 2001). In other words, good relationships between students and their teachers are essential to the development of all students in school. Hamre and Pianta (2001) concluded that "forming strong and supportive relationships with teachers allows students to feel safer and more secure in the school setting, feel more competent, make more positive connections with peers, and make greater academic gains" (p. 57). Similarly, Darling-Hammond (2006) explains that, "teaching is in the service of students, which creates the expectation that teachers will be able to come to understand how students learn and what students need if they are to learn effectively – and that they will incorporate that into their teaching" (p. 4). It is this idea of determining what needs to be incorporated into instruction for effective learning to take place that makes teacher-student relationship crucial to be studied alongside the student factors.

Positive teacher-student relationship are classified as having the presence of closeness, warmth, and positivity (Hamre & Pianta, 2001). Students who have positive relationships with their teachers use them as a secure base from which they can explore the classroom and school setting both academically and socially, to take on academic challenges and work on social-emotional development. This includes relationships with peers, and developing self-esteem and self-concept (Hamre & Pianta, 2001). Through this secure relationship, students learn about socially appropriate behaviours as well as academic expectations and how to achieve these expectations (Hamre & Pianta, 2001). Within the school, Adeniji (2002), Opeifa (2004), and Ukwuju (2006), are of the opinion that unhealthy interpersonal relationship between teacher and teacher, teacher and student, student to teachers and headteacher usually affects the progress of the student and the tone of the school generally.

Anderman and Anderman (1999) observe that classroom relationship is to a large extent determined by the kind of relationship operating between the teacher and the students in the classroom. The kind of relationship in the classroom is, therefore, in turn determined by the kind of teacher in the classroom. In fact, there is plausible proof that the nature and quality of teachers' relationship with children has a significant effect on their learning (Brophy-Herb, Lee, Nievar, & Stollak, 2007). A teacher who is autocratic, (Bamard, 1999; Oguntade, 2005; Yabe, 2002) creates a stormy and passive emotional climate within and outside the classroom; and those who choose to be laissez-faire are doing nothing more than paying lip services to the principle of teaching. Teacher-student relationship has a strong bearing on students' academic performance; hence, it is necessary that such relationship has to be cordial always if the teaching and learning process is to yield a fruitful result. Hamre et al. (2012) posit that "teachers need to be actively engaged in interactions with children in order for learning to occur" (p. 98). They hypothesized that "it was not sufficient for teachers to be able to gain knowledge about effective teacher-child interactions; they needed actual skills involving identification of effective interactions with a high degree of specificity in order to be most likely to transfer the coursework into changes in their practice" (p. 98).

Stronge (2002) suggests praising students, reinforcing positive behaviours, and establishing trust helps to build caring and respectful teacher-student relationships. When the relationship between the students and teachers is very cordial, students tend to develop more interest in teachers' subjects and this interest has a greater influence on students' academic wellbeing. Unfortunately, many teachers seldom realize that how they teach, how they behave and how they interact with students can be more paramount than what they teach (Yara, 2009). Students are likely to learn effectively if the environment is conducive and the teacher is enthusiastic in teaching. A possible reason for the association between academic improvement and positive teacher-student relationships is students' motivation and desire to learn (Wentzel, 1998).

Motivation may play a key role in the relationship between teacher-student relationships and academic outcomes (Bandura, 1997; Fan & Williams, 2010). Motivational theorists suggest that students' perception of their relationship with their teacher is essential in motivating students to perform well (Bandura, 1997; Fan & Williams, 2010; Ryan, Stiller, & Lynch, 1994; Wentzel, 2003; Zimmerman et al., 1992). Students who perceive their relationship with their teacher as positive, warm and close are motivated to be more engaged in school and to improve their academic achievement (Hughes & Cavell, 1999). The focus on accountability and standardized testing should not confuse the contribution that the quality of teacher – student relationships has on academic development (Hamre & Pianta, 2006). Students' motivation to learn is impacted positively by having a caring and supportive relationship with a teacher (Wentzel, 1998).

The literature review so far seems to point in the direction of teacher-student relationship as a catalyst that could initiate positive attitude and motivation, as well as reduce anxiety in students. It behooves on teachers to comfortably accept that teaching necessarily must involve listening to students and responding to their needs. Therefore, there should be collaboration between teachers and learners to promote an environment that supports learning, pursues a learning dialogue approach to teaching, and ultimately involves a focus on learning (MacBeath & Dempster, 2008). This must include listening to students and watching what they do. This will position teachers to learn more about what students know, how they think, and what they need to succeed. Such an approach to reconsidering teaching could engage teachers to think critically and reflectively about their instructional delivery. They would experience valuable critical thinking processes while at the same time deepening expertise in how to promote students' learning.

Historical Background of Critical Friendship

The term "Critical friend" originated from the education reform in England in the 1970s and came out of the self-appraisal activity which is attributed to Desmond Nuttall (Heller, 1988). A Critical friend is perceived as falling between the extremes of the 'hostile witness' and the 'uncritical lover' (Brighouse & Woods, 1999).

Critical friends: Ideal partners or odd bedfellows?

It seems difficult to tell whether the relationship between critical and friendship is that of ideal partners or odd bedfellows because of the different hermeneutical lenses through which scholars perceive these concepts. In their conceptual work that looks at the understanding of friendship between critical friends, Gibbs and Angelides (2008, p. 217) argue that linking the positive notion of friendship with the potentially negative connotation of the term 'critique' often poses a contradiction for 'critical friends'. Hill (2002) shares a similar view when he says merging the norms of friendship with those of critique has often been regarded as a contradiction, both in its conception and practice. Thus, the traditional dichotomy and hierarchical relationship between friendship and critique make the notion of a critical friend hardly reasonable (Gibbs & Angelides, 2008). But, is this really the case? Experiences shared by Baskerville and Goldblatt (2009) in their action research and Ramnarain and Modiba (2013) in their research on self-determined professional development using critical friendship, show that marrying the two concepts is not unreasonable or contradictory. Similarly, the use of the word "contradiction" seems too negative to allow a form of relationship between the two concepts. It may be more appropriate to think of a tension rather than contradiction between critical and friendship, because tension seems to have some level of positive connotation.

Swaffield (2007) supports the idea that the juxtaposition of 'critical' and 'friend' creates a tension. But this tension, she insists, may not necessarily be negative because as she stated in her earlier work (2002), the tension could be seen as the point of balance along the continuum from 'total friend' to 'total critic'. Writing within the context of a two-year research and development project in eighty Scottish schools, Macbeath (1998) also explored the complexities and difficulties of the critical friend. His conclusion resonates with Swaffield's when he avers that "the critical friend is a powerful idea, perhaps because it contains an inherent tension" (p. 118).

Though none of these contributions openly tells what actually the two concepts denote as atomic units, one can deduce that Gibbs and Angelides (2008) and Hill (2002) seem to have a more negative understanding of the concept 'critical'. That perhaps informs their insistence on the relationship as being contradictory and even unreasonable. They are likely to see the relationship between the two concepts as one of 'odd bedfellows'. Swaffield (2007) and Macbeath (1998) seem to have more positive understanding of the concept 'critical' and consequently accept the possibility of an inherent tension but which appears as the very binding agent of the relationship, the very tension, which was painful yet inevitable as critical efforts were made to help these struggling schools, also underpinned the eventual gains in those schools.

However, depending on the cultural context, critical or critique can convey positive or negative connotations. As Swaffield and MacBeath (2005) state, within different linguistic traditions, the term "critical" itself translates something uneasily. Wachob (2011) confirms this when she states that Egyptian culture frowns on criticism, perhaps, because this culture promotes submissiveness and thus perceives criticism negatively. Further, Evans, Pucik, and Baesoux (2001) show how it is possible for American bosses to accept critiques from their subordinate and it is never possible for Japanese teachers to ask their bosses questions directly unless they are sure the boss has the answer. So perceptions of the word 'critical' depend on the context. It also depends on the epoch.

Kant suffixes his philosophical corpuses with the word critique: *Critique of Pure Reason* (1781), *Critique of Practical Reason* (1787) and *Critique of Judgment* (1790). In the first case, critique means examining the limits of theoretical recognition of human mind. The second one is about moral judgments, and the third is about judgment of beauty. These were the comments of Gregor (1987) in her 'Forward' to Kant's *Critique of Judgment*. Kant therefore uses the term 'critique' to denote a method for reflective examination or *Urteilskraft*– judgement, a critical perspective on a matter as opposed to a dogmatic one (Pluhar, 1987). For Kant, critiquing is an awakening from a "dogmatic slumber" (1790, xxxi).

Thinkers like Bloom, Engelhart, Furst, Hill, and Krathwohl (1956) equate critique to evaluation, which considers both the weaknesses and strengths of the partners in the friendship. "Critical" is defined as a review leading to a better understanding of practice and potential emancipation from existing traditions or patterns of practice (Carr & Kemmis, 1986). In a published online article, which employed mixed methods — surveys and interviews to ascertain headteachers' perceptions of the support and challenge School Improvement Partners portrayed as 'critical friends' provides in England, Swaffield (2015) notes that the word "critical" denotes a constructive and informed challenge and support; it is not about fault finding but a critique that is essential for refining a professional practice. From these definitions, critique and critical appear as cognate terms designating systematic inquiry, evaluation and review of existing relational realities that aim at improvement of a practice. Costa and Kallick (1993) believe critique is a vital part in the process of quality development. Therefore, critiquing has the tendency to enhance friendship. That is, perhaps, why Macbeath and Jardine (1998) articulate that critical friendship is not a simple trade-off between the competing roles of friend and critic, but rather a richness resulting from the combination of both. Critical friendship is not a one-way affair. It is a 'give' and 'take' relationship; it is mutually inclusive. It is a kind of symbiotic relationship.

This model of a critical friend could be represented diagrammatically as shown in Figure 4.

Figure 4: Critical friendship in one dimension, (Swaffield, 2004, p. 5)

In presenting a paper at a symposium in Singapore, Towndrow (2007) agrees with this view, and states that critical friendship is entirely possible for a friendship to include a productive critical edge so long as the relationship is participative, collaborative and mutually informing. This critical edge needs to develop sensitively (Schuck & Russell, 2005). Once this occurs, critical plus friendship creates productive critical edge to the relationship and this is what makes critical friendship unique.

Critical friendship is being increasingly "examined in many contexts" (Baskerville & Goldblatt, 2009, p. 207) but it is scarcely defined. The concept is either researched on without a definition or the definition is quoted from Swaffield's (2004, 2008) works. Towndrow (2007) says it is not an oxymoron, but he does not tell us what it is. Essiam (2010) quotes Swaffield (2008) to define critical friendship as a relationship in which someone (a critical friend) provides both support and challenge for the partner or other people in the group if more than one.

Researching on the contribution of critical friends to leadership and school improvement in different contexts, Swaffield (2004, p. 267) defines critical friendship as "a versatile form of external support for school colleagues engaged in leadership activities". Then, in the context of 'Learning How to Learn' (LHTL) project, Swaffield (2007) again defines critical friendship as a flexible form of support for school colleagues and one that is increasingly being applied to different contexts, including the New Relationship with Schools and School Improvement Partners. From the *Carpe Vitam* Leadership for Learning project, Swaffield says critical friendship is a flexible form of assistance for development and research.

The common denominator of these definitions is 'flexible or versatile form of support'. The flexibility of the support is exemplified in the different contexts in which the support can be rendered, for example, in school self-evaluation, and development and research. The inclusion and exclusion of the word 'external' in the three definitions, however, suggests a subtle difference. When the word 'external' prefixes the word 'support' in the first definition, it seems to suggest that in a school self-evaluation context, school colleagues need to see their professional practice through the lens of an extern, the critical friend. So what is nuanced here is that, critical friendship can be between colleagues who are not in the same school environment.

Characteristics of critical friendship and critical friends

Researchers attribute all kinds of qualities to critical friendship. Hill (2002) talks of a critical friend being an attentive, reflective listener, an articulate and a visionary scholar. Towndrow (2007) mentions participative, mutually-informing and collaborative spirit. On his part, Swaffield (2005) outlines five areas to describe the work, conduct and characteristics of a critical friend. These are roles, behaviours, knowledge and experience, skills and qualities. The roles stand for the particular functions that the critical friend fulfills (supporter, critic, challenger); Behaviours involve the specific things that the critical friend does (listens, questions, reflects, feeds back); while Knowledge and experience involves the relevant background which the critical friend brings and uses (for example about the educational system); Skills apply to particular techniques employed (interpersonal and interpretation skills); and finally Qualities define character, attitudes, beliefs, and values (respect, genuineness).

However, embodying these characteristics may not necessarily and sufficiently guarantee a successful critical friendship because a person may have these qualities, but if the person is in an environment of suspicion, mistrust and rigid hierarchical structures, developing a critical friendship with others is unlikely, considering the fact that anatomical components such as context, trust and dialogue are cardinal factors to critical friendship and friends.

Factors that determine the success of critical friendship

Context

Considering its versatility, critical friendship is applicable in different contexts. These include educational institutions, research, self-support study groups, development projects, teacher training programmes etc. Context became a catchword in the writings of the post-modern thinkers who reject the universalization of truths or grand theories. "Grand theories of truth, justice and progress have fallen out of fashion" (Haralambos, Holborn, & Heald, 2004, p. 974). For Rorty (1967), the standards and norms of a community determine people's perception of a reality. In his contribution in *The Cambridge Companion to Gadamer*, Watchterhauster (2002) wanted to know if there is a conception of reality that can be rationally justified independently of the standpoint of the persons whose conception it is. All these suggest that context matters in understanding, accepting and rejecting a reality such as critical friendship.

In critiquing scholars such as Bacon (1960), who evaluates the environment instrumentally, Cooper says "The environment is not something a creature is merely *in*, but something it *has*" (1992, p. 169). This definition seems to see context as a ubiquitous reality that is part of what we are as humans so that we cannot adequately identify ourselves without it. Swaffield and MacBeath (2005) confirmed this view when they insist:

> Context is not a static place saturated with a set of immutable beliefs and values. It is not just "out there", person plus context, but is itself an activity system in which the various players bring their own "rules" and professional goals (p. 245).

This definition is comprehensive and profound, leaving no room for unhelpful relativist and universalist polemics. The phrase, 'it is not just out there' demonstrates that context is both an objective and a subjective reality. The dynamistic nature of context implies its link to culture, a system of beliefs and practices through which human beings understand, regulate and structure their individual and collective lives (Parekh, 1999). Context plays a pivotal role in the success of critical friendship. Thus, familiarity with it is crucial for critical friends (Swaffield, 2004). Context defines the specificity of the goals of critical friendship. For example, the context of a poor academic performance in the Scottish schools mentioned earlier informed the specific goals of the research by Macbeath (1998), which was to seek ways to improve the academic performance of those struggling schools.

In other words, relationships do occur in a particular context. For example, a critical friendship for school improvement will have a particular focus such as extending the practice of distributed leadership, located within specific schools each of which has a unique combination of history, culture, resources, and pupil and staff profiles. Schools function within local communities and are influenced by their administrative, accountability and funding structures, as well as needing to take account of national priorities, pressures and opportunities. All these factors mean that no school is like any other, and critical friend relationships need to adapt to each situation. According to Swaffield (2004), there is therefore no single formula for the work of critical friends, as acknowledged by Healey and De Stefano, cited by Fullan (2001) as saying 'what works in one location won't necessarily work in another' (p. 64).

Finally, Koo (2002), talks of competency and problem-based approaches to critical friendship based on context. What this means is that skills and attitudes are learnable through scholarly and investigative reframing provided by an expert outsider or critical friend. This implies that the giver and recipient of the feedback should not be a world apart contextually— intellectually and professionally. But context alone cannot suffice for the formation and sustenance of critical friendship. Trust is needed to sustain it.

Trust

O'Neill (2002, pp. 3-4), in her *A Question of Trust: The BBC Reith Lectures 2002*, says:

Without trust we cannot stand. We need it because we have to be able to rely on others acting as they say that they will, and because we need others to accept that we will act as we say we will. It seems that in the anatomy of critical friendship, trust is to critical friendship as a heart is to the human body, pumping blood to the other parts of the body for its nourishment and sustenance. That may explain why Costa and Kallick (1993) emphasise that the bedrock of critical friendship is trust. All the articles about critical friendship and friends support this point. Golby and Appleby (1995) and Baskerville and Goldblatt (2009) share in this position. The latter moved from an initial professional indifference to trust as soon as each recognized and respected the other's integrity and passion. The fruit of the trust was their willingness to dissect their practices. For Coleman (2012) studying the significance of trust in school-based collaborative leadership in England, trust promotes effective communication between partners. It is beneficial to student achievement (Goddard, Tschannen-Moran, & Hoy, 2001) leadership success (Bennis, 2009), positive interpersonal relationships (Hoy & Sabo, 1998), professional co-operation (Fan, Suo, Feng, & Liu, 2011), mutual respect and credibility between professionals (Muijs, 2007), greater ownership of change amongst staff, managing issues of power, and control and risk (Vangen & Huxham, 2003).

Coleman (2012) defines trust as a confidence in the integrity and abilities of another which serves as a basis for discretionary individual or collective action. This definition is inclusive and attractive because it shows trust as a quality, a foundation, and a means to something, and this fact is embedded in the phrase 'confidence in the integrity and abilities of another'. The word 'confidence' suggests qualitative character of trust and 'abilities of another' shows it is a means to a goal. The phrase 'basis for' shows trust is a foundation. Concepts such as confidence, integrity, ability and action, which underpin this definition, also suggest the relational nature of trust. We talk of confidence because we are dealing with the significant other in critical friendships where the recognition of others as such warrants symbiotic exhibition of integrity and respect. It entails responsibility, duty, and what Sarason (1986) calls 'exquisite sensitivity'. Since trust entails all these, it takes time and effort to develop. This could be the reason why Coleman (2012) talks of trust in stages: ideological, behavioural and perceptual. In his view, Ideological trust is concerned with the underpinning values and ethics of a potentially trusted individual. Behavioural trust is what we do— the day-to-day manifestations of values such as altruism and fairness; Perceptual trust is what others see— our perceived authenticity and integrity.

The ideological and behavioural trusts seem comparable to the tentative trust of Baskerville and Goldblatt (2009) and the perceptual trust to the calculative trust of Bottery (2003), one that weighs the evidence. These elucidations show that it is diachronic, developing through time, from ideological to perceptual trust. O'Neill (2002) believes trust between professional friends is likely to start with a role-play, a reality identifiable with critical friends. In considering the essence of trust, it must be emphasized that it is inextricably linked to professionalism which also is a crucially determinant of critical friendship.

Professional relationship which aims at offering informed and expert assistance to individuals in an organization and to foster their career development and improve their performance in the organization, is an indispensable component of critical friendship; hence it requires trust as a foundation for its anchorage. Swaffield (2004) noted that critical friendship sticks to clear foci and boundaries for the task in hand. Personal or private relationships do not feature here.

Professional relationships of teachers involve the need to adhere to norms that govern the ways teachers carry out their duties and socialize with students, colleagues, parents and the community. A norm is an accepted standard or a way of behaving or doing things that most people agree with. Professional relationship between teachers and students is a trust-based relationship. It always includes elements of power and dependency as well as boundaries, although it differs from those between therapists and patients because of the collegiality considered important for the students' development, teachers need to find a balance of nurturance and separateness in their relationships with their students (Plaut, 1993).

Teacher-student relationship demands that despite the closeness and sharing, teachers remain teachers and the students remain students. Teachers maintain certain evaluative responsibilities and students continue to be dependent on teachers' guidance and approval. Sometimes, however, the very closeness of the relationship challenges that necessary distance. Feelings of admiration and respect may become intense and personal, that notwithstanding, the appropriate teacher-student boundaries are to be maintained. Teacher-student sexual relationship is considered exploitive by many and should be avoided. Ethical standards warn against relationships with those to whom one provides professional services. Even at the university level, a number of authors have questioned the appropriateness of sexual interaction in teacher-student relationships even when they are consensual (Abbott, 1984; Corbett, Gentry, & Pearson Jr., 1993; Wishnietsky, 1991).

It may be argued that professionals, such as teachers, should be included under the heading of 'fiduciaries' like the physicians, psychiatrists, mental health counselors, and attorneys. This is because students, even university students, often place trust and confidence in their teachers in a manner similar to that observed in, say, the therapist-client relationship, especially when the teacher is sought out for individual guidance and assistance. Fiduciary relationship is defined as a special relationship in which one person accepts the trust and confidence of another to act in the latter's best interest. In such a relationship, the parties do not deal on equal terms. The fiduciary must act with the utmost good faith and solely for the benefit of the dependent party. The type of relationship teachers develop with students could directly impact positively or negatively on the latter's learning outcomes (Agezo, 2010; Dolton & Marcenaro-Gutierrez, 2011).

Implicit in the idea of professionalism is the recognition by those in positions of authority that in their relationships with students there is always an element of power. It is incumbent upon those with authority not to abuse, nor seem to abuse, the power with which they are entrusted. While the importance of mutuality and social interaction may appear to threaten necessary boundaries to some extent, there is another vital element to the teacher-student relationship that more than outweighs that threat, and that is the teacher's obligation to foster independence and autonomy in his or her students. In this way, the role of a teacher is similar to that of a parent or a therapist. The characteristics of a helping relationship, involves the importance of warmth, caring, liking, and interest, all of which reflect a degree of closeness to the client. But there is the need for separateness, and of not being compromised in the role of helping the client's helplessness, dependency, depression or love. Boundary violations compromise the integrity and effectiveness of the student-teacher relationship.

Good teachers should expect their students to contribute to their own professional growth. They should learn from what their students read, be challenged by their students' questions, and should like to see their success as reflecting, at least in part, on their own professional expertise and devotion to them. Their social interaction with their students, especially in a close academic environment should help contribute to the personal development of the students. And such activities should reflect a concern with the development of the whole person, not only a well-educated individual or professional.

Dialogue

According to Swaffield (2008), dialogue is a very particular form of conversation involving the exchange of ideas and the search for shared meaning and common understanding, quite different in form and purpose from casual chat or combative debate. Watkins (2005, p. 93) understands dialogue as a sort of talk that is mostly closely "associated with rich learning, development of understanding and building of community". For Gadamer (1975, p. 143), dialogue is a "conversation, a process of two people understanding each other". He maintains that people bring their 'prejudices', or 'horizon of understanding' to the encounter and the result of this interaction is what he calls 'fusion of horizons'. These definitions suggest that dialogue is a purpose-driven interpersonal rapport with the cardinal goal of achieving a common good. This is where the relationship between dialogue and critical friendship lies.

Critical friendship is a purpose-driven relationship. That is probably why Kazepides (2012), who, in looking at education as dialogue, states that dialogue has a serious, challenging and demanding character, requiring respect, trust, open-mindedness, a willingness to listen and to risk one's own preconceptions, fixed beliefs, biases and prejudices. Its aim is not to win an argument but to advance understanding and human wellbeing. The prefix 'dia' in "dialogue" is a Greek word, which means between or through and thus indicates interpersonal communication, while the word 'logos' suggests that the interchange among people is governed by appropriate rules of reasoning (Kazepides, 2012).

Critical friends, be they peers or not, need dialogue through which they will test each other's understanding of friendship and nourish it. This is because in dialogue, positions are checked and crosschecked, and unsatisfactory claims are critiqued and the author asked to explain more leading to a better understanding and knowledge of each other or one another in a relationship. The very fact that understanding of a reality is never complete, absolute, or total but a happening, a process, always on the way (Gadamer, 1983) is a good reason for dialogue in critical friendship, considering the fact that critical friendship is a dynamic relational concept that is contextually vulnerable. Thus, constant disciplined dialogue is required, not only to gain deeper understanding but also to sustain critical friendship. For Swaffield and Dempster (2009, p. 118), "Disciplined dialogue is the key — dialogue that is informed, inclusive and enabling" for critical friendship. In addition to these factors, some other studies have argued that time is required for their actualization. Consequently, it becomes a significant factor to be considered in relation to the determination of success or otherwise of critical friendship.

Time

Critical friendship is also a 'dynamic relationship' that particularly integrates critique and friendship, or challenge and support, which evolve over time. The relationship initially emphasizes friendship or support, and critique or pressure features later. With time, the critical friend judges and employs the appropriate combination of the two elements. With the third dimension of time (as shown in Figure 5), the complexities of critical friendship are revealed further.

This has led to the development of a model for conceptualizing it (Swaffield, 2004).

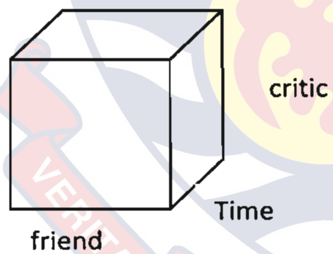

Figure 5: Critical friendship in three dimensions (Swaffield, 2004, p. 6)

Each and every student is unique and has something to contribute to the teaching of a teacher. Based on the essence of critical friendship, teachers must know the existence of various categories of students as defined by Rudduck, Chaplain, and Wallace (1996), in their classrooms. According to this categorization, there are in every classroom, rejecting, indifferent, compliant or influencing learners. Each of these categories is characterized by specific traits or behavioural patterns. The rejecting learner disrupts teaching and learning, behaviour is anti-social, attends school irregularly, frequently on report and sometimes excluded; indifferent learner mistrust school and teachers, withdraws from sources of support and denies concern about progress; compliant learner attends school regularly, quite likes school and teachers, does what is required and trusts school to 'deliver' a future and influencing learner wants to understand and to contribute, wants to discuss progress in learning, is ready to organize things and take responsibility and is ready to help others. Based on this diversity of categories and behavioural patterns, for the critical friendship to be effective, teachers must have grounding on these realities.

Giving young people more opportunities to say what they think about schooling and developing their sense of responsibility as members of a learning community represents moves towards a different construction of the student's role. Rather than being seen as dependent and incapable, students are regarded as individuals possessing the right to be heard and to be respected as well as the responsibility to act in ways that align with the best interests of their school community (Flutter & Rudduck, 2004). Similarly, where the student's voice is attended to, learning becomes a more holistic process with broad aims rather than a progression through a sequence of narrowly focused performance targets. Student's participation supports a view of learning that accords with the vision of educational priorities proposed by the European Commission: 'The global objectives of learning are threefold: personal fulfillment, social inclusion and active citizenship. Learning also plays a fundamental role in fostering employability' (European Commission, 2001, p. 30). Consulting students about teaching and learning and giving them a role in decision making represent first steps towards the creation of schools as 'learning communities'.

The nature of teachers' relationships with children, including the way rules are set and discipline is administered, is one of the six important ways listed by Hart (1997) through which school can influence the development of children as democratically competent and responsible members of society. Asare (2009) corroborates Hart by indicating that a very important element in the process of education is the interactions that go on between the teacher and the learners. He adds that through such interactive processes, education quality is achieved. Figure 6 shows the sub-constructs of critical friendship.

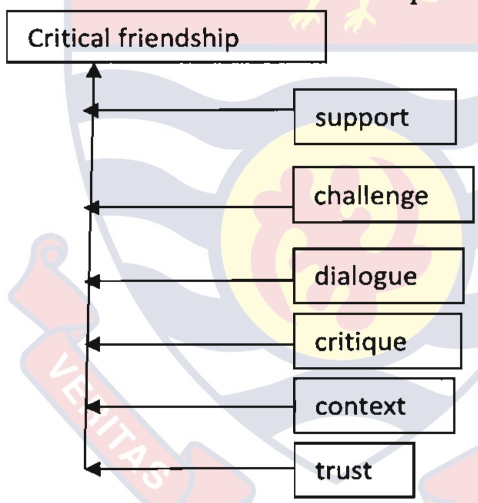

Figure 6: The sub-constructs of critical friendship

Teacher Attitude

Beliefs and attitudes are socially and culturally constructed, deeply seated, opposed to change, and crucial to our way of thinking, doing, and being (Rivalland, 2007). Beliefs are also the end result of an individual's upbringing, life experiences, and in the case of teachers, the result of socialisation processes in schools they have attended as students and worked in as teachers (McLachlan, Carvalo, de Lautour, & Kumar, 2006). Wherever they stem from, it seems that teachers' implicit beliefs are enduring and tricky to change (Hall, 2005; McLachlan et al., 2006; Sumsion, 2003) and are used to assess existing and new ideas about pedagogy.

Beliefs, knowledge, and practice are inextricably intertwined (Foote, Smith, & Ellis, 2004) acting as a 'contextual filter' through which teachers screen their classroom experiences, unravel opportunities and what responses will be rewarded. Teachers play a crucial role in providing students with opportunities for learning mathematics, their attitudes and beliefs directly and indirectly influence student's developmental outcomes in mathematics (Arbeau & Coplan, 2007).

Teachers who provide support, encouragement and respect for their students' values are able to eradicate unwanted behaviour in students. If for instance a teacher is perpetually coming late to class or fails to acknowledge his/her mistakes whenever he/she goes wrong, he/she is indirectly teaching students to be irresponsible. To approach the teaching of mathematics from a Vygotskian perspective is to recognise mathematics as a complex cultural phenomenon that will give students access to a new set of cognitive tools (Egan & Gajdamascko, 2003).

It is consequential from Vygotskian theory that (i) students develop a number of culturally transmitted mental tools through their interactions with more experienced 'others', (ii) mathematics is identified as one of these tools (Bodrova & Leong, 2007); (iii) the teachers' role is not just about direct teaching of facts or skills; rather it involves enabling students to use culturally transmitted mental tools independently and creatively.

Vygotskian theory stipulates the essential role of mediating agents (in this case teachers), in the development of student's higher mental processes. As such, construction of knowledge cannot be separated from its social context, the classroom. Within the classroom, what teachers attend to (or neglect) in relation to mathematics generally, will influence what knowledge students construct about mathematics. "The teacher's ideas mediate what and how the student will learn; they act as a filter in a sense, determining which ideas the student will learn" (Bodrova & Leong, 2007, p. 9). Instruction according to Vygotsky (1978), contributes to cognitive development by moving "ahead of development, pushing it further and eliciting new formations"(p. 198).

A student can develop positive attitude towards mathematics because he/she learns to associate positive experiences. Researchers have shown that the attitude of the mathematics teacher affects that of the students. For example, Churcher, Asiedu-Owuba, and Michael (2015) have establish a connection between teachers' and students' attitudes and performance. According to them, students' scores on the perception of their mathematics teachers have the strongest correlation with their mathematics anxiety scores. Their study corroborated the findings of some earlier researches by Schofield (1981) who reports that positive teacher attitude towards mathematics was significantly related to high achievement in students and Biggs, Vernberg, Twemlow, Fonagy, and Dill (2008) also demonstrated how teachers' attitude contributed to students' academic performance and behaviour. The study among other things discloses that students with the devoted teachers had the courage and determination to face difficulties in school life.

It is believed that a teacher who sees no usefulness of mathematics in the real world and believes that mathematics should be learnt as a set of rules and algorithms will require students to memorize procedures and rules without meaning. This is a negative outlook that will make students develop a negative attitude towards the subject or fail to utilize mathematics for personal growth and development. Studies have shown that students fail to make connection between classroom mathematics and its real life applications (Fletcher, 2010; WASSCE, 2015). In fact, some scholars posit that the current educational system does not provide opportunity for students to acquire critical thinking skills that are crucial for achieving personal and national development goals (e.g. Awosabo-Asare, 2013). Corroborating this claim, Professor P.L.O. Lumumba, the director at the Kenya School of Law, at a public lecture in Accra, on Friday 28th August 2015 declared that "African think tanks don't think, they are merely interested in the prestige that comes with the name and association but rarely do any serious thinking for the continent" (TV3, 2016) .

Studies confirm that emotional responses toward mathematics that are found in teachers which include like and dislike of mathematics, anxiety associated with mathematics and self-confidence in relation to mathematics (Brady & Bowd, 2005; Henderson & Rodrigues, 2008; Philippou & Christou, 1998) have been found to have an impact on student performance. The learner draws from the teacher's disposition to form his/her own attitude which may affect their learning outcomes.

Furthermore, research has shown that positive teacher-student relationship provides good environment for high academic performance (Nyadanu, Garglo, Adampah, & Garglo, 2015). The teacher–student relationship is viewed as integral to successful teaching and learning. The school environment creates the context for a variety of emotional experiences that have the potential to influence teaching, learning, and motivational processes (Goldstein, 1999; A. Hargreaves, 1998; Hargreaves, 2001; Sutton, 2004; Zembylas, 2005).

Consequently, this study examined teacher–student relationship in the classroom using critical friendship as a theoretical base.

Conceptual Framework

From the critical examination of the literature thus far, it can be deduced that good teacher-student relationship would help to motivate, create positive attitude, as well as reduce anxiety in students. On the other hand bad teacher-student relationship could de-motivate students, create negative attitude and increase anxiety among students. As indicated in the conceptual model (Figure 7), the nature of the relationship between students and teachers in the mathematics classroom depends on the nature of critical friendship that exists between teachers and students as discussed. Hence teacher-student relationship in this study is theorised to be determined by the same factors that determine the nature of critical friendship that exists between teachers and students.

Indeed, considering the importance of working relationship required for the effective transfer or sharing of knowledge in educational context, the nature and degree of critical friendship, which is manifested through teacher-student relationship, cannot be ruled out in any study that seek to investigate classroom relationship and student performance.

Therefore for the purpose of this research, a combination of the variables: (i) student affective variables and (ii) teacher-student relationship (indicating the nature of critical friendship) was adopted to explore their effect on performance in mathematics. A conceptual framework of the relationship between the variables on performance in mathematics was used to examine the data in the study as shown in Figure 7.

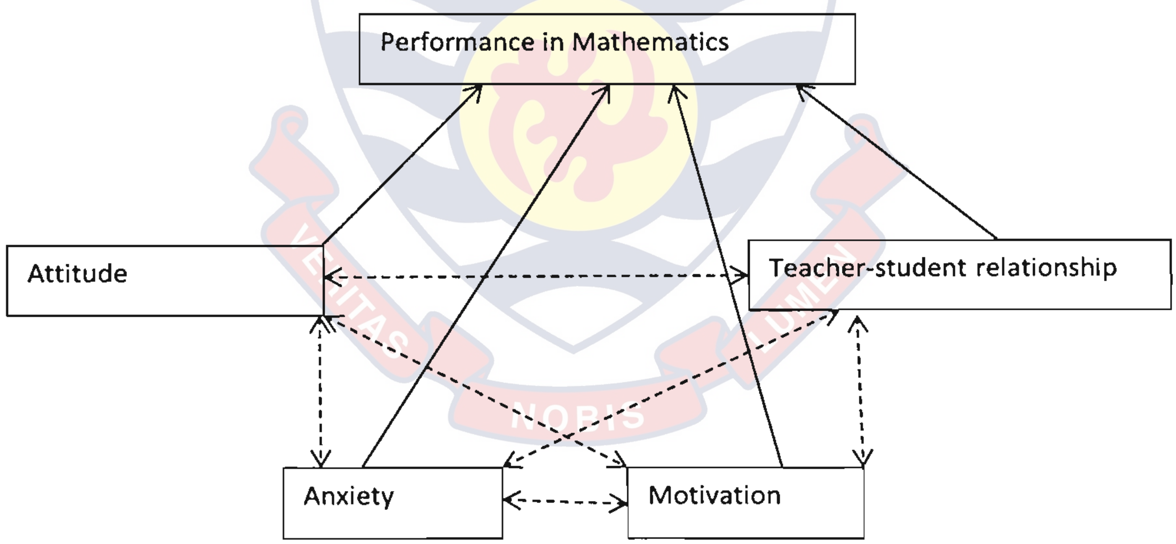

Figure 7: A conceptual framework for the research

Review of some of the past researches has shown that many of these affective constructs and their sub-constructs are strongly correlated. For instance, Lim and Chapman (2015), claim that the review of the studies conducted by

Gottfried (1982), Ryan and Connell (1989), Tapia (1996), Ryan and Deci (2000a), and Zakaria and Nordin (2008) have shown that favourable affective sub-constructs such as enjoyment of mathematics, general motivation in learning mathematics, confidence in solving mathematics problems, assignment of high value to mathematics, ease with the subject and positive motivation demonstrate positive correlation with one another and also with good mathematics achievement. The reverse results, according to them, were reported for perceived negative outcomes such as mathematics anxiety and negative motivation. Hence, Lim and Chapman (2015) recommend that in studies on relationships between affective domains and mathematics performance, researchers only need to measure a few selective affective sub-constructs, which correlate most robustly with mathematics achievement.

Consequently, the conceptual framework is made up of the relationships between the performance in mathematics, which is the dependent variable and the affect-related variables and teacher-student relationship, which are the independent variables. The solid lines represent the relationship between each of the independent variables and the dependent variable while the broken lines represent the relationships among the independent variables. Nonetheless, the present research compared the strength of the relationships between the independent variable and performance in mathematics.

CHAPTER THREE

RESEARCH METHODS

In the previous chapter, attention was devoted to a review of the literature with respect to the four factors under consideration. In this chapter, a discussion on the methodology that was employed in this study is considered. It is sub-divided into five sections. The first section deals with the research design while the second deals with the population and then sample/sampling procedure. The third section covers the research instruments (including pilot-testing of the instruments), while the fourth section deals with data collection procedure. The last section deals with the data analysis.

Research Design

The sequential explanatory mixed method research design was adopted in this study. The choice of this design is predicated on the fact that mixed method research paradigms was used involving qualitative and quantitative research methods. The design was used to obtain both the quantitative and qualitative data that helped to investigate the effect of teacher-student relationship and students' affective variables on performance in mathematics.

Research designs are plans and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis (Creswell, 2009, p. 3). The function of a research design is to ensure that the evidence obtained enables the researcher to answer the research questions as unambiguously as possible.

With the type of the research problem to be addressed in this study, which has to do with determining the extent to which the affective variables: anxiety, attitude, motivation and teacher-student relationship are present in the subjects (the students), as well as determining which of these variables best predict performance in mathematics, it is imperative that the quantitative research approach processes and procedures that would meaningfully produce findings arrived at by statistical procedures be used on one hand. On the other hand, the study involves students' ways of life, lived experiences, behaviours, emotions, and feelings as well as relationship with their teachers and among fellow students. These are better studied in ways that could generate qualitative data that are mainly descriptive and interpretative (Strauss & Corbin, 1998). Thus, mixed methods design was used for this study. This is because it has a much greater potential not just for predicting scores in achievement test using the independent variables but also for explaining reality more fully than is possible when only quantitative method is used.

The quantitative method was employed first through the use of the questionnaires, observation schedule and achievement test. These quantitative tools collected standardized information by asking exactly the same questions to students (3,324) and organising their answers into quantifiable response categories. This method allows for the measurement of many students' reactions to a set of questions. That is, quantitative methods are standardized in presentation, systematically obtaining succinct responses from as many students as possible. Although, these features provided the findings with a high degree of credibility for decision making, the weakness of the approach is the difficulty of establishing controlled conditions in the real world and its insensitivity to complexities and subtleties in human interaction (Lincoln & Guba, 1985; Stecher & Davis, 1987).

Consequently, qualitative method in the form of the focus group interview for students and one on one interview for teachers was used. The semi-structured interview guides gathered more detailed information through a more flexible, in-depth dialogue with students and teachers. The qualitative method provides the context against which to more fully understand the results provided by the questionnaires. They capture what the students have to say in their own words and describe their experiences in depth. The qualitative data provides the texture of real life in its many variations; it gives insight into the reasoning and feelings that motivate the students to behave in a particular way. Although some researchers like Gioia, Corley, and Hamilton (2012) claim that qualitative research explicitly turns itself against reliability and validity, and has been critiqued to be lacking scholarly rigour, nonetheless, a qualitative approach provided greater richness and more detailed information about 240 students in this study (Patton, 1986).

The qualitative approach is sensitive to each individual participant's observation; nonconforming cases were examined closely and explained because one misfit could have an important impact. Hence substantively important cases were explained. In other words, qualitative approach provided the explanation of outcomes in this study but not for individual cases because of the large sample size. A ''causes-of-effects'' approach was adopted for the explanations. However, for quantitative approach, substantively important cases are not given special attention but the ‘‘effects-of-causes’’ approach is employed to estimate average effects (Mahoney & Goertz, 2006).

The intention of utilizing the strengths of both qualitative and quantitative research provided insights that enabled a better and expanded understanding of the students (Boutellier, Gassmann, Raeder, & Zeschky, 2013). The quantitative research method provided the opportunity to collect data with a distant and objective science stance from the outside; whereas face-to- face interactions (interview), engagement and role taking from the inside provided the researcher with the opportunity to observe the body languages of the respondents during the interviews.

The mixed methods help to better understand, explain, or build on the results from quantitative and qualitative approaches. Thus the biases inherent in quantitative method could neutralize or cancel the biases of qualitative method. Triangulating data sources, a means for seeking convergence across qualitative and quantitative methods (Jick, 1979) is another way of ensuring the quality of the data. Thus, it is for this reason of complementarity and triangulation that mixed method approach was adopted in this study.

Population

The target population from which samples were selected for the study was all senior high school Form Two students and their mathematics teachers in the ten public senior high schools in Cape Coast Metropolis. The population comprises 6, 317 Form Two students.

Sampling Procedure

Using the table of sample sizes for research activities by Krejcie and Morgan (1970), sample size that is proportional to the population of Form Two in each of the ten schools was randomly selected. Nevertheless, intact classes were chosen to avoid disrupting the school programmes for the students. The selected Form Two students and their mathematics teachers in the ten public senior high schools in Cape Coast Metropolis who have taught the students for at least one year at the time of the study were requested to participate in the study. In all 3,342 students and 57 teachers were sampled to participate in the study, however, 2,575 students and 49 teachers representing 77% and 86% respectively participated.

In each of the ten schools, the researcher obtained the sampling frame which consisted of the list of the population from which students were selected as units for the study. The list consists of the Form Two students according to their class categorization which was based on the programme offered by the student. Different schools used different letters (A1, A2, B3, etc.) to represent the classroom groupings or categorization according to the programme or specialization of the student. For example, School I (SchI) used 2A1, 2A2, 2A3 and 2A4 to represent her four General Art classes comprising of 41, 40, 36 and 35 students respectively. The school used 2S1, 2S2, 2S3, 2S4 and 2S5 to represent her five General Science classes comprising of 37 students in each of the classes. The categorization in other schools was similar to that of the SchI with little deviations such as using small letters in place of numbers. For example, School G (SchG) uses 2Aa, 2Ac comprising 54 and 57 students respectively to represent her two General Art classes. However, School H (SchH) usage of letters for categorization was unique. The school uses 2C1, 2C2, 2C3 comprising 42, 38 and 45 students respectively to represent her three Business classes while 2H1, 2H2 and 2H3 comprising 44, 46 and 49 students correspondingly represent her General Art classes.

To make selection in each of the schools, the representations (2A1, 2A2, etc.) of the Form Two's for each of the school were put together and required number of classes that sum up to the sample size based on the recommendation by Krejcie and Morgan were randomly selected. Where necessary more intact classes were selected to avoid disrupting and distracting the students from the usual organization of the school, which may result, should few students from a particular class be asked to join the other intact classes for the study.

More intact classes were selected to cater for weary students who may want to discontinue after some time due to the intensive nature of the data collection which spanned seven months (January to July). For example, School F is mostly a Day school with few boarders. However, with a research population of 476 (Form Two students), that is, 2A1 66students; 2A2 44students; 2A3 51students; 2B1 31students; 2B2 26students; 2B3 25students; 2S 14students; 2H1 70students, 2H2 40students; 2V 60students and 2T 49students, the sample size should have been 214 (Krejcie & Morgan, 1970). The classes that were randomly selected initially were: 2H2, 2T, 2B2, 2B1, 2A3 which added up to 197 students. However, to make up the sample size for the school and for possible irregularities, two extra classes were randomly selected. These were 2H1 and 2A1. Hence, the sample size was 333 but 243 persevered to the end of the study.

Furthermore, for the semi-structure focus group interview, the means for each of the students from the four questionnaires were sorted in ascending order and the first 250 students from both ends were shortlisted. Volunteers were sought from the 500 students shortlisted. Consequently, 333 students comprising 200 from the upper boundary and 133 from the lower boundary volunteered for the interview but only 240 students participated in the interviews.

Table 1 present data on the participating schools in the Cape Coast Metropolis and the sample sizes.

Table 1: Participating schools in Cape Coast Metropolis

N/S	Name of Institution	Population size	Sample Size Required	Sample Size Selected	Sample Size Persevered
1	School A	1100	285	423	351
2	School B	949	274	375	312
3	School C	849	265	441	250
4	School D	699	248	327	281
5	School E	550	226	370	289
6	School F	476	214	333	243
7	School G	450	205	253	219
8	School H	450	205	252	230
9	School I	419	196	279	247
10	School J	375	191	289	157
	Total	6, 317	2, 309	3,342	2,575

Source: Field data (2016)

Demographic Profile of Students

Table 2 presents data on the age, gender of student, the school of students and their academic programmes.

Table 2: Demographic Profile of Students

Demographic information	Response	Frequency	Percent
Age groups	15 and below	203	7.88
	16 – 18	2273	88.27
	19 – 21	95	3.69
	22 and above	4	0.16
Gender	Male	1396	54.21
	Female	1179	45.79
The school the student attends	School I*	247	9.59
	School C**	250	9.71
	School D**	281	10.91
	School F	243	9.44
	School B	312	12.12
	School*	230	8.93
	School **	347	13.48
	School J	157	6.10
	School G	219	8.50
	School E	289	11.22
Programmes of students	Science	865	33.59
	Business	386	14.99
	Technical	86	3.34
	General Arts	729	28.31
	Home Economics	305	11.85
	Visual Arts	204	7.92

*Single sex school (Female); ** Single sex (Male); Total sample size 2,575

Table 2 shows that majority of the sampled students, about 88% were between the ages of 16 to 18 years, out of which 54% were male while 46% were female, despite the fact that three of the schools with very huge populations are single sex male schools, only two single sex female with light populations were involved. The remaining five schools have more female representations than male. This could be an indication that the gap between male and female representations in our second cycle institutions is closing-up (Bofah, 2016). Although the research samples were randomly selected based on their class categorizations, all the conventional programmes were involved in the study, with the highest representations of 34% and 28% from Science and General Arts respectively and the lowest 3% from the Technical.

Demographic Profile of Teachers

Table 3 presents data on the age, gender and school of teachers, qualification and teaching experience of the teachers.

Table 3: Demographic Profile of Teachers

Demographic information	Response	Frequency	Percent
Gender	Male	44	89.80
	Female	5	10.20
Age groups	20-25yrs	3	6.12
	26-30yrs	11	22.45
	31-35yrs	15	30.61
	36-40yrs	9	18.37
	41-45yrs	3	6.12
	46-50yrs	8	16.33

Table 3 cont'd

Qualification	B.Sc.	17	34.69
	B.Ed.	21	42.86
	M.Sc.	3	6.12
	M.Ed.	5	10.21
	PGDE	1	2.04
	Others	2	4.08
Teacher's school	School I	7	14.29
	School C	6	12.24
	School D	6	12.24
	School F	4	8.16
	School B	5	10.21
	School H	5	10.21
	School A	4	8.16
	School J	4	8.16
	School G	3	6.12
	School E	5	10.21
Teaching experience	1 – 4yrs	16	32.70
	5 – 8yrs	17	34.70
	9 – 12yrs	11	22.40
	13 – 16yrs	4	8.20
	17 – 20yrs	1	2.00

Source: Field data (2016)

It is observed from Table 3 that out of the 49 teachers involved in this study, only five were females. This proportion is grossly inadequate. It is an indication that probably there is a fewer representation of females in mathematics education at the tertiary institutions or that the trained teachers found themselves elsewhere. There is a need to find out where the problem is, either fewer girls go to the university to pursue mathematics education or they do go but later at the end of the programme they find themselves outside the classroom. If the former is the case, then we need to find a way of encouraging more females to enter into mathematics education in order to produce more role models for girls not just in the teaching profession but in mathematics related disciplines as a whole. However, if is the latter, then there is a need to motivate more females to embrace the teaching profession.

Considering the age of the teachers and teaching experience as reflected in Table 3, it shows that the teaching profession remains attractive to the younger generations. As the elderly ones are going on retirement, there are more young teachers replacing them. However, a look at the qualifications of these teachers revealed that about 45% (B. Sc., M.Sc. and others) of them are unskilled for the job because they do not have teaching qualifications. This is unlikely to change for the better in the nearest future because at the moment both trained and untrained graduates are given equal opportunity to write a qualifying examination that is based only on mathematics content without any reference to the pedagogy, for them to be employed as teachers (GES, 2016).

Data Collection Instruments

The research instruments used for the study were student and teacher questionnaires, interview guides, observation schedule and achievement test. This study required theoretically and methodologically sound instruments to measure each of the four identified factors that are possibly affecting the performance of the senior high school students in mathematics. There were four different questionnaires for the students on the four factors: anxiety, attitude, motivation and teacher-student interaction. As part of the feasibility study, before using the instruments for pilot testing, students in similar social and cultural context with those for the main study were interacted with, in order to adapt the instruments to the local setting. The instruments were then piloted on two different occasions in different localities of similar features.

For the anxiety factor, according to Evans (2001), there are two most commonly used mathematics anxiety scales in research studies which are: the Fennema-Sherman Mathematics Anxiety Scale (FSMAS) and the Mathematics Anxiety Rating Scale (MARS). Even though both scales measure mathematics anxiety, the FSMAS was designed to measure mathematics anxiety in classrooms, whereas the MARS was designed to measure general anxiety toward mathematics and consists of items that are not related to school mathematics. The Fennema-Sherman Mathematics Anxiety Scale Revised (FSMAS-R) was chosen because the aim of this study was to measure anxiety in classrooms. This revised version consists of 10 items from the original 12 FSMAS items, some of which have been reworded. Out of these 10 items, 5 are positively worded and they measure the level of comfort of the students with mathematics while the other 5 are negatively worded and measure the level of discomfort of the students with mathematics. The FSMAS-R instrument has a split-half reliability coefficient of .92 and

Cronbach's α of .90 as reported by Betz, and Pajares and Kranzler respectively on high school sample (as cited by Lim & Chapman, 2013a).

Furthermore, the Modified Fennema-Sherman Mathematics Attitude Scales (FSMAS) which was adapted by Kahveci (2010) to provide the evidence for the reliability of the instrument while at the same time investigating high school students' motivation to use technology for learning by a comparative analysis with respect to varying personal characteristics was adapted in this study. The modified version of FSMAS which was administered by Kahveci (2010) to 9th-12th grade students at a gifted boarding high school in Istanbul, Turkey, recorded a high reliability: Cronbach-α, from .777 to .942. According to Kahveci, the factor analysis of the 57 item questionnaire showed that there were eight different thematic categories among the items: relevance, satisfaction, confidence, gender differences, personal ability, social influence, perseverance and interest. However, the items measuring the gender differences and social influence were deleted due to the fact that the feasibility study before the piloting did not find them relevant to the present study. Hence, the questionnaire which originally contained 57 items now contains 28 items.

Regarding the motivation factor, the Academic Motivation Scale (AMS) adapted by Lim and Chapman (2014) supported in Self-Determination Theory was adapted. It is a comprehensive and widely used instrument for assessing the different domains of motivation (stipulated by the self-determination theory) in mathematics education at the pre-tertiary level (Grades 11 and 12). The modified instrument exhibited good internal consistency of Cronbach α =.88. According to

Lim and Chapman (2014), the validity of the 21 items modified AMS was further demonstrated through correlational analyses among scores on its subscales, and with scores on other instruments measuring mathematics attitudes, anxiety and achievement. The modified questionnaire which originally contained 21 items now has 35 items measuring low self-determination level to high self-determination level, low autonomy to high autonomy and low self-control to high self-control. The items focused on amotivation, external regulation, introjections, identification regulation, intrinsic to accomplish, intrinsic to know and intrinsic to stimulate.

Finally, the teacher-student interaction questionnaire was constructed based on empirical studies on student voice and critical friendship as expressed by researchers such as: Cook-Sather (2002); Flutter and Rudduck (2004); Gadamer (1975); Stronge (2002); Darling-Hammond (2006); Hamre and Pianta (2006); Downey (2008); MacBeath and Dempster (2008); O'Connor et al. (2011); Hamre et al. (2012); Fielding (2012); Fehr (2012); Xue (2013); Brighouse and Woods (1999); Macbeath (1998); Gibbs and Angelides (2008); Baskerville and Goldblatt (2009); Ramnarain and Modiba (2013); Costa and Kallick (1993); Macbeath and Jardine (1998); Coleman (2012); Watkins (2005); Kazepides (2012). Based on the six sub-constructs that these experts claim constitute critical friendship, a questionnaire containing 70 items to measure teacher-student interaction was constructed, however after the pilot tests and experts' contributions, the items were reduced to 33.

The teacher questionnaire contained 74 items that were similar to those on the student questionnaires. It was meant to confirm or deny the presence of anxiety, highlight the characteristics of different attitudes that students may have and the teachers opinions about their students' attitude, seek for teachers' opinion, attitude or belief about motivation and teachers' perceptions of their interactions with their students. Nonetheless, after piloting and experts' contribution, the items reduced to 59.

The interview guides for the students' focus group interview and individual teacher's interview which contained 32 and 20 items reduced to 27 and 16 items respectively after the piloting. The interview was meant to seek for in-depth information and necessary clarity about the issue at hand. Observation schedule was designed based on Teaching Practice Assessment Form A (College of Education Studies Teaching Practice Unit, n.d.). The schedule which contained 20 items was adapted to reflect anxiety, attitude, motivation and critical friendship concepts. This was used as observation guide for the teachers. The achievement test was based on the SHS syllabus and sample of WASSCE mathematics questions as a guide in constructing the test items. The test contained 40 multiple items questions that were answered within 60 minutes. All these instruments were made available to experts in the field to determine their face validity after which they were pilot-tested in senior high schools, in the Central Region.

Reliability

Reliability is an important concept for scholars in the social and behavioural sciences, helping researchers to gain real insights into relationships among observed phenomena and the individual differences in a specific latent construct (Raykov, 2012). Although it is subject to much abuse, misinterpretation and confusion (Sijtsma, 2009), Cronbach's alpha (α) has long been the most widely used quality indicator in test statistics (e.g. Novick & Lewis, 1967). It is acknowledged to be an inconsistent estimator of reliability. It either overestimates or underestimates (Geldhof, Preacher, & Zyphur, 2014; Peterson & Kim, 2013). There are controversies over the use of Cronbach's alpha which stem from different interpretations of the alpha coefficient in the literature (Cortina, 1993). For instance, Cronbach's alpha has been described as the mean of all split-half reliabilities (Cronbach, 1951) and as the lower bound of true reliability (Novick & Lewis, 1967; Peterson & Kim, 2013).

According to Cortina (1993), Cronbach's alpha is highly dependent on the number of items on a construct, that is, as the number of items on the scale increases, α will increase. As such, it's possible to get a large value of α because there are a lot of items on the scale, and not because the scale is reliable. Sometimes alpha is taken as a measure of 'unidimensionality', or the extent to which the scale measures one underlying factor or construct. This is true when there is one factor underlying the data (Cortina, 1993) but Grayson (2004) demonstrated that the same alpha value can be achieved in a scale with one underlying factor, with two moderately correlated factors and with two uncorrelated factors. Consequently, Cronbach (1951) suggested that if several factors exist then the Cronbach's alpha should be calculated separately to items relating to different factors. In other words, if a questionnaire has subscales, α should be applied separately to these subscales. Such is the case in this research, where alpha coefficients were obtained for each of the questionnaires and their subscales separately.

Pilot testing (Reliability and Validity) of the instruments

The Fennema-Sherman Mathematics Anxiety Scale Revised (FSMAS-R) was adapted to measure anxiety. Although the scale contained 10 items, two of the double-barreled items were separated to make 12 items. The Modified Fennema-Sherman Mathematics Attitude Scales (FSMAS) which was adapted by Kahveci (2010) was modified and reduced to 41 items after the initial interactions with the students during the feasibility study. Academic Motivation Scale (AMS) adapted by Lim and Chapman (2014), containing 21 items was modified and increased to 23 items. However, regarding the Teacher-student relationship scale, the questionnaire was pilot tested two times earlier with constant refinement from experts and those who supervised the study. The instrument which originally was made up of 116 items reduced to 70 items after the first piloting and further reduced to 44 items after the second piloting.

Consequently, the 12 items of the Anxiety scale, 41 items of Attitude scale, 44 items of Teacher-student scale and 23 items of Motivation scale were combined to make a questionnaire containing 120 items which was piloted in School K. The school was purposively chosen for the piloting of the instruments because it had all the characteristics being looked for and is outside of the Cape Coast Metropolis. The questionnaires were personally administered to the students in the school and a response rate of 93.75% was achieved. Nevertheless, due to random missing values as a result of lack of familiarity with some of the wordings of the items, only 75% of the data collected were analysed to determine the content validity of the instrument. The internal consistency of the instrument was determined using the Cronbach Alpha Co-efficient.

First pilot test

Pilot testing of the four questionnaires otherwise known as a small scale trial run (Polit, Beck, & Hungler, 2001) of the questionnaires was carried out on the 4th of November 2015 for the purpose of discovering errors and to ensure that the questions were understood by the respondents and there were no problems with the wordings. A small number of respondents comprising of 100 students of General Art and Home Economics programmes of School K, far away from Cape Coast Metropolis were engaged to test the appropriateness of the questions and their comprehension.

The piloting took an average of 90 minutes to complete; the students were fagged out and constantly sought for clarifications. For example, the students could not make meaning out of items 9 and 12 of the Anxiety scale that state 'I get a sinking feeling when I think of trying hard mathematics problems' and 'My mind goes blank and I am unable to think clearly when working mathematics'; items 30 and 36 of the attitude scale which state 'Figuring out Mathematics problems does not appeal to me' and 'I think I will need Mathematics rarely when I graduate from senior high school'. Some items were removed from the teacher-student relationship scale, for example, items 39 and 41 which state 'Every question is important in my mathematics class' and 'There is no stupid question in my mathematics class'. According to the students, it depends on who is asking the question. In some situations if the question is from a student who is good in mathematics, no matter how stupid the question might sound, the teacher may be inclined to answer it unlike if it is from a weak student.

Due to the huge number of items on the questionnaire during the first piloting, the researcher faced some challenges during the analysis. The sample size of 100 which was reduced to 75 as a result of missing values, were grossly inadequate for any meaningful analysis to be done. The ratio of participants to items recommended by some experts was violated, for example, Nunnally (1978) recommends a 10 to 1 ratio; that is, ten cases for each item to be factor analysed. Others suggest that five cases for each item are adequate in most cases (Tabachnick & Fidell, 2007). The initial factor analysis revealed 35 factors that were all mixed up and were difficult to interpret. Following the scree plot specification, a re-run was carried out to extract four factors.

The items that factored into the four different columns aligned to the four questionnaires that were originally put together, although some items factored highly across the board. Those items were removed completely while others were refined, for example, the items such as 'For the teacher and students in the mathematics class, the relationship is like boss and subordinates' 'Debates in mathematics class help me to recall things during examination' 'I fear to approach my mathematics teacher for help in mathematics class' 'The situation in my mathematics class is not allowing students to freely make contributions' were all changed to 'The relationship between my Mathematics teacher and students is like master and servant' 'Discussion in mathematics class helps me to recall things during examination' 'I am afraid to approach my mathematics teacher for help in mathematics class' 'During class, my mathematics teacher does not allow students to freely make contributions' respectively.

As a result of the boredom created by the first piloting due to the huge number of the items on the questionnaire which could inadvertently introduce errors into the students responses and the inability of the data to conform to statistical analysis, it became necessary to split the questionnaire into its original components, that is, 'Anxiety', 'Attitude', 'Teacher-student relationship' and 'motivation questionnaires and pilot tested it separately from 11th to 15th of January, 2016, using a sample of 200 students (four classes) that were randomly chosen from the Form Two students of Senior High School K (SchK). A response rate of 85% (170 students) was recorded due to the fact that not all the students that started with the piloting remained till the end. Along the line, some were sacked for school fees, while some were not regular in school during the period.

Second Pilot test: Anxiety Questionnaire (A1)

The first questionnaire titled 'A1 Student questionnaire on Anxiety' comprised 12 items and took an average of 15 minutes to complete by the students. While attending to the questionnaire, the students asked for clarification if 'quizzes' and 'tests' mean the same, as they are used to the word 'test'. The pre-testing provided the opportunity to see the acceptability of the wording of the questions in the local context. During the interaction with the respondents after the administration of the first questionnaire (A1), some of the respondents complained of the item 5 which states 'I almost never get uptight while taking mathematics quizzes'. According to them, it was a bit confusing. This item has been changed to 'I feel relaxed while taking mathematics tests'. Again, all of the items that were double-barreled have been separated to produce multiple items. At the end, the first questionnaire contains 18 items. The factor analysis for the questionnaire produced two factors: the positive (8 items, α = 0.820) and the negative (10 items, α = 0.830), overall (KMO = 0.870, α = 0.820) is very close to the producer's specification of 0.9 (as cited by Lim & Chapman, 2013a).

Second Pilot test: Attitude Questionnaire (A2)

Regarding the second questionnaire titled 'A2 Student questionnaire on Attitude' there were 40 items. The respondents claimed that they had difficulty understanding item 12 which was: 'Most subjects I can handle okay, but I have a knack for flubbing up the problems about mathematics'. This item has been changed to 'Most subjects I can handle well, but I have problems with mathematics' Item 35 of the questionnaire 'I am challenged with problems in Mathematics that I cannot understand immediately' connotes different meanings to the students with some students taking the word 'challenge' to mean 'giving up' on the mathematics problem while others took it to mean 'confronting the problem till it is solved'. Due to the discrepancy in the understanding of the students, the item was removed entirely from the questionnaire. Finally, there were 28 items on the questionnaire that took 20 minutes on the average to complete. However, the questionnaire factored into 7 subgroups (KMO = 0. 890, α = 0.900). This is within the manufacturer's specification ($.942 \leq \alpha \leq .777$).

Second Pilot test: Teacher Student relationship Questionnaire (A3)

The third questionnaire is titled 'A3 Student questionnaire on teacher-student interaction'. The questionnaire contains 44 items. It took an average of 30 minutes to be completed by the students. However, during the factor analysis some items loaded on two or three different sub-constructs, hence, they were totally removed. Consequently, there were 33 items left on the questionnaire. The questionnaire factored into 8 sub-constructs (KMO = 0.850, $\alpha = 0.820$).

Second Pilot test: Motivation Questionnaire (A4)

The fourth questionnaire titled 'A4 Student questionnaire on academic motivation' which contained 23 items during the first piloting, with some double-barreled items separated and adjustment made where necessary came up to 35 items that took 20 minutes on the average to complete. The questionnaire factored into four sub-constructs (KMO = 0.810, $\alpha = 0.880$). This is exactly the manufacturer's specification of α value. Furthermore, during the piloting it became necessary to code the questionnaires in such a way that the same student received the questionnaire carrying the same code all through the time to avoid a mismatch along the line. This was crucial because the questionnaires were not filled all at once on the same day.

The pre-testing did help in putting questions in proper sequence, using acceptable wording based on the cultural context, doing appropriate translation, question spacing, coding system, and helped to highlight the necessary areas to probe further during the interview.

Piloting of observation schedule

Two Mathematics lessons in the same school were observed on two different occasions. Class 2A had 45 students and 2B had 60 students. The observation gave clues to possible challenges that could be encountered during the study. One of such clues was absenteeism and lateness to lessons by teachers, another had to do with lack of commitment on the part of the teacher to work given to students. One of the teachers observed did not give any class work during the lesson apart from the ones he solved for them as examples. Interaction with his students after the lesson confirmed the suspicion that he had no time for markings. Consequently, it was decided to have a check on students' exercise books during the main study to ascertain the level of commitment of teachers to students in correcting their errors or mistakes and verify the comments made by teachers, if any, to see the level of encouragement given to students through such medium. Some of those comments were snapped during the main study for references.

Piloting of interview guides

The students' focus group interview took place on three occasions. The first interview lasted for 150 minutes, and it involved the entire class of 45 students. Every student had a contribution to make towards each of the interview items and due to lack of experience on the part of the researcher, neither the researcher nor the students voices could be heard clearly in spite of everything. It was recorded on a telephone and there were many stopping during the recording. The second recording was an improvement over the first, digital voice recorder was used but 30 students were involved, it lasted for 120 minutes Consequently, it was decided in consultation with the supervisors to reduce the number of interviewees to maximum of 20 students for the third interview. As a result, the interview lasted for 75 minutes. The piloting helped to prepare the researcher adequately for the main study. In the same way, teacher interviews helped to fine-tune the interview guide and time management.

Piloting of the achievement test

It took most of the students 75 minutes to hand in their scripts, on their own, without being stopped while few of the students finished in less than an hour. Thus, finding the average of the time spent for the test, 60 minutes were stipulated for the achievement test for the main study. Students were asked to express their opinions after the test, some said one of the topics covered in the test was just taught two days prior to the test and that they were yet to assimilate what the topic was all about. As a result, the researcher decided to check the topics covered in the ten schools and the extent of coverage before finalizing the items for the main study.

Data Collection Procedure

Multiple data collection methods were used in this study. The data sources included: teacher and student questionnaires, semi-structured interview of the teacher, the focus group interview of the selected students, classroom observations using observation schedule and achievement test for students. The questionnaires were administered to 3,342 students in the 10 schools that participated in the study with the assistance of the Heads of Department in the schools.

In each of the schools, the purpose of the study was explained to the students and the mathematics teachers, and they were encouraged to respond to all the items as candid as desired, while assuring them that no attempt would be made to associate their names or institutions with the responses. Questionnaires were then distributed to the students. There was time for questions, during which respondents had the opportunity of asking questions that were not clear to them before responding to the questionnaires. The administration of the four different questionnaires to the students was done on four different occasions between January and April, 2016.

Three thousand three hundred and forty two students (3,342) were given the questionnaire to fill but two thousand five hundred and seventy five respondents (2, 575) filled all the four sets of questionnaires, with no missing values and participated in the achievement test giving a 77% response rate. The deletion of all the respondents with some missing values is based on the advice of Tabachnick and Fidell (2007), that if only a few cases have missing data and they seem to be a random subsample of the whole sample, deletion is a good alternative.

Interviews were conducted using interview guide consisting of relevant items from the questionnaire. The items on the interview guide were constructed based on the responses received from the respondents on the questionnaires. Observation of lessons took place in May/June, 2016, and two hundred and forty students (240) were interviewed on Weekends (Saturdays and Sundays) in June 2016, while achievement test was taken in July, 2016. The administration of teachers' questionnaire took place in May/June, 2016 and teachers' interviews were conducted in August, 2016.

Data Processing and Analysis

The data collected in this study were edited, coded and analysed with both descriptive and inferential statistics based on the research questions and the literature reviewed for the study. After collecting the data, the responses to the items on both the teachers' questionnaire and students' questionnaire were coded. Nevertheless, cases with random missing values as a result of lack of familiarity with some of the wordings of the items were excluded. To avoid a mismatch, each of the respondents was assigned a code at the beginning of the study and this ran through his/her contributions. The responses to the items on the students' and teachers' questionnaire were assigned values: '5'for '*strongly agree*', '4' for '*agree*', '3' for '*neutral*', '2' for '*disagree*' and '1' for '*strongly disagree*'.

There were two levels of analysis carried out in this study. The first being the diagnostic analysis which was carried out to ensure the suitability of the data for further analysis and the unit of analysis is the students. The diagnostic analysis includes parametric tests and factor analysis, while other analysis includes mean, standard deviation, correlation and multiple regression analysis.

The maximum score a student could obtain on all the variables was 570 (114 x5) and the minimum was 114 (1 x 114). In addition the maximum score a teacher could obtain on all the variables was 295 (59 x 5) and the minimum 59

(59 x 1). The achievement test were scored out of forty (40). The means and standard deviations were determined for the scores of students on the achievement test, as well as on their perceptions of teacher-student interaction and students' affective variables for easy understanding and interpretations. If the sub-construct is made up of positive items, a score of less than 3 measures a negative characteristic of the construct and a score of greater than 3 indicates a positive characteristic of the variable. On the other hand, if the sub-construct is made up of negative items, a score of less than 3 measures a positive characteristic of the construct and a score of greater than 3 indicates a negative characteristic of the variable.

Furthermore, semi-structured interview guides were used for teachers and students separately. Using the items on the guides, the researcher was privileged to probe further when necessary to obtain clarifications on the responses from the participants on each of the items of the interview guides. The responses were manually transcribed, common responses were put together under the same theme and some responses were presented as narratives to support some of the quantitative findings.

In summary, the data collected from quantitative sources were analysed using inferential statistics and frequency counts. While those collected from interviews were analysed qualitatively and presented as narrative with some examples.

Research Question One

What are students and teachers views on teacher-student relationship in the mathematics classroom?

The question sought to find out the students' and teachers' understanding of teacher-student relationship. Item B of the student questionnaire A1 and students' responses to item 1 of the interview guide sought to find out the ideal way(s) students expect their mathematics teacher to relate to them and item B of teacher questionnaire and teachers' responses to items 2, 3 and 5 to 9 of the interview guides sought to find out the ideal way (s) teachers think they should relate to their students. Both items of the questionnaires were open-ended questions. The data collected in response to these questions were analysed qualitatively using common themes in the responses to answer Research question one.

Research question Two

What teacher-student relationship exists in the mathematics classroom and the effect of the relationship on students' achievement?

This question sought to find out from the students the relationship between them and their mathematics teachers and which of the sub-constructs of critical friendship: trust, dialogue, challenge, support, context, or critique, influence the relationship using teacher-student relationship questionnaire (A3). The question also sought to find out their perceptions of the benefits of freedom of expression in the learning of mathematics using items 2 to 8 and 26 of students interview guide. The quantitative data on the questionnaire was analysed using factor analysis, frequencies, percentages, mean, standard deviation and regression analysis while the qualitative data collected in response to this question was analysed qualitatively using common themes.

Research Question Three

What are the levels of mathematics- related affect (anxiety, attitude and motivation) in students and their effect on students' achievement?

This question sought to find out the level of mathematics anxiety in students when learning mathematics using anxiety questionnaire (A1) and the items 9 to 13 of student interview guide. Focus group interview investigated the students' understanding of mathematics anxiety, what causes anxiety, their feelings in mathematics class, and their feelings when writing a mathematics test and how mathematics anxiety can be minimized.

Secondly, the question sought to find out the level of attitude of students towards the learning of mathematics using attitude questionnaire (A2) and items 14 to 21 of student interview guide. Lastly, the question sought to find out the level of motivation in student towards the learning of mathematics using motivation questionnaire (A4) and items 22 to 25 of student interview guide which provided detail explanation on the students' understanding of motivation in the learning of mathematics, the reasons for learning mathematics and what can inspire them to or prevent them from learning mathematics.

The quantitative data on each of the questionnaires was analysed using factor analysis, frequencies, percentages, mean, standard deviation and regression analysis. The qualitative data collected in response to student interview guide was analysed qualitatively using common themes and quotations to provide in-depth meaning to the claims of the students on the questionnaires.

Research Question Four

Which of the factors of affective variables and teacher-student relationship predicts student performance in mathematics?

This question sought to find out the relationship between the sub constructs of the independent variables and the performance of students in mathematics by calculating Pearson Correlation coefficient using the scores from the responses of the students to the sub constructs of the four variables and the achievement test. In addition, the question sought to find out which of the sub constructs of the independent variables best predicts the performance of students in mathematics using questionnaires A1 to A4. The data collected in response to this question was analysed quantitatively using multiple regression analysis.

Null Hypothesis

H_0: There is no significant influence of anxiety, attitude, motivation and teacher-student relationship individually or collectively on performance of students in mathematics.

Alternate Hypothesis

H_1: There is a significant influence of anxiety, attitude, motivation and teacher-student relationship either individually or collectively on performance of students in mathematics.

The null hypothesis sought to find out whether any of the four factors: anxiety, attitude, motivation or teacher-student relationship influence(s) the performance of students in mathematics individually or collectively, using A1 to A4 student questionnaires' items. The data collected in response to this question was analysed quantitatively using multiple regression analysis.

Getting permission from the schools for data collection

Getting school heads to agree for the study to be carried out in their schools was a hurdle to overcome. With the permission of the supervisors, the researcher sought for a letter of introduction 'to whom it may concern' from her department (Science and Mathematics Education) to the headmasters of the schools to be assisted in any way possible to facilitate the collection of data. The letter was taken to the schools but was rejected by some of the schools on the ground that the research would be too involving; envisaging that it might span beyond a year, hence, the need for approval from Ghana Educational Service (GES). The challenges the researcher faced in this regard were the bureaucratic process maintained in the education office. It took her two weeks to deal with the GES bureaucracy before she could be issued such a letter. It was until then that the school headteachers gave permission through the Assistant Headmaster (academic) AHA. While most AHAs were helpful, it was personal relationships with some individuals in some of the schools that helped to foster the necessary support for the study as few of the AHAs remained hostile all through the study.

Choosing the participating classes

Some of the AHAs preferred their high performing classes to be chosen, such as the science classes, in order to portray good image of the school. In such situations, it took the researcher time to convince such AHA that she (i.e. the researcher) came as a learner and not as an assessor and that her aim was to observe what happened in schools and improve on her practice as a potential teacher at the university in the training of the trainees.

Using four different questionnaires for students

Administering the first questionnaire was the easiest thing to do since all the students in the classroom at the point of contact were encouraged to participate. However, administering the second questionnaire two days later was a difficult task, some of the students that participated on the first day were absent and vice versa. An appeal was made that only the continuing students should participate but this did not happen as many new students chose to participate. The situation was the same for the rest of the two questionnaires.

Due to the fact that some students along the line were sacked for school fees, administering the four questionnaires in some of the schools span over a period of four weeks or more. In some cases it took them two weeks or more to return to school after being sacked. Some schools went on mid-term break, inter-college sporting activities had its own fair share of attention, standardized test week, and end-of-term examination took their turns. The administration of the four questionnaires in all the ten schools covered a period of four months (January to April, 2016). This period was the second term of the Academic Schedules for Senior High Schools in Ghana.

Regarding the teachers' questionnaire, although there were 57 Mathematics teachers responsible for the selected 69 Form Two Mathematics classes in the ten schools in the Cape Coast Metropolis, 49 teachers (86%)

returned their questionnaires filled after so much efforts and inconveniencies. Teachers' questionnaires were administered between May and June of 2016.

Observation of lessons

The schools resumed in May from the second term vacation and there were some adjustment in the classes' timetable in some schools in an attempt to incorporate the Form Three Mathematics teachers who were free from teaching because their students had just graduated from the Senior High Schools. It took so much time to secure the authentic class timetables from the teachers. In some of the schools, the students' class timetables were different from the operational timetable of the teachers. Hence, the researcher experienced some disappointment of having to leave, as early as 6:00am, for a school for an observation at 7:00am, only to be told on reaching the school that the class will be at the last period of the day, which is, at 1:40pm to 3:00pm or sometimes it might even be on the following day. The worst scenarios had been in situations where students' timetable indicates a lesson will take place for a particular class later in the day, which is, say 1:30pm to 2:10pm and a different class will have mathematics at 7:00am in the same school. After observing that of the 7:00am, the researcher had to keep busy with the examination of the students' exercise books for one to two hours, after which she was more or less redundant waiting for the afternoon class, only to be told on reaching the long awaited class that the lesson had already taken place at 10:00am while she was in the school doing nothing.

The researcher observed two to four lessons for each of the teachers between May and June 2016. In all, 52 teachers (94.5%) out of the 57 teachers were observed. The five remaining teachers could not be available due to ill health (for three teachers) and sandwich programmes (for the other two). Observation schedule used was adapted and designed based on the "University of Cape Coast College of Education Studies Teaching Practice Unit' Teaching Practice Assessment Form A". The schedule was adapted to reflect anxiety, attitude, motivation and critical friendship concepts and was used as observation guide for the teachers. All these instruments were made available to experts in the field to determine their face validity after which they were pilot-tested in senior high schools, in the Central Region.

Focus group interview

The data from the four questionnaires were analysed by finding the mean to determine those students that fall within the two extreme ends (using the aggregate of all the questionnaires). The means for each of the students were sorted in ascending order and the first 250 students from both ends were shortlisted. These add up to 500 students of two different categories, Group A and Group B. From these, four students were asked to volunteer for the focus group interview for each class, with two students belonging to each of the two extreme ends. Thus, in a school where five classes of Form Two's were involved, there were 10 students for Group A interview and 10 students for Group B interview.

Consequently, 200 students from the upper boundary and 133 students from the lower boundary volunteered for the interviews. Unfortunately, only 240 students participated in the interview. There were 18 groups of 12 students each, one group of 10 students and one group of 14 students. Hence, in all, there were

20 focus group interviews from the ten schools and each of the interview lasted for an hour. The reason for requesting for only the volunteers for the focus group interviews was that some of the students were already weary as the research lasted for a period of time. Many of them expressed the fact that they were used to one shot research. As a result, to avoid pressurizing the students beyond their limit, only the volunteers participated in the interview.

Nonetheless, even though the lists of the interviewees were given to some of the prefects to be announced at dining as a reminder of their commitment, some of the students did not show up. According to their colleagues, the students have either forgotten or changed their minds. It was difficult to know what the case was because some of the schools had very large compounds that searching for individuals when they were not having a common programme was impossible. Consequently, the interview took place with those in attendance. In all the ten schools, only four schools had full attendance of the interviewees. The remaining six schools either had four or five students instead of ten students as originally planned. In fact, a school had to be re-scheduled for the interview due to the non-availability of the interviewees.

Achievement test

After the test items (Appendix E) were carefully written using senior high school syllabus as a guide, they were scrutinized by experts in assessment and those who supervised the study. It was then pilot tested in a school far away from the Cape Coast Metropolis to avoid any leakage. The test contains 40 multiple choice items based on what the students had covered within the two years of senior high school. After the piloting, one item was re-constructed for easy understanding by the students, especially those students from such environment where English language is slightly a problem. The question papers were printed and photocopied with utmost security and the test was written by all the participants, across the board from 5th to 27th July, 2016.

Teacher interview

Teachers' interviews took place in the month of August. The interviews were scheduled from the onset of the research to begin as soon as the students go on long vacation, phone numbers were exchanged with the teachers for easy communications and participants were reminded regularly. The candidates for the interviews were randomly chosen based on the claims on the questionnaire. Finding the mean of the scores on the Likert scaled questionnaire, 15 respondents from among those who fall into the two extreme ends: those with lowest and highest scores were shortlisted for the interview.

The first three interviews faced some challenges, such as noisy environment, inability of the teachers to keep to the interview time and emergency meetings in the schools leading to re-scheduling on two occasions but the fourth, fifth and sixth interviews were successful but not without hiccups. There were failed attempts and change of venues but it was brilliantly carried out. In all, eleven teachers were interviewed.

CHAPTER FOUR

RESULTS AND DISCUSSION

The purpose of this study was to investigate the influence of teacher-student relationship and student factors (anxiety, attitude and motivation) on student performance in mathematics in senior high schools in the Cape Coast Metropolis in order to ascertain which of the factors (if any) could be concentrated upon with the view to improving student performance in mathematics. This chapter presents the results and discussion in relation to the purpose and the research questions and hypothesis formulated for the study. There were two levels of analysis carried out in this study. The first being the diagnostic analysis which was carried out to ensure the suitability of the data for further analysis. The diagnostic analysis included parametric tests and factor analysis, while the other analysis included frequencies, percentages, mean, standard deviation, correlation, and multiple regression analysis. Tables and Figures are provided to illustrate and support the findings. The presentation of results was done in the order in which research questions and the hypothesis were presented in Chapter One.

Diagnostic Analysis

Parametric tests

The parametric tests carried out include sample size test, normality test using Kolmogorov-Smirnov and Shapiro-Wilk significant values test and regression standardized residual plot, while multi collinearity was checked using scatter plots, correlation test, Variance Inflation Factor (VIF) and Tolerance before embarking on regression analysis.

Items 1 to 114 (Appendix F) provided responses on the students' experiences in the learning of mathematics. These items were from four variables: anxiety, attitude, motivation and teacher-student relationship. The students' ratings on items for each of the variables were aggregated. The computed variables were factor analysed to determine the underlying constructs within each variable and were further investigated to determine the agreement and the level of variations in their responses using frequencies, mean and standard deviation. The statistical procedures including correlation and regression, were based on the confirmation that the data followed a normal distribution, (Altman & Bland, 1995; Driscoll, Lecky, & Crosby, 2000; Field, 2009; Ghasemi & Zahediasl, 2012; Pallant, 2007), after the scores from the achievement test which was the main variable in answering the four research questions and testing the main research hypothesis had been assessed to find out if they met the three parametric assumptions underlying regression analysis, in addition to determining the degree of relationship between the Dependent Variable and the Independent Variables as well as among the Independent Variables using Multiple Correlation. Thus, the data (the achievement scores) were subjected to the sample size assumption, normality test assumption, multicollinearity, Variance Inflation Factor and Tolerance assumptions.

With regards to the sample size which determines the power of the test, the sample size (2,575) makes it adequate for the study. Pallant (2005, p. 199) stated that "the power of a test is very dependent on the size of the sample used in the study". According to Stevens (1996), when the sample size is large (e.g. 100 or more subjects), then "power is not an issue" (p. 6). However, when one has a study where the sample size is small (e.g. n = 20), then one needs to be aware of the possibility that a non-significant result may be due to insufficient power.

Consequently, the data was assessed for normality. The skewness (-.092) and kurtosis (-.708) are within the acceptable limit of ± 1 and the actual mean (53.72) is almost the same as the trimmed mean (53.90) suggesting that data is approximately normally distributed (Field, 2013). Although both Kolmogorov-Smirnov and Shapiro-Wilk significant values violated normality somehow, with a sample size of 2,575 in this study, the violation of the normality assumption should not cause major problems (Field, 2013). According to Oztuna, Elhan, and Tuccar (2006), small deviation which is as a result of over sensitivity of the normality tests to large sample sizes will not affect the results of a parametric test.

However, since the normality tests are supplementary to the graphical assessment of normality (Elliott & Woodward, 2007), the researcher looked for normality visually by using normal plots (Altman & Bland, 1995; Field, 2009). An inspection of the normal probability plots (labeled Normal Q-Q Plots, that is, figure 8) with reasonably straight line suggests a normal distribution. Normality is finally supported by a box plot of the distribution of scores for the achievement test. The box plot shows the absence of any outlier in the data (Figure 9).

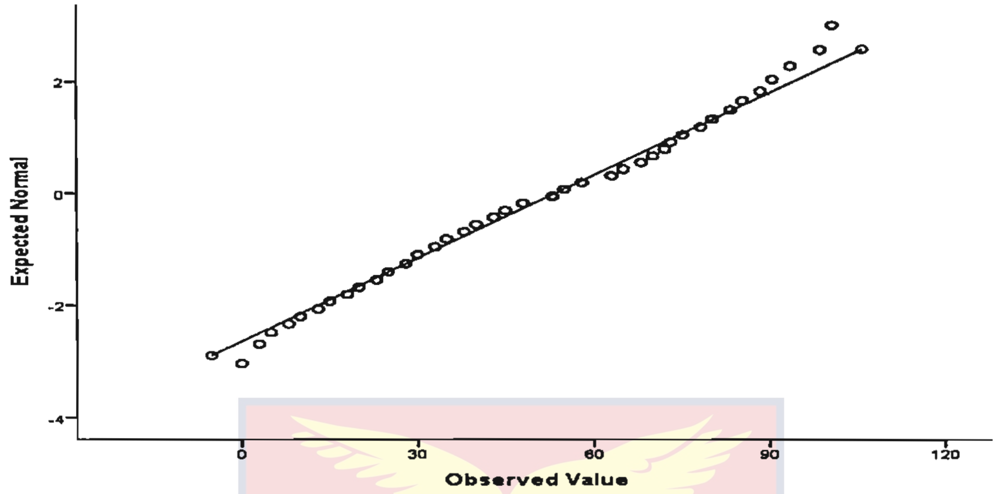

Figure 8: Normal Q-Q Plot of Achievement test scores

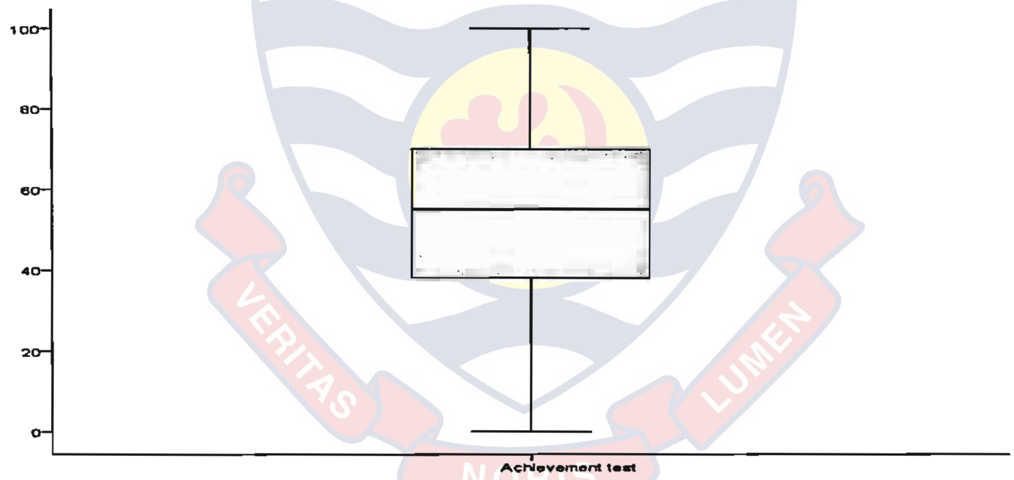

Figure 9: Box plot of the distribution of scores for the Achievement scores

Furthermore, the residuals were subjected to normality check to determine their suitability for regression analysis. Figure 10 and Figure 11 display the Normal Q-Q Plot and the scatter plot of the regression standardized residual of the achievement test scores respectively.

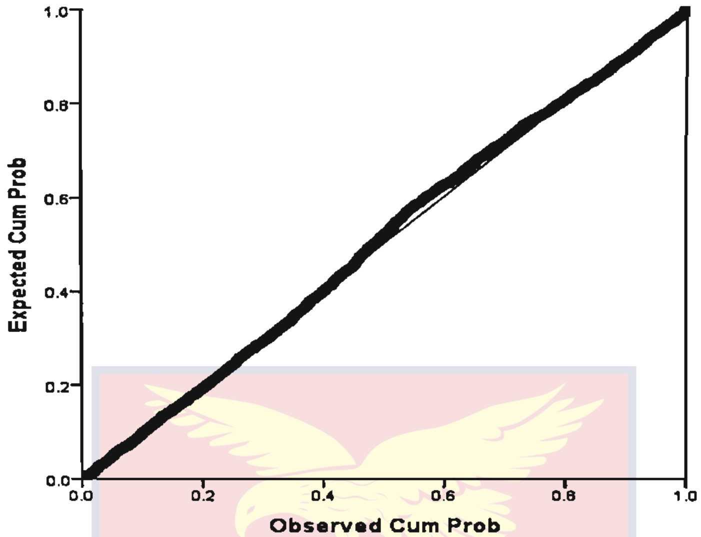

Figure 10: Normal Q-Q Plots showing the regression standardized residual of Achievement test scores

Inspecting the Normal Q-Q plots of the Regression Standardised Residual, the points lie in a reasonably straight diagonal line from bottom left to top right which suggest no major deviations from normality.

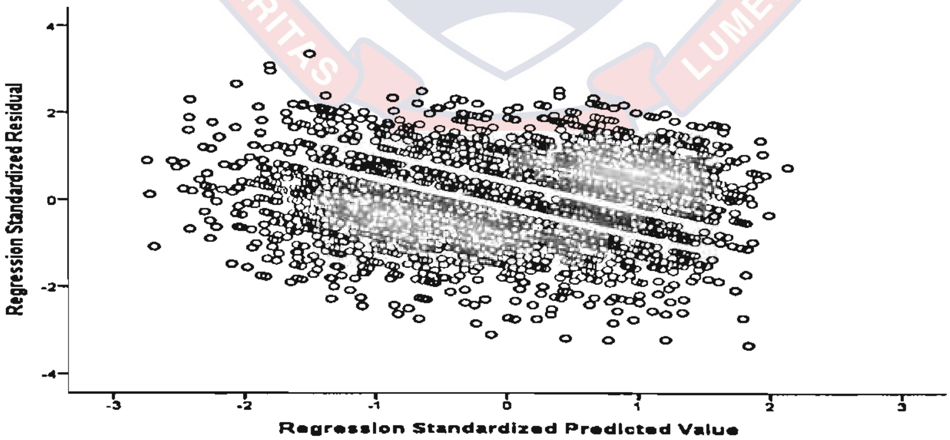

Figure 11: Scatter Plots showing the regression standardized residual of Achievement test scores

The residual is nearly rectangularly distributed with a concentration of scores along the centre. It revealed a pileup of residuals in the centre of the plot at each value of predicted score and a normal distribution of residuals trailing off symmetrically from the center.

According to Tabachnick and Fidell (2007), in regression, if the residuals plot looks normal, there is no reason to screen the individual independent variables for normality other than their relationship with the dependent variable. However, correlation test was carried out and the result is presented in Table 4

Table 4: Correlation Matrix of the Achievement Test Scores and the Independent Variables

	AT	AY	AE	RP	MN
Achievement Test (AT)	1	.381**	–.388**	.110**	–.161**
Anxiety(AY)		1	–.701**	.111**	–.136**
Attitude (AE)			1	–.097**	.107**
Relationship(RP)				1	–.123**
Motivation (MN)					1.

**. Correlation is significant at the 0.05 level (2-tailed).

Table 4 suggests absence of multicollinearity, the correlation coefficients for each pair of independent variables are all very lower than 0.9 (Field, 2013; Pallant, 2011; Tabachnick & Fidell, 2007).

The Variance Inflation Factor (VIF) indicates whether a predictor has a strong linear relationship with the other predictor(s). Table 5 shows the Tolerance and VIF for the Independent Variables.

Table 5: Tolerance and VIF values for the Independent Variables

Independent Variables	Part	Tolerance	VIF
Anxiety	.140	.503	1.988
Attitude	–.167	.508	1.970
Relationship	.051	.975	1.026
Motivation	–.101	.970	1.031

According to Field (2013), the Tolerance below 0.2 and VIF greater than 10 indicate a serious problem. However, Table 5 shows that the lowest Tolerance is .503 and the largest VIF is 1.988. This is an indication of absence of multicollinearity. In conclusion, the data satisfied all the parametric (diagnostic) tests for further analysis to be carried out.

Nonetheless, despite the fact that the correlation ($r = -.701$) between the Anxiety and Attitude variables was within the acceptable limit of ± 1 as specified by literature, the researcher realized during the interview that some (40 students) of those with attitudinal problems with mathematics, that is, those who perceived their personal ability to succeed in mathematics negatively were those at ease with mathematics.

For example stuF1 declared:

> As for me and mathematics, we are not friends. If luck brings me success in mathematics I will be very grateful but if otherwise I have to accept

whatever comes. Thus, I don't worry about mathematics; I work harder for better grades in other subjects to make up for the lapses in mathematics.

In order words, the 'helpless learner' seemed to have given up the hope of being successful in mathematics hence he felt at ease with mathematics with nothing to worry about. Ironically, those who were confident or believed they have what it takes to succeed in mathematics were those anxious in relation to mathematics, hence, removing anxiety produced Tolerance and VIF as reflected in Table 6.

Table 6: Tolerance and VIF values for the Independent Variables (Anxiety deleted)

Independent Variables	Tolerance	VIF	Part correlation
Attitude	.981	1.019	–.367
Relationship	.978	1.023	.059
Motivation	.976	1.025	–.113

A look at the Tolerance value for Attitude increased from .508 to .981 as reflected in Table 6, when Anxiety variable was removed. The Part correlation, which is a measure of the unique contribution of Attitude also increased from -.167 to -.367, an indication that the variable explained 13.5% of the variance in the dependent variable, when the variance explained by all other variables in the model is controlled for, instead of 2.9% when Anxiety was included. In other words, the impact of the attitude (negative) increased in the absence of anxiety. Consequently, the total variance explained by the independent variables when anxiety was included in the model was higher than when it was removed, as R^2 recorded were respectively 18.8% and 16.9%.

Factor analysis

The responses to the items on the students' and teachers' questionnaire were assigned values: '5'for '*strongly agree*', '4' for '*agree*', '3' for '*neutral*', '2' for '*disagree*' and '1' for '*strongly disagree*'. If a student disagrees with a statement indicating a negative attitude (e. g. my mathematics teacher is not friendly), the response was rescaled (and assigned '4' as its value) and if strongly disagrees it was rescaled (and assigned '5'). This was necessary for factor analysis because each of the questionnaires was made up of both negative and positive statements (Salazar, 2015). See Tables 7 – 10 for example. Nevertheless, the rescaled items were not used in the further analysis, where negatively statements were analysed separately from positively stated items. Rather, the scales in their original form were used (See Tables 13 – 18 and 20 – 30 for example).

Consequently, factor analysis was carried out using eigenvalue criteria to ensure that the items were actually measuring the underlying construct that were intended. To help assess the factorability of the data, Bartlett's test of sphericity (Bartlett, 1954), and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were carried out. KMO values reported in each case exceeded the acceptable limit of 0.5 (Field, 2013) to indicate the adequacy of the number of items predicting each factor. The KMO and Bartlett tests' and 'Total Variance Explained' Tables for all the factor analysis were provided (Appendix A, Tables 2 to 11). In addition, factor loadings- correlations between observed variables and factors which reflect the extent of relationship between each observed variable and each factor were provided but lower than ±.3 were suppressed in all the factor analysis because they are considered low according to Leech, Barrett, and Morgan (2005). Nevertheless, during the factor analysis, the few items that loaded on two or three different sub constructs were removed.

The eigenvalues, variance explained and Cronbach Alpha values of the sub constructs were provided along with the factor loading while at the same time presenting the scree plots at the appendix (Appendix B, Figures 1 to 4).

Principal component analyses were conducted on the anxiety questionnaire (A1) and attitude questionnaire (A2) with oblique rotation (direct oblimin) based on the suggestion of Field (2013) for a naturally occurring data. That is, since the items of anxiety or attitude are related it will be quite rare to expect their underlying dimensions to be completely independent. However, oblique rotation (direct oblimin) could not give any meaningful and interpretable sub constructs in the case of teacher-student relationship and motivation hence orthogonal rotation (varimax) was employed.

Factor analysis of Anxiety variable

A principal component analysis was conducted on the 18 items of the anxiety questionnaire (A1). Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .962. An initial analysis was run to obtain eigenvalues for each factor in the data. Three factors had eigenvalues over Kaiser's criterion of 1 and in combination explained 58.09% of the variance (Appendix A, Table 3) with two opposing items constituting the third factor.

The scree plot showed inflexions that would justify retaining 2 factors (Appendix B, Figure 1). A re-run of the factor analysis was carried out to retain two factors based on parallel analysis and the convergence of the scree plot (Field, 2013). The two factors explained 57.38% of the variance (Appendix A, Table 4) and the reproduce correlation matrix indicates that there are 37 (30%) non-redundant residuals with absolute values greater than .05, an indication of nothing to worry about since it is below 50% (Field, 2013). The overall reliability coefficient, α, for the anxiety questionnaire was .933. With the KMO of .957, the items that cluster on the same factor suggest that Factor 1 with reliability coefficient of .908 represents a 'discomfort with mathematics' and Factor 2 with reliability coefficient of .870 represents 'ease with mathematics'. Table 7 presents the factor loadings for each of the constructs of the anxiety variable, together with the Eigenvalues, variance explained and Cronbach Alpha. However, the two opposing items 'I am comfortable with mathematics' and 'I usually make mistakes while solving Mathematics questions' were excluded from further analysis because they recorded low communalities of .153 and .166 respectively during the initial analysis.

Table 7: Factor Loading for the Anxiety Construct

ITEM	1	2
Mathematics makes me feel confused.	.864	
I get confused when working mathematics.	.810	
I am unable to think clearly when working mathematics.	.806	
Mathematics makes me feel impatient.	.768	
Mathematics makes me feel uncomfortable.	.763	
Mathematics makes me feel nervous.	.737	
Mathematics makes me feel restless.	.703	
I am afraid of Mathematics.	.585	
I feel relaxed while taking mathematics tests.		.890
I feel relaxed when taking mathematics tests.		.887
I am often at ease in mathematics class.		.707
I feel very calm when working mathematics.		.644
I relax in Mathematics class.		.604
I feel no stress when answering mathematics questions.		.608
A mathematics tests do not scare me.		.547
I mostly feel peaceful when solving mathematics problems.		.490
Initial Eigenvalues	**8.042**	**1.139**

Table 7 cont'd

% of variance explained	**50.264**	**7.116**
Cumulative % of variance explained	**57.380**	
Cronbach Alpha	**.908**	**.870**
Overall Cronbach Alpha	**.933**	

Source: Field data (2016)

Mean and Standard deviation were calculated for each of the sub constructs. The Mean for 'discomfort with mathematics' was 3.50 with Standard deviation of 1.01 and Mean of 3.17 with Standard deviation of .92 for 'ease with mathematics'. Here 3.5 means more than average 'discomfort' and this was interpreted as such and not rescaled to 1.5 and interpreted as low 'comfort' with mathematics. Both say the same thing but in the factor analysis bigger negative meant greater dislike for mathematics. The means for 'discomfort with mathematics' and 'ease with mathematics' provided above might be an indication that more students experienced more discomfort with mathematics than those that experienced ease with mathematics. Nevertheless, judging from the coefficient of variation (C.V. = 29% for each sub-construct), the two sub-constructs have the same dispersion. This is an indication that the items for each of the sub-constructs are spread out 29% from their respective means. The overall Mean and Standard deviation for the Anxiety variable were 3.3 and .91 respectively, an indication that anxiety had high effect on their learning of mathematics in general (conf. Appendix A, Table 5). Thus, the absence of anxiety (conf. Table 6) seems to be responsible for 13.5%

variance explained by attitude (i.e. part correlation = .367) because the students probably became too comfortable, thereby allowing their negative attitude to override the need to make effort to achieve better in mathematics.

Factor analysis of Attitude variable

A principal component analysis was conducted on the 28 items. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .969. An analysis was run to obtain eigenvalues for each factor in the data and four factors had eigenvalues over Kaiser's criterion of 1 and in combination explained 66.30% of the variance (Appendix A, Table 7). The scree plot showed inflexions that would justify retaining the four factors (Appendix B, Figure 2). The overall reliability coefficient, α, for the attitude questionnaire was .845.

Table 8 shows the factor loadings after rotation. The items that cluster on the same factor suggest that Factor 1 with reliability coefficient of .926 represents 'learned helplessness', Factor 2 with reliability coefficient of .954 represents 'perseverance', Factor 3 with reliability coefficient of .962 represents 'confidence', and Factor 4 with reliability coefficient of .863 represents 'enjoyment'. In addition, there was an item 'Thinking out Mathematics problems does not appeal to me' that did not load on any of the sub constructs, an indication of no contribution to any of the constructs being measured (Field, 2013). Hence, it was entirely excluded from further analysis. Table 8 shows the factor loading of the attitude questionnaire.

Table 8: Factor Loading of the Attitude Construct

ITEM	1	2	3	4
I do badly in tests of mathematics as compared to that of my friends.	.748			
My friends do better than me in mathematics.	.748			
I do not have the ability to do well in Mathematics.	.722			
I do not see myself becoming successful in the learning of mathematics.	.713			
In mathematics class, I see others to be better than me.	.669			
Mathematics is the most difficult subject for me.	.631			
I do not see myself to be good in mathematics.	.608			
I am not good in the study of mathematics.	.586			
Mathematics related subjects have been my worst subjects.	.572			
Even though I work hard on mathematics, it seems difficult for me.	.537			
Most subjects I can handle well, but I have problems with mathematics.	.512			
I do not enjoy learning mathematics.	.450			
I feel I cannot do well in Mathematics.	.355			
When I am faced with mathematics related problem that I cannot solve immediately I stick with it until I solve it.		.959		

Table 8 cont'd

Even when a mathematics question is difficult, I keep working until I find an answer.		.945		
When I am left with a question that requires the use of Mathematics to answer, I will keep on trying until I answer it.		.944		
I am sure I can do advance work in mathematics.			.967	
I can learn advanced mathematics.			.945	
I can handle more difficult mathematics problems.			.913	
I have a lot of confidence when it comes to mathematics.			.911	
I am capable of solving difficult mathematics questions.			.887	
I usually feel relax when solving mathematics questions.				.690
A mathematics test is always welcome by me.				.682
I feel comfortable with Mathematics.				.581
I feel good solving Mathematics questions.				.512
I like Mathematics.				.408
Generally I feel secure about undertaking Mathematics related programme in future.				.310
Initial Eigenvalues	**13.413**	**1.797**	**1.549**	**1.142**
% of variance explained	**49.677**	**6.657**	**5.737**	**4.230**

Table 8 cont'd

Cumulative % of variance explained			**66.301**	
Cronbach Alpha	**.926**	**.954**	**.962**	**.863**
Overall Cronbach Alpha			**.845**	

Source: Field data (2016)

Mean and Standard deviation were calculated for each of the sub-constructs (Appendix A, Table 5). The Mean for 'personal ability' was 2.57 with Standard deviation of .95. Here, 2.57 means that the students' beliefs about their personal ability to perform mathematical tasks, is below average. This was interpreted as 'learned helplessness' (Slavin, 2003). Mean for 'perseverance' was 2.49 with Standard deviation of 1.18; Mean for 'confidence' was 3.01 with Standard deviation of 1.20 and 'enjoyment' had a mean of 2.72 with Standard deviation of .94. The overall Mean and Standard deviation for the Attitude variable were 2.69 and .57 respectively, an indication that the students had negative attitude towards their learning of mathematics in general.

Factor analysis of teacher-student relationship variable

The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .953. An analysis was run to obtain eigenvalues for each factor in the data and six factors had eigenvalues over Kaiser's criterion of 1 and in combination explained 49.50% of the variance (Appendix A, Table 9). The scree plot (Appendix B, Figure 3) showed inflexions that would justify retaining the six factors. The overall reliability coefficient, α, for the teacher-students relationship questionnaire was .506. Table 9 shows the factor loadings after rotation. The items that cluster on the same factor suggest that Factor 1 with reliability coefficient of .86 represents 'support', Factor 2 with reliability coefficient of .755 represents 'unhealthy context', Factor 3 with reliability coefficient of .751 represents 'dialogue', Factor 4 with reliability coefficient of .642 represents 'challenge', Factor 5 with reliability coefficient of .564 represents 'fear' and Factor 6 with reliability coefficient of .547 represents 'disrespect for students' leaning.

The factor analysis produced six sub constructs as presented by Table 9 with their respective loadings of teacher-student relationship as constituted by the respondents in this study.

Table 9: Factor Loading for the Teacher-student Relationship Construct

	1	2	3	4	5	6
My mathematics teacher challenges me to be creative in mathematics class.	.665					
My Mathematics teacher encourages me to think critically in mathematics class.	.664					
I have the opportunity to talk to my mathematics teacher about my concerns in mathematics.	.620					
My mathematics teacher encourages me to ask him/her questions during mathematics class.	.617					
My mathematics teacher is approachable.	.539					
My mathematics teacher encourages me to ask difficult questions in mathematics class.	.536					

Table 9 cont'd

I am free to express my opinion in mathematics class even if it is different from my teacher's opinion.	.531		
I am good at mathematics because my mathematics teacher believes in me.	.512		
Discussion in mathematics class helps me to recall things during examination.	.428		
My mathematics teacher gives enough attention to every student.	.425		
My mathematics teacher gives a harsh response when I give a wrong answer in mathematics class.		.666	
My mathematics teacher gets angry when I fail to answer questions correctly in class.		.634	
My mathematics teacher could disgrace anyone before other students in mathematics class.		.522	
My mathematics teacher is not friendly in class.		.502	
My mathematics teacher does not pay attention to students who ask questions that have nothing to do with the topic the teacher is discussing.		.472	
My mathematics teacher ignores students when he/she thinks your contribution in mathematics is not relevant.		.437	
My mathematics teacher is only nice to those he/she thinks are good at mathematics.		.403	
My mathematics teacher sometimes jokes in mathematics class to release tension.			.737
My mathematics teacher has good social relationship with students in mathematics class.			.579

Table 9 cont'd

My mathematics teacher promotes a relaxed atmosphere for our learning of mathematics.	.537			
My mathematics teacher believes students have something good to offer in mathematics class.	.480			
My mathematics teacher allows exchange of ideas in class.	.386			
My mathematics teacher encourages students to discover new methods of solving mathematics questions.		.697		
My mathematics teacher is very happy when a student uses a method he/she did not teach to solve mathematics questions.		.674		
My mathematics teacher easily accommodates alternative methods of solving questions apart from his/her approach.		.616		
My mathematics teacher says he/she is learning from us in mathematics class.		.464		
I am afraid to approach my mathematics teacher for help in mathematics class.			.615	
Some of my mates are afraid to ask questions in mathematics class.			.600	
The relationship between my Mathematics teacher and students is like master and servant.			.569	
I feel intimidated in my mathematics class.			.484	
My mathematics teacher comes late to class most of the time.				.655
My mathematics teacher rushes through lessons in class.				.578
During class, my mathematics teacher does not allow students to freely make contributions.				.491

Table 9 cont'd

Initial Eigenvalues	**9.778**	**1.726**	**1.301**	**1.282**	**1.157**	**1.092**
% of variance explained	**29.630**	**5.229**	**3.943**	**3.885**	**3.506**	**3.310**
Cumulative % of variance explained			**49.503**			

Table 9 cont'd

Cronbach Alpha	**.860**	**.755**	**.751**	**.642**	**.564**	**.547**
Overall Cronbach Alpha				**.506**		

Source: Field data (2016)

Mean and Standard deviation were calculated for each of the sub constructs (Appendix A, Table 5). The Mean for 'support' was 2.14 with Standard deviation of .74; Mean for 'unhealthy context' was 3.81 with Standard deviation of .77; Mean for 'dialogue' was 4.04 with Standard deviation of .73; Mean for 'challenge' was 3.79 with Standard deviation of .79; 'fear' had a Mean of 3.40 with Standard deviation of .85 while 'disrespect for students' learning' had a Mean of 4.10 with Standard deviation of .79. The overall Mean of 3.55 and Standard deviation of .80 were obtained for the Teacher-student relationship variable, an indication that the variable had a high effect on their learning of mathematics.

Factor analysis of motivation variable

A principal component analysis was conducted on the 35 items. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .953. An analysis was run to obtain eigenvalues for each factor in the data and five factors had eigenvalues over Kaiser's criterion of 1 and in combination explained 51.53% of the variance (Appendix A, Table 11). The scree plot showed inflexions that would justify retaining the five factors (Appendix B, Figure 4). The overall reliability coefficient, α, for the motivation questionnaire was .655. Table 10 shows the factor loadings after rotation. The items that cluster on the same factor suggest that Factor 1 with reliability coefficient of .841 represents 'amotivation', Factor 2 with reliability coefficient of .885 represents 'identified regulation', Factor 3 with reliability coefficient of .763 represents 'introjections', Factor 4 with reliability coefficient of .661 represents 'intrinsic' and Factor 5 with reliability coefficient of .666 represents 'external regulation'. The sub constructs and their respective factor loadings are as presented in Table 10.

Table 10: Factor Loading for Motivation Construct

	1	2	3	4	5
Solving mathematics problems is boring.	.704				
I don't see how mathematics is of value to me.	.674				
Trying to solve mathematics related problems does not appeal to me.	.666				
The subjects which require mathematics are waste of time.	.657				
I would rather have someone give me an answer to mathematics questions than to solve it by myself.	.640				
I don't enjoy doing mathematics.	.638				
I feel that it is a waste of time studying mathematics.	.633				
I can't see why I should study mathematics.	.628				
It does not make any difference whether I learn mathematics.	.596				

Table 10 cont'd

I feel helpless studying mathematics.	.531		
For me, solving mathematics problems is a waste of time.	.514		
Mathematics will not be important for the rest of my life.	.484		
Mathematics is not useful to me.	.470		
I am studying mathematics because it is a compulsory subject in senior high school.	-.460		
I am studying mathematics because I think that mathematics will help me better prepare for my future career.		.741	
I am studying mathematics because studying mathematics will be useful for me in the future.		.715	
I am studying mathematics because what I learn in mathematics now will be useful for the course of my choice in university.		.658	
I am studying mathematics because I want to have "the good life" later on.		.649	
I am studying mathematics in order to have an opportunity to study a programme of my choice later on.		.638	
I am studying mathematics in order to obtain a more prestigious job later on in life.		.633	
I am studying mathematics because I believe that mathematics will improve my work competence in future.		.614	
Using mathematics effectively will help me in my future studies.		.585	
I am studying mathematics because I am sure I can use mathematics in the future.		.562	
I am studying mathematics so as to broaden my knowledge.		.486	
I am studying mathematics to show myself that I am an intelligent person.			.768
I am studying mathematics because I want to show myself that I can do well in mathematics.			.746

Table 10 cont'd

I am studying mathematics because I want to show to others (e.g., teachers, family, and friends) that I can do mathematics.			.676		
I work very hard in mathematics because I want to be respected as an intelligent student.			.579		
I am studying mathematics because of the fact that when I do well in mathematics, I feel important.			.513		
I am studying mathematics for the pleasure that I experience when I learn how things in life work because of mathematics.				.635	
I am studying mathematics for the pleasure that I experience when I am able to solve questions.				.519	
I am studying mathematics because I want to feel the personal satisfaction of understanding mathematics.				.464	
I am doing my best in mathematics so that I can have the best grade at WASSCE.		.360			
I am studying mathematics because I plan to major in a mathematics related programme at the university.					.593
I will need a firm mastery of mathematics in my future work.					.553
Initial Eigenvalues	**10.382**	**3.412**	**1.979**	**1.186**	**1.076**
% of variance explained	**29.662**	**9.749**	**5.654**	**3.388**	**3.076**
Cumulative % of variance explained			**51.529**		
Cronbach Alpha	**.841**	**.885**	**.763**	**.661**	**.666**
Overall Cronbach Alpha			**.655**		

Source: Field data (2016)

Mean and Standard deviation were calculated for each of the sub constructs (Appendix A, Table 5). The Mean for 'amotivation' was 4.00 with

Standard deviation of .62; Mean for 'identified regulation' was 4.22 with Standard deviation of .67; Mean for 'introjections' was 3.16 with Standard deviation of .93; Mean for 'intrinsic' was 3.81 with Standard deviation of .77 and 'external regulation' had a Mean of 3.56 with Standard deviation of 1.12. The overall Mean of 3.75 and Standard deviation of .31 were obtained for the motivation variable, an indication that the variable had high effect on their learning of mathematics. In the same way, the mean of each of the four of the sub constructs approximated to 4 (with the exception of 'introjections') and therefore had high effects on the respondents' learning of mathematics, within the same range of variations. With the overall Mean of 3.33 and standard deviation of .16 for all the students' affective variables and the teacher-student relationship, the students agreed that the variables have minimum effect on their learning of mathematics.

In conclusion, since the preliminary data analysis was satisfactory, that is, the data passed all the diagnostic tests (both the factor analysis and parametric tests), further analysis were carried out on the data in the order in which research questions and the hypothesis were presented in Chapter 1.

Research Questions

Research Question One: What are students' and teachers' views on teacher-student relationship in the mathematics classroom?

Students' views on what constitute teacher-student relationship

Students were asked to describe their views on what constitute teacher-student relationship.

Table 11 represents the students' ideas on what constitute teacher-student relationship.

Table 11: Students' views of teacher-student relationship in a mathematics class

Students' understanding of teacher –student relationship	Frequency	(%)
Friendly		
Be cheerful and laugh with us	30	1.17
In a father/mother - child relationship	87	3.38
In a calm, patient, attentive, understanding and cordial manner	827	32.12
In an interactive, approachable, jovial, kindly and friendly manner	1147	44.54
In a manner that students can easily share their difficulties	121	4.70
In an encouraging and not intimidating manner	121	4.70
Should congratulate students for work well done	7	.27
Support		
Be willing to relate to students outside the classroom	32	1.24
Be willing to help students without discrimination	90	3.50
Make students feel at ease during lessons	95	3.69
In a way that create room for asking questions without discriminating against the weak students	104	4.04
Should concern self with not just the academic work but students' welfare as well	33	1.28
Should combine good sense of humour with teaching	53	2.06
Be free like colleagues to help us bring out our problems	233	9.05
Respect		
Avoid the use of cane in class	101	3.92

Table 11 cont'd

Avoid unhealthy comparison of schools	21	.82
Avoid tongue-lashing students for lack of understanding	21	.82
Avoid condemning students because they failed	24	.93
Be punctual in class and apologise when late	50	1.94
Avoid being absent from school too often	53	2.06
Be kind and nice	42	1.63
Avoid been harsh, too strict and scary when teaching	175	6.80
Context		
Motivate students rather than condemn them	12	.47
Be firm yet easy to approach	21	.82
Avoid focusing only on good/smart students	5	.19
Make class interesting through jokes to help remember the lesson taught	14	.54
Trust/Challenge		
Should sometimes chip in the local language to facilitate understanding.	15	.58
Allow students to use other correct methods to solve problems	7	.27
In a way that ensure understanding of a topic before moving on to another	192	7.46
Allow students to work on the board	6	.23
Give rooms to students to ask questions without been biased about the student's programme of study	33	1.28
Should not be deceived by chorus answers	38	1.48
Should allow group work to help weak students learn from smart students	16	.62
Provide more questions to solve under different topics	83	3.22

Table 11 cont'd

Avoid teaching for examination	70	2.72
Avoid rushing through the lessons to cover syllabus	188	7.30
Find practical way of explaining mathematics to students	53	2.06
Be sensitive to the quiet students	16	.62

Source: Field data (2016)

It is observed from Table 11 that the respondents gave multiple responses. Thus, the sum is meaningless. Therefore, there was no need compiling the sum nor the percentages sum. According to the Table, 44.54% (1147) of the respondents stated that a teacher should relate to the students in an interactive, approachable, jovial, kindly and friendly manner while some respondents, 32.12% (827) indicated that teachers should relate in a calm, patient, attentive, understanding and cordial manner. Both items which are the highest occurring on Table 11 point to the fact that friendship is core in learning. The quality of the relationship between a student and the teacher will result in a greater degree of learning in the classroom (Downey, 2008).

About 9.05% (233) expressed the need for teachers to be free with them like colleagues to help them bring out their problems. These students' desire was to see their teachers as their equals and friends. In order words, they seem to be asking for mutuality or reciprocity. This is an important constituent of friendship because friendship is a means through which friends complement each other in order to be happy. The necessity of this complementarity is based on the need for respect and social support. Teachers should avoid the use of cane in class, being harsh, too strict and scary when teaching. The students respect their teachers by sitting in the class to be taught, they do not expect their teachers to humiliate them in the manner they inflict pain on them. These views of these students corroborate the position of Fehr (2012) and Xue (2013) that the non-reciprocal friendship may frustrate the support being given by the teachers (Fehr, 2012; Xue, 2013).

The students want to be trusted and challenged by their teachers. Coleman (2012) defines trust as confidence in the integrity and abilities of another which serve as a basis for discretionary individual or collective action. Relationship between teachers and students is a trust-based relationship. The students sit in class trusting the teacher to do his/her best to prepare them for life, the teacher also needs to trust that the students are teachable and so challenge them to unearth the hidden treasures within them.

The students were engaged in focus group interview (Appendix D, exhibits 1 to 10) to gain a better understanding of how in their views, teachers should relate to students. Some of their responses were that teacher-student relationship should be like that of colleagues in other that, they will not feel shy or be afraid or fearful to bring out their problems. StuJ1 stated that "if we relate as equals I will not be afraid of being insulted or being beaten because once I am insulted now, next time if I have an idea, I cannot say it". The issue here is fear, just like the saying that once bitten twice shy. Some of the students coiled into their shell once they sensed that the teacher was unfriendly. For example, StuJ2 observed that:

> If the teacher is so strict with us, it's hard for us to bring out what we have to say, but if the teacher is really free with us, it makes us bring out what

we have to say because if in class he is always strict with us, it is like he puts fear in us. Anything we have to say we keep it inside us. You are like if you are going to say it, is like shut up, keep quiet, sit down, it is wrong. He tries to insult us and call us all kinds of names. So it is better we keep it than to say it and get insulted.

Another stuA1 stated that "he should be free and be able to make things more practical by using the materials around to teach us well". The student added "he should be a lot more practical and more patient".

Nevertheless, as many as 98% (Appendix A, Table 12) of the teachers agreed that friendship and learning are linked because when the students consider a teacher as a friend, they learn better, especially in mathematics class and about 88% consented to the fact that friendship makes the classroom atmosphere cordial and everyone feels at home in mathematics class. However, disappointedly about 77% claimed that building relationship in mathematics class will prevent teachers from finishing their syllabus. In addition, observation data (Appendix A, Table 13) items 2, 3, 4 and 6 demonstrated that about 37% of the teachers are either unfriendly or distributed questions unfairly, 17% called only those who raised up their hands to attempt questions or encouraged chorus answers, 4% were harsh in their tone while addressing the students or appeared tired, weak and agitated throughout the lessons. On one occasion, a teacher caned some students for failing to do their assignment and made them lie down on the floor in front of the classroom, facing the floor till the lesson was over. As a sequel to that, during the interviews, StuC1 (a class captain) referred the research to the incident saying:

You saw what happened in the class today. He has a policy not to cane his class prefect, so I was lucky but imagine the way he treated my classmates. He made them lie down facing the floor throughout even after caning them.

Students' views of the influence of their relationship with their teachers on their performance in mathematics

During the focus group interview, students were asked to share their views on the influence they think their relationship with their mathematics teachers had on their performance in mathematics. StuI1 stated that:

My interaction with my teacher promotes my learning in several ways. The teacher gets to know my weaknesses. Again, good interaction drives freedom that enhances learning. It also boosts my confidence level. Consulting with teachers outside the lesson periods also help me better.

Another StuI2 retorted 'there is less interaction due to time factor. Sometimes, my teacher is deceived by chorus answers. Also, failure of my teacher to respond to my questions discourages me'.

Majority of the students (180 out of the 240 interviewed) were of the opinion that good relationship with their teachers matter a lot to them. Some of them attributed their constant failure in mathematics to the teacher-student relationship. According to them, learning has to do with exchange of ideas, it involves remembering and applying what is taught, teaching colleagues what is acquired and exploring more to gain knowledge. For them, without expressing their views or exchanging ideas with friends, they forget easily what they are taught. That is, exchange of ideas during lessons help them to remember knowledge gained in examinations. This is why it is necessary for good relationship to prevail in the classroom to allow freedom of expression. Unfortunately, teachers understand learning to mean (during interview) transfer of knowledge (TrJ1, TrF1 and TrG1) , 'change in knowledge and skills'(TrI1, TrH1, TrD1, TrB1), 'process of acquiring knowledge and skills' (TrA1), 'observations from our environment'(TrD1, TrE1) and 'social interaction' (TrC1). However, there is a gap between teachers and students understanding of learning, the 'social interaction' in the teachers' understanding of learning seem not to include exchange of ideas in the classroom since they often prevent students from making contributions during lessons. Furthermore, when students were asked how their ability or freedom to express their opinions in class helps in their learning, one of the respondents, StuI3 stated:

> My views in class help me to retain knowledge gained or improve my level of learning, help to correct misconceptions, help to remember things learnt in examination. However, too much rushing by my teacher makes no room for expressions. The teacher also overlooks individual IQ and tends to brush off students.

The student claim is in line with Agezo (2010), Dolton and Marcenaro-Gutierrez (2011) positions that the type of relationship teachers develop with students could directly impact positively or negatively on the latter's learning outcomes. This is why it is very essential for teachers to communicate not just the mathematics syllabus content to students, they also need to demonstrate understanding towards the students while communicating their expectations of the students. In relationship, there is a need to hear and be heard. When teachers listen, students not only feel more engaged but are also more inclined to take more responsibility for their education because it is no longer something being done to them but rather something they do (Cook-Sather, 2002). This is what Swaffield (2008) referred to as dialogue.

Dialogue is a very particular form of conversation involving the exchange of ideas and the search for shared meaning and common understanding, quite different in form and purpose from casual chat or combative debate. Watkins (2005, p. 120) understands dialogue as a sort of talk that is mostly closely "associated with rich learning, development of understanding and building of community". For Gadamer (1975), dialogue is a "conversation, a process of two people understanding each other"(p. 143).

He maintains that people bring their 'prejudices', or 'horizon of understanding' to the encounter and the result of this interaction is what he calls 'fusion of horizons' and for me this is learning. These definitions suggest that dialogue is a purpose-driven interpersonal rapport with the cardinal goal of achieving a common good. As a result, students need to bring into the classroom their understanding, in order for the teacher to have a foundation to build on. In situations where students are not able to express their views or opinion in a classroom, the teacher is not likely to succeed in facilitating learning.

Conversely, students were asked to explain why some of them will not like to express themselves in class even when given the opportunity, one of the respondents, StuI4 said:

> One of the reasons why I will not express myself in class includes the fact that my teacher does not believe in me because I once gave an incorrect answer. Another contributing factor is the fear of being mocked or laughed at by colleagues. Lack of motivation from my mathematics teacher, who often thinks nothing good can come out of me, fear of making mistakes and teacher questioning my admission to such a prestigious senior high, contribute to the reasons why I will not express myself in class.

There is a need for educators to understand how students think, thereby providing information which can help improve teacher-student relationship that may result in intergenerational learning as lived democracy – in which there is a shared commitment to / responsibility for the common good (Fielding, 2012).

In order to help the students realise the danger of their refusal to participate fully in class, the researcher asked them for the disadvantages of not actively getting involved in class. Some of them expressed the fact that it may result in failure or errors in examination, un-clarified or unanswered questions in the minds of the students, loss of interest in mathematics, or may prevent understanding. One student (StuA2) said it includes 'misconception, which hinders retentive memory and also deprives my friends of my good contribution'.

Furthermore, students were asked if classroom learning of mathematics helped them develop critical and creative thinking and to explain how. Almost half of the interviewed group claimed it does not help because according to them, the mathematics in the classroom is too abstract. One student (StuH1) shared that she feared to think that she will one day write WASSCE because whenever she sees any WAEC past questions (Essay section) she wonders what it was all about. Nonetheless, the remaining half of the group indicated that classroom learning helps them develop their critical and creative thinking capacities, provided the teaching is practical oriented, mathematics brings creativity. They claimed that 'sometimes too, combining so many ideas to solve a question enables deep thinking'. Again, some of them declared (All the schools with the exception of SchH and SchI) 'being told about the usefulness of Mathematics makes me pay particular attention to it. In addition, it helps me in my daily activities'. Yet another student (StuH2) claimed 'mathematics lends itself to other subjects'.

However, one of the students (stuE1) could not hide her anguish as she exclaimed 'I cannot see the connection; my teacher always rush through the topics such that I don't know what some topics in mathematics are used for'.

Finally, the respondents were asked to explain how teachers and students could learn from one another. The students were of the opinion that teachers and students can learn something from one another through students' contribution that may lead to better discovery for the teacher, or student's questions that may prompt the teacher for more research. In addition, a student (StuJ3) opined that 'sluggishness of weak students can teach the teacher to be patient'. Lastly, one student described a scenario where her access to some reading materials and sharing in class, as well as her extra lesson knowledge had increased her teacher's knowledge. The student (StuA3) indicated:

> my teacher acknowledged my contributions in class, he said he had learnt from me. He made photocopy of some of the reading materials from my

long vacation lessons and went through my lesson exercise book to see what I was taught. I was happy he identified with my learning.

Teachers' view on what constitute teacher-student relationship

In other to compare the point of convergence and divergence between teacher and students on teacher-student relationship, Teachers' understanding of teacher-student relationship was sought. Table 12 represents the teachers' ideas on what constitute teacher-student relationship.

Table 12: Distribution of Items on Teachers' views on Teacher-student relationship

Item	Frequency	%
Strictly Academic		
Academic issues	3	6.12
Just the teaching	17	34.69
Need to discipline students	4	8.16
Non-challant		
Lack of time	4	8.16
Unseriousness on the part of the students hinder learning.	4	8.16
Academic and friendship		
Academic and foster parenting	4	8.16
Cordial, enabling and caring interaction	9	18.37
Learning environment as a dual carriageway	4	8.16
Showing concern for students outside classroom	1	2.04
Avoid being strict and authoritative	2	4.08
Down to earth to the learners	1	2.04
Academic, advisory, guidance and counseling	12	14.0
Free and fair environment where everyone is important	1	2.04

Table 12 cont'd

Building friendship, trust and helping them to learn	10	20.41
Positive relationship including social and spiritual to promote learning	6	12.24
Providing shoulders for the weak students to lean on	1	2.04
Establishing enabling environment that promote learning	2	4.08
Trust based relationship	1	2.04

Source: Field data (2016)

It is observed from Table 12 that the respondents gave multiple responses. According to the table, as many as 48.97% (24) of the respondents saw their duty as teachers to involve just teaching and nothing else, hence, they relate to students on academic issues and discipline them when the need arises. Furthermore, 16.33% (8) of the respondents are nonchalant about their relationship with the students. In some cases, they blamed their negligence on lack of time or unserious attitude of students to learning. However, about 34.69% (17) believed in developing a good rapport with the students in such a way that will foster learning. They were of the opinion that when relationship is cordial, and the two parties involved respect each other, challenging and critiquing will be taken in good faith. But a relationship that is not reciprocal is likely to create suspicion and lack of trust.

Some of the teachers were engaged on one-to-one interviews to gain a better understanding of how in their views, teachers and students should relate. Some of their responses were that 'cordial and enabling environment, very good mood enable students to feel free to ask questions and interact among themselves'.

Others believed that formal approach of learning is a two way affair, from the teacher to students and from the students to the teacher in a conducive atmosphere, where learners understand the teacher and the teacher understands the students. To them, good interaction between student and teacher and even between students and students would promote learning. One of the teachers (TrB1) said that "the teacher should ensure cordial relationship between him/her and students, be friendly and not be angry if students say they do not understand an aspect of a topic. He/she should show concern for the students even outside the class and vary his/her method of lesson presentation". Another teacher (TrF1) is of the opinion that a teacher should relate in a way that makes students feel free to ask question if they lack understanding about the topic.

One of the respondents (TrB1) claimed that "making the concept known to students with ease connotes beginning the lesson by allowing the students to tell you what they know about the concept". This teacher believes that the students have something to offer, hence, it is good to help the students unearth the hidden treasure within them. One of the teachers (TrI2) believes in cordial relationship, according to her there is the saying that "if you like me, you like my subject" the students should not be frightened when they see their teachers, strict teachers may limit how frequently students go to them with their problems. In order words, the teacher should be friendly and approachable.

Finally, teachers were asked to indicate the percentage of students in their classes that were eager to learn mathematics. In response to this, out of the 11 teachers interviewed, three teachers indicated 60% - 65%; another three teachers indicated 70% - 75%; four teachers indicated 90% - 95% and one teacher indicated 80% - 85%. Finally, teachers were asked to make educated guesses of how many of their students are likely to study mathematics or its related programmes after senior high school. Out of the 11 teachers, one indicated 20% - 25%; four indicated 30% - 35%; one indicated 50% - 55%; two indicated 5% - 10%; one indicated 80% - 85% and two indicated 90% - 95%.

Research Question Two: What teacher-student relationship exists in the mathematics classroom and the effect of the relationship on students' achievement?

Unhealthy interpersonal relationship between teacher and student, according to Adeniji (2002), Opeifa (2004), and Ukwuju (2006), usually affects the progress of the student and the atmosphere of the school generally. Table 13 to Table18 give the frequencies, percentages, mean and standard deviations of the sub constructs of teacher-student relationship.

Support

Students with devoted teachers had the courage and determination to face difficulties in school life. Teachers who provide support, encouragement and respect for their students' values are able to eradicate unwanted behaviour in students (Biggs et al., 2008). Table 13 represents the respondents' choices on the level of support they were given by their mathematics teachers.

Table 13: Distribution of Items regarding Support

ITEMS	SD	D	N	A	SA	MEAN	STD
My mathematics teacher challenges me to be creative in mathematics class.	764 (29.7)	1180 (45.8)	162 (6.3)	389 (15.1)	80 (3.1)	2.16	1.10
My Mathematics teacher encourages me to think critically in mathematics class.	1071 (41.6)	1156 (44.9)	100 (3.9)	189 (7.3)	59 (2.3)	1.84	.964
I have the opportunity to talk to my mathematics teacher about my concerns in mathematics.	760 (29.5)	1019 (39.6)	159 (6.2)	462 (17.9)	175 (6.8)	2.33	1.26
My mathematics teacher encourages me to ask him/her questions during mathematics class.	1125 (43.7)	1085 (42.1)	116 (4.5)	192 (7.5)	57 (2.2)	1.82	.974
My mathematics teacher is approachable.	986 (38.3)	1157 (44.9)	148 (5.8)	214 (8.3)	70 (2.7)	1.92	1.006
My mathematics teacher encourages me to ask difficult questions in mathematics class.	608 (23.6)	1136 (44.1)	267 (10.4)	433 (16.8)	131 (5.1)	2.36	1.16
I am free to express my opinion in mathematics class even if it is different from my teacher's opinion.	677 (26.3)	1169 (45.4)	172 (6.7)	409 (15.9)	148 (5.7)	2.29	1.18
I am good at mathematics because my mathematics teacher believes in me.	494 (19.2)	897 (34.8)	319 (12.4)	603 (23.4)	262 (10.2)	2.71	1.29
Discussion in mathematics class helps me to recall things during examination.	974 (37.8)	1212 (47.1)	131 (5.1)	200 (7.8)	58 (2.2)	1.9	.97
My mathematics teacher gives enough attention to every student.	890 (34.6)	1086 (42.2)	147 (5.7)	320 (12.4)	132 (5.1)	2.11	1.16

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Teachers who support students in the learning environment can positively impact their social and academic outcomes, which are important for the long-term trajectory of school and eventually employment (Baker et al., 2008; O'Connor et al., 2011; Silver et al., 2005). Table 13 reveals that each of the items has a mean below 3.0 indicating that the mean rating for teachers in terms of support is low. Students were of the opinion that their teachers do not give them the support that they need. Most of them disagreed to the items regarding support from the teacher whiles few agreed. With a mean of 1.82 and standard deviation of 0.97, only 10% of the students agreed that their mathematics teachers encouraged them to ask questions during mathematics class and as many as 68% of them said their teachers discouraged them from asking difficult questions in mathematics class.

Nevertheless, observation data (Appendix A, Table 13, item 19) shows that about 8% of the teachers were either intolerant of recalcitrant students, impatient with unruly students and spent all the time insulting them for their unruly behaviour, while about 19% (Appendix A, Table 13, Item 9) of the teachers were supportive of their students but did not distribute their questions evenly. These avoided calling the quiet students and two of the teachers (TrF1, TrG1) left bullied students unattended, and about 2% of them dealt with misbehaviour by insulting or sacking the students (Appendix A, Table 13, Item 5). About 452 representing 18% students agreed or strongly agreed that their mathematics teachers gave enough attention to every student in their class. This indicates that most Mathematics teachers do not support their students in the learning of Mathematics. However, the 77% students that were not privileged to be given enough attention constitutes about three-quarter of the respondents. This percentage of students is too big to be ignored. There is a need for teachers to form positive bonds with every student, in order for classrooms to become supportive spaces in which students can engage in academically and socially productive ways (Hamre & Pianta, 2001).

During the focus group interview which was conducted to obtain clarification for the respondents' ideas as indicated on the questionnaire, majority (about 67%) of the students wanted their teachers to be free and friendly with them in all respects, that teachers should see them as their colleagues and treat them as such. According to them, this would lessen their fear for Mathematics.

Patience, tolerance, pragmatism, versatility in solving problems with a good sense of humour are what most of them want to see in their teachers. This would help to develop their interest for the subject and increase their desire to meet with such teachers in classroom. Behaviour like impatience, overly strictness, use of cane on students for not getting an answer right, not giving room for questions from students and lack of attention to weak students hinder their interest for Mathematics. They were of the view that if they were given the opportunity to freely express themselves, if they were given assistance, or helped with words of encouragement, or given attention and the listening ears from their teachers, it would go a long way in developing their interest in the subject. For example one of the interviewees (StuJ4) stated that:

> Our teacher should give us the chance to solve our mathematics problems instead of always solving all the questions, they should be patient with us

> and not be too much in a rush and they should invite us to participate in making decisions. For example, we should decide together what to do to anyone who refused to do assignment or who cheated in class exercise and stop caning us. Some people you cane them, they will never forgive you for life but some too, it would force them to work harder.

The observation of this student is in line with the United Nations Convention on the Rights of the Child (article 12) and European Commission (2001). Giving students a role in decision making, represent first steps towards the creation of schools as 'learning communities'.

In the same manner, some of the teachers lamented on the kind of treatment melted on some of the students by their colleagues to be inappropriate. One of the teachers (TrC1) complained that:

> …I don't understand why some of us behave in such a barbaric manner. One even went to the extent of slapping a student for arguing with the teacher because the student claimed he had learnt a different and easy or better method of solving a particular question at a vacation class.

Another teacher (TrE1) said:

> I have noticed a colleague who mostly on Mondays angrily abandon his class on the pretense that the students are not serious or ready for him but the truth of the matter is that, he travels most weekends and returns on Monday morning unprepared to teach, thus, he blames the students for any little thing that happens in the class.

In my opinion, such a teacher was only exposing his lack of preparedness by blaming the students because as Anderman and Anderman (1999) observe, the kind of relationship in the classroom is determined by the kind of teacher in the classroom. This explains why Solaja (2004) supported teachers having qualities which would make them acceptable to the students. He enumerates these qualities as including: wholesome personality characteristics; leadership qualities and democratic attitude; expressive qualities of kindness, patience, good humour, consideration and sympathy; a sense of justice and fairness in dealing with children, sensitivity to the needs of children and their reactions in different situation, professional insight into the growth pattern of children showing understanding and respect, the ability to establish good social relationship with children. Out of the 52 teachers observed during lessons, students seemed to be indifferent regarding the presence of about 19% (Appendix A, Table 13, Item 4) of the teachers. The students were busied chatting among themselves (e.g. in SchC and SchG) instead of recognizing the presence of their teachers.

The cry for support and understanding by the students was corroborated by the teachers. A look at the teachers' questionnaire revealed that even though 95.9% (Appendix A, Table 14) teachers claimed that they attend to every question posed in the classroom, 51% of them admitted that it is sometimes difficult to treat all students fairly in mathematics class and 57.2% of them believed that students do not have to understand everything during their teaching. In fact, 44.8% claimed the understanding of mathematics may come later after the classroom encounter, while 63.3% were of the opinion that it is not helpful to waste time on a recalcitrant student when teaching mathematics. As many as 63% (Appendix A, Table 15) took delight in 'blind obedience' when they strongly agreed that their students have so much confidence and trust in them that many of them simply take what they give them in mathematics class and 28.5% agreed that students should obey their teachers no matter the situation in order to understand mathematics (Appendix A, Table 15). Some of the teachers (27%) seem to be ignorant of the fact that a teacher who is autocratic, (Bamard, 1999; Oguntade, 2005; Yabe, 2002) creates a stormy and passive emotional climate within and outside the classroom.

Surprisingly, during the teachers' interview, when teachers were asked for the qualities that students who challenge and give new perspectives to their ideas have, majority of them stated: Clever, Knowledgeable, Intelligent, Outspoken / Extrovert, Always want to know, Go extra mile and do things differently, Answer questions thrown back to the class, etcetera.

The data on teachers' questionnaire regarding support (Appendix A, Table 14), suggest that some of the teachers (78%) were of the view that not every student can learn mathematics because it is a difficult subject, hence, they (77.6%) believed that mathematics should not be compulsory for every student, since they (95.9%) claimed that mathematics is not useful for every student. Although, 96% teachers agreed or strongly agreed that allowing students to be free enhances the classroom atmosphere for learning mathematics, and 57.2% rendered assistance to students in mathematics after the class, as many as 53% found teaching some of the students boring.

Nonetheless, teachers were asked during the interview to explain how their relationship promoted learning. Many of them claimed they have been opportune to help identify problems in homes of students that hindered learning. According to one of the teachers (TrI1), some of the students who could have dropped out of school were rescued due to her interventions. For example, she claimed: a student almost went into depression for fear of a possible divorce between her parents due to 'male child syndrome' which is common in Africa tradition' This confirmed some of the expectations of the students that teachers should not concern themselves with just the academic work but students' welfare as well.

Developmental Context

The concept of developmental context in the teacher-student relationship entails providing friendly environment for students as a secure base from which they can explore the classroom and school setting both academically and socially, to take on academic challenges and work on social-emotional development (Hamre & Pianta, 2001). The concept is used to explore students perceived level of contexts within which mathematics lessons are delivered. Table 14 represents the respondents' ideas on the unhealthy context within which they learn mathematics in the classroom.

Table 14: Distribution of Items regarding unhealthy Context

ITEMS	SD	D	N	A	SA	MEAN	STD
My mathematics teacher gives a harsh response when I give a wrong answer in mathematics class.	111 (4.3)	248 (9.6)	139 (5.4)	1028 (39.9)	1049 (40.8)	4.03	1.11
My mathematics teacher gets angry when I fail to answer questions correctly in class.	154 (6)	451 (17.5)	187 (7.3)	998 (38.8)	785 (30.4)	3.70	1.24
My mathematics teacher could disgrace anyone before other students in mathematics class.	337 (13.1)	579 (22.5)	184 (7.2)	879 (34.1)	596 (23.1)	3.32	1.38
My mathematics teacher is not friendly in class.	81 (3.1)	125 (4.9)	144 (5.6)	1081 (42)	1144 (44.4)	4.20	.97
My mathematics teacher does not pay attention to students who ask questions that have nothing to do with the topic the teacher is discussing.	156 (6.1)	423 (16.4)	187 (7.3)	976 (37.9)	833 (32.3)	3.74	1.24
My mathematics teacher ignores students when he/she thinks your contribution in mathematics is not relevant.	152 (5.9)	355 (13.8)	157 (6.1)	1081 (42)	830 (32.2)	3.81	1.20
My mathematics teacher is only nice to those he/she thinks are good at mathematics.	208 (8.1)	266 (10.3)	128 (5)	953 (37)	1020 (39.6)	3.90	1.26

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

From Table 14, it could be seen that majority of the students agreed that their teachers are not friendly, this constitute 86.4% of the students, however, few disagreed. About 1,809 students representing 70% agreed or strongly agreed that their mathematics teachers do not pay attention to students who ask questions that have nothing to do with the topic the teacher is discussing. As many as 2,077 students claimed their teachers give harsh responses when they give wrong answers in mathematics class. Here, since all the items are negatively stated, a higher mean suggests that students' perceptions were negative. In other words, the higher the 'raw' mean, the worst the situation. No rescaling was necessary here as the overall mean represented overall student perceptions of the negative attitudes of teachers.

Similarly, some students in some schools (SchA, SchC, SchH) expressed the opinion that their teachers were only nice to good students in class, but ignored contributions which are not relevant and get angry at them when they fail to give correct answers to questions in class. Likewise, the observation data (Appendix A, Table 13, Item 16) shows that out of the 52 teachers whose lessons were observed, seven (13.5%) of them were either indifferent to students' responses, accepted chorus answers or allowed the few active students to take over the class to the neglect of the majority. In addition, three of them (5.8%) neither used students' ideas nor encouraged co-operative learning all through their lessons while six of them (11.5%) directed their interactions towards the school fees that must be paid and threaten the students with being sent home (Appendix A, Table 13, Item 1).

In all, the learning environment of these students could be said to be non-conducive and could lead to feeling of uneasiness that could result in math-anxiety (Olaniyan & Salman, 2015) since these affect the attention and interest of students in the subject. This might be one of the causes of low performance in mathematics in view of the fact that such conditions are likely to destroy the interest of students on the subject. The school environment creates the context for a variety of emotional experiences that have the potential to influence teaching, learning, and motivational processes (Goldstein, 1999; A. Hargreaves, 1998; Hargreaves, 2001; Sutton, 2004; Zembylas, 2005).

Teachers seem to be ignorant of the importance of environment on students' learning as majority (55.1%) claimed that students do not ask questions in mathematics class for fear of being shouted down by peers while as many as 49% agreed that some students are too shy to answer questions in mathematics class (Appendix A, Table 16). That notwithstanding, it is the duty of the teacher to ensure a good atmosphere for the learning of the students.

Dialogue

Dialogue is a purpose-driven interpersonal rapport with the cardinal goal of achieving a common good. For Gadamer (1975, p. 143), dialogue is a "conversation, a process of two people understanding each other". Table 15 presents data on the level of collaboration between teachers and learners to promote an environment that supports learning.

Table 15: Distribution of Items regarding Dialogue

ITEMS	SD	D	N	A	SA	MEAN	STD
My mathematics teacher sometimes uses ice-breaker in mathematics class to release tension.	142 (5.5)	220 (8.6)	110 (4.3)	990 (38.4)	1113 (43.2)	4.05	1.15
My mathematics teacher has good social relationship with students in mathematics class.	81 (3.1)	180 (7)	132 (5.1)	1155 (44.9)	1027 (39.9)	4.11	1.00
My mathematics teacher promotes a relaxed atmosphere for our learning of mathematics.	128 (5)	354 (13.7)	200 (7.8)	1161 (45.1)	732 (28.4)	3.78	1.15
My mathematics teacher believes students have something good to offer in mathematics class.	49 (1.9)	131 (5.1)	145 (5.6)	1299 (50.5)	951 (36.9)	4.15	.88
My mathematics teacher allows exchange of ideas in class.	60 (2.3)	180 (7)	138 (5.4)	1300 (50.5)	897 (34.8)	4.09	.94

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Kazepides (2012), in looking at education as dialogue, states that dialogue has a serious, challenging and demanding character, requiring respect, trust, open-mindedness, a willingness to listen and to risk one's own preconceptions, fixed beliefs, biases and prejudices. Its aim is not to win an argument but to advance understanding and human wellbeing. Fortunately, such is the case in this study, as it is observed from Table 15 that about 86% of the students agreed or strongly agreed that their mathematics teachers believed that students have something good to offer in mathematics classes. Majority of the students were of the view that mathematics teachers had a good social relationship with their students in class and also promote a relaxed atmosphere for learning. In all, only 10% of the students had a contrary view, that their mathematics teachers are not sociable, do not act jovially to lessen tension in class or promote a relaxed learning atmosphere. Nonetheless, Swaffield and Dempster (2009) recommended "Disciplined dialogue or dialogue that is informed, inclusive and enabling (p. 118)" to develop friendship and not just casual chat or combative debate. But one wonders the kind of dialogue involved.

Fortunately, the interview revealed that many of the teachers could crack jokes with the students as long as it has nothing to do with the learning of mathematics. For example, a student (StuH3) stated 'I pretend to laugh at his dry jokes to avoid being called to answer questions' and another student (StuI5) lamented 'our teacher sometimes turn to a jester by humiliating weak students. It is not funny but some of my colleagues do laugh'. Surprisingly, one student (StuB1) claimed "I smile nicely at my teacher whenever I sensed I am 'in trouble' of being call to answer question in class" From the interviewees sharing, some of the conversations in their classrooms may be 'casual chat' that are not task related. They are not dialogue that is informed, inclusive and enabling. For learning to take place, constant disciplined dialogue is required, to gain deeper understanding and to sustain friendship (Kazepides, 2012; Swaffield & Dempster, 2009).

Fear

Some students (about 75%) had unpleasant emotions or thoughts about their teachers which translated into how they relate to the subject as well. Table 16 reveals respondents fear in relation to their mathematics teachers.

Table 16: Distribution of Items regarding Fear

ITEMS	SD	D	N	A	SA	MEAN	STD
I am afraid to approach my mathematics teacher for help in mathematics class.	161 (6.3)	337 (13.1)	142 (5.5)	976 (37.9)	959 (37.2)	3.87	1.22
Some of my mates are afraid to ask questions in mathematics class.	523 (20.3)	883 (34.3)	147 (5.7)	614 (23.8)	408 (15.8)	2.81	1.41
The relationship between my Mathematics teacher and students is like master and servant.	282 (11)	613 (23.8)	211 (8.2)	894 (34.7)	575 (22.3)	3.34	1.34
I feel intimidated in my mathematics class.	183 (7.1)	398 (15.4)	254 (9.9)	1161 (45.1)	579 (22.5)	3.60	1.19

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

It could be observed from Table 16 that about 75% of the respondents were afraid to approach their mathematics teachers, 40% claimed some of their mates were afraid to ask questions in class, while as many as 57% saw their teachers to be bossy. Despite the level of the fear associated with the learning environment of the students, about 23% of them did not feel intimidated in mathematics classes. Nevertheless, the nature and quality of teachers' interactions with children have a significant effect on their learning (Brophy-Herb et al., 2007). This is probably why Stronge (2002) suggests praising students, reinforcing positive behaviours, and establishing trust in order to build caring and respectful teacher-student relationships. When the relationship between the students and teachers are very cordial, students tend to develop more interest in teachers' subjects and this interest has a greater influence on students' academic wellbeing.

Unfortunately, many teachers seldom realize that how they teach, how they behave and how they interact with students can be more paramount than what they teach (Yara, 2009). Such teachers probably confuse the focus on accountability and standardized testing to the contribution that the social quality of teacher – student relationships has on academic development (Hamre & Pianta, 2006). Students who perceive their relationship with their teachers as positive, warm and close are motivated to be more engaged in school and to improve their academic achievement (Hughes & Cavell, 1999). Thus, it seems that teacher-student relationship is a catalyst that would initiate positive attitude and motivation, as well as reduce anxiety in students.

Nonetheless during the interviews with teachers, some of them alluded to the fact that familiarity breeds contempt. According to them, without some levels of discipline, especially in boys' schools nothing good would be achieved. One of the teachers (TrD1) declared '…hun! This is not a girls' school but boys' school, we cannot survive here without the use of cane, it would never work, quote me anywhere'. The teacher's claim was corroborated by some of the class prefects in boys' schools. One of them stated that:

> my mates made me submit our mathematics assignment exercise books late all the time, which worries me. I often complained but they don't mind me because the teacher does not cane but they would not dare try

that with elective mathematics teacher, he warned me to always submit the books on his table even if only one student had submitted to me and he would cane every other person

Challenge

Good teachers should expect their students to contribute to their own professional growth. They should learn from what their students read, be challenged by their students' questions, and should like to see their success as reflecting, at least in part, on their own professional expertise and devotion to them. Table 17 displays the experiences of the students on how much room they were given by their teachers to be creative and critically minded.

Table 17: Distribution of Items regarding Challenge

ITEMS	SD	D	N	A	SA	MEAN	STD
My mathematics teacher encourages students to discover new methods of solving mathematics questions.	84 (3.3)	309 (12)	175 (6.8)	1145 (44.4)	862 (33.5)	3.93	1.08
My mathematics teacher is very happy when a student uses a method he/she did not teach to solve mathematics questions.	97 (3.8)	245 (9.5)	183 (7.1)	1100 (42.7)	950 (36.9)	3.99	1.08
My mathematics teacher does easily accommodate alternative methods of solving questions apart from his/her approach.	106 9(4.1)	335 (13)	165 (6.4)	1151 (44.7)	818 (31.8)	3.87	1.12
My mathematics teacher says he/she is learning from us in mathematics class.	231 (9)	553 (21.5)	284 (11)	1035 (40.2)	472 (18.3)	3.37	1.25

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Students would be able to make quality contribution to education, if and when, they are challenged, seen and treated as friends by their teachers. That is, teachers are expected to see students as their critical friends and as such critique them in a manner that leads them to happiness, progress, and fulfilment of being the second-self, which in the words of students in this study means co-equals (Swaffield, 2007). The idea of seeing students as welfare dependents, incompetent, vulnerable and in need of care, protection and guidance ought to change to seeing them as 'young citizens' that have strengths and capacities, and need recognition, respect and opportunities to participate in decision making and to have their voices heard (Fielding, 2007). This is in line with the position of Towndrow (2007) that critical friendship is entirely possible so long as the relationship is participative, collaborative and mutually informing. In other words, critical friendship is possible between teacher and students provided it is like a dual carriage way, a situation that involves give and take.

Table 17 shows that less than 80% of the students attested to the fact that their teacher challenged them to learn by appreciating their creativity and accepting and encouraging alternative methods to problem solving. When educators listen to student's voice and use them to co-create the learning environment, students feel they are an integral part of a learning community, that they matter and that they have something of value to offer (Fielding, 2007). This empowers them to take responsibility for their own learning, and that of others, and to take risks and explore new ideas. According to Shanker, taking responsibility for their learning and that of others "is the most authentic opportunity that students can have to develop self-regulation in the classroom" (2013). In an environment where educators listen, capture and are responsive to student voice, they have noticed that students believe they are capable and competent to learn. Swaffield (2015) notes that the word "critical" denotes a constructive and informed challenge and support; it is not about fault finding but a critique that is essential for refining a professional practice.

Data from the teacher's questionnaire regarding 'challenge' reveals that some of the teachers (about 78%) in this study claimed they encouraged students to be independent minded in mathematics class in order to promote self confidence (Appendix A, Table 17), unfortunately only 36.8% teachers were able to recognize that students who asked questions in mathematics class were those who were able to articulate their ideas. Between 84% and 98% of the teachers agreed that dialogue in mathematics class boosts students' confidence, helps teacher and students to learn from one another, makes students share and this helps to avoid tension, reduces students' anxiety in class, helps teachers to improve on their teaching of the topic, and so on. According to them, some of the students have the critical capacity to make constructive contributions in mathematics class but lack of debates in mathematics class impedes learning.

Nevertheless, between 43% and 78% believe otherwise. For them, too much freedom of expression for students in mathematics class is not good, because if students are given too much space for discussion in mathematics class, bringing them back on line could be difficult and the authority of the teachers who give room to students to express themselves in mathematics class can easily be undermined by some students (Appendix A, Table 18). This was noticed during the observation of lessons where about 10% (Appendix A, Table 13, item 8) of the teachers ignored some of the questions asked by the students or merely taught without asking for input from the students. About 19% (Appendix A, Table 13, item 10) of the teachers reacted positively to students' good responses but ignored students' errors, laughed at errors or admonished students to think before talking, while about 44% (item 11) of them simply accepted students' responses at face value without probing or asked the students to trust them and simply accept what they taught them, or demand that students ask questions only when it was very necessary. Some of the teachers (6%) rarely involved the students in decision making or had no time for negotiations; they simply gave verdict which all the students must abide by.

In addition, the way the presentation of the learning materials is done during teaching activities equally matters. About, 2% of the teachers either did all the work while the students merely followed, or did not arrange the learning activities sequentially and logically (Appendix A, Table 13, Item 7).

Furthermore, the teachers were asked during the interview for the benefits of allowing students to freely express their views in class, their responses corroborated students' stand that the learners would get to know their weaknesses and attend to them on time. Some said it helps to motivate students to learn better, enhances students' interest in mathematics, makes them feel recognised as active members of the class, promotes better assimilation and retentive memory, boosts confidence, enables them to think critically and logically and so on. Meanwhile, when they were asked to state the circumstances under which such privileges would not be given, they claimed when the contributions could dampen the spirit of other students in the class, if the opinion is above the scope of other students or is based on a topic yet to be treated, if the opinion is based on a topic that was already taught long in the past, if the opinion is vague, and so on. Some claimed that to avoid conflicts in class, to manage time adequately and curtail unnecessary funny and distracting encounters, they would not permit any exchange of ideas because sometimes students intentionally seized the opportunity to challenge their teachers, it could also lead to misbehaviour, students could go over the top or good students might overshadow the weak ones.

Disrespect for Students' Learning

As the saying goes 'respect begets respect'. In order words, respect should be reciprocal. Unfortunately, when one is young, to Africans, one make a lot of mistakes (Ndofirepi, 2013). Hence, children are not to be given too much room to operate. Nevertheless, teachers' social interaction with their students, especially in a close academic environment should help contribute to the personal development of the students. And such activities should reflect a concern with the development of the whole person, not only a well-educated individual or professional. Table 18 presents data on how teachers disrespect their students' learning.

Table 18: Distribution of Items regarding Disrespect for Students' Learning

ITEMS	SD	D	N	A	SA	MEAN	STD
My mathematics teacher comes late to class most of the time.	96 (3.7)	225 (8.8)	100 (3.9)	788 (30.6)	1366 (53)	4.21	1.10
My mathematics teacher rushes through lessons in class.	177 (6.9)	388 (15.0)	133 (5.2)	966 (37.5)	911 (35.4)	3.79	1.26
During class, my mathematics teacher does not allow students to freely make contributions.	44 (1.7)	123 (4.8)	70 (2.7)	1120 (43.5)	1218 (47.3)	4.30	.87

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Table 18 reveals that between 73% and 91% of the students claimed that the mathematics teachers showed them no respect to their learning. This is not surprising because for Africans, children or young individuals are assumed to be subjects who are yet to reach biological and social maturity or simply they are younger than adults and are yet to develop those competencies adults possess. The 'less than-adult' status implies that childhood is a stage in human development when children are to be developed, stretched and educated into their future adult roles (Ndofirepi & Shumba, 2014). The developmental perspective of childhood is rooted in the view that children are in a position of immaturity represented by being irrational, incompetent, and a-social and a-cultural, passive and dependent. The elderly according to Van der Geest (1998) is a person who knows what is going on. He/she must receive respect and obedience. An elderly person should not be challenged. It is the duty of the elders to give advice to young people.

This may be the philosophy of some teachers who often take things for granted when dealing with students but the consequences of their actions may be too costly to estimate. A teacher that often arrives late to teach or fail to apologise for his/her mistakes stands the risk of losing his/her respect or loses the moral justification of correcting students when they go wrong. Courtesy demands that teachers apologise when they make mistakes, it is also a way of training the future leaders to be respectful, courteous and polite. Where teachers live above the law, they are indirectly teaching the students to be irresponsible. As the saying goes, 'actions speak louder than words'. What teachers do is more important and shows their intentions and feelings more clearly than what they say.

Some young people have greater autonomy and responsibility at home or in part-time employment and these experiences contrast sharply with their roles as students in school. Many find their personal interests, experience and capabilities not recognised or valued in the classroom (Flutter & Rudduck, 2004). This was the situation in this study where as many as 90% students (Table 18) claimed that their mathematics teachers did not allow them to freely make contributions. Schooling continues to be based upon conceptions of childhood that regard young people as dependent and incapable (Lloyd-Smith & Tarr, 2000; Wyness, 2003). Such teachers failed to admit that information from students not only provides a valuable resource for helping teachers to discover 'what works' in the classroom but also enables them to refocus on learners and their learning.

Giving young people more opportunities to say what they think about schooling and developing their sense of responsibility as members of a learning community represents moves towards a different construction of the student's role. Rather than being seen as dependent and incapable, students should be regarded as individuals possessing the right to be heard and to be respected as well as the responsibility to act in ways that align with the best interests of their school community.

The claim by the students that their teachers rush through lesson was corroborated by the teachers' claim to lack of time (Appendix A, Table 19). Majority of the teachers (83.7%) agreed that they have too much to cover in mathematics within a limited time frame, and this had affected their interaction with their students. About 2% of the teachers showed their displeasure about students' misdeeds during lessons in a way that humiliated the students or with references to some privileged information on the students. In fact, 48.9% blamed time factor for poor performance of students in mathematics. According to 30.6% of the teachers, there is no sufficient time to treat mathematics very well. Observation data (Appendix A, Table 13, item 18) confirmed both the teachers' and students' claims. Some of the teachers (about 10%) forced to achieve all the aims and objectives of the lesson and ignored the slow learners or encouraged the students to have peer-learning during their free period.

When the students were asked how they cope with such situations of their teacher either rushing through the lessons or not giving room for students' contributions, one said (StuC2) 'I attend extra lessons with the teacher to catch up' another student (StuD1) claimed 'I already learnt most of the topics during the long vacation, prior to our resumption and I helped my friends as well'. Sadly however, one student (StuG1) claimed she had to sell sachet water at a lorry station during the long vacation to save money for her education and as such had no time for any academic work. Most students (70% to 75%) in three of the schools in this study have to do some work to finance their education (SchE, SchF, and SchJ). This is an indication that the reality on the ground could be likened to that of the survival of the fittest. While some of the students were able to adapt to the situation, others languished in pains of not knowing what to do.

Factors that influence the interaction between teachers and students in mathematics class

In order to determine which of the sub constructs of teacher-student relationship influence interaction in the classroom, the Means, Standard deviations as well as the correlations between the sub constructs of teacher-student variable were calculated and presented in Table 19.

Table 19: The Means, Standard deviations and Correlation among the Teacher-student Relationship Sub constructs

	C1	C2	C3	C4	C5	C6	Mean	Std. dev.
support mean (C1)	1	-.630**	-.675**	-.551**	-.481**	-.510**	2.1441	.73959
Unhealthy context mean (C2)		1	.562**	.440**	.499**	.489**	3.8136	.76646
dialogue mean (C3)			1	.505**	.454**	.459**	4.0377	.72761
challenge mean (C4)				1	.299**	.345**	3.7919	.78866
fear mean (C5)					1	.330**	3.4037	.85323
disrespect mean (C6)						1	4.0995	.78851

**. Correlation is significant at the 0.01 level (2-tailed).

Table 19 shows that the sub construct 'disrespect for students' learning' and 'dialogue' with standard deviations of 0.78851 and 0.72761, and the higher means of 4.0995 and 4.0377 respectively, possibly influenced the relationship between the teachers and the students in this study than others. It points to the fact that, students were affected by the lateness to classes of some of the teachers, the pace at which the teachers taught, the hindrance to students' freedom of expression, teachers' believe in students that they have something good to offer and giving room for exchange of ideas. However, inferential analysis through regression analysis would help to better determine the extent of the impact of each of the sub constructs on students' achievement.

The effect of the relationship on students' achievement

Regression analysis was carried out on the teacher-student relationship (TSR) variable, which is made of six sub constructs: *support*, *unhealthy context*, *dialogue*, *challenge*, *fear* and dis*respect for students' learning*. 'unhealthy context' and 'challenge' negligibly (but not significantly) correlated with achievement scores (r_1 = – .030, r_2 = .013). While 'dialogue', 'fear' and 'disrespect for students' learning' negligibly and significantly correlated with achievement scores (r_3 =.088, r_4 = .207, r_5 = .043) but support did not correlate with achievement scores.

TSR variable shared a variance of approximately 8% with achievement scores (R square = .079 and Adjusted R Square = .077). The model reaches statistical significance (p <.05). The six sub-constructs: *Fear* (β = .290, $p < 0.05$); unhealthy *context* (β = –.187, $p < 0.05$); *support* (β = .133, $p < 0.05$); *dialogue* (β = .129, $p < 0.05$); dis*respect for students' learning* (β = .047, $p < 0.05$) and *challenge* (β = .001, $p > 0.05$) uniquely and respectively explained (s^2 = 5.8%, s^2 = 1.8%, s^2 = 0.71%, s^2 = .80%, s^2 = 0.15%, s^2 = 0.0001%) variances, when the variance explained by all others in the model is controlled for. The *p*-value is significant for all the sub constructs ($p < .05$) with the exception of challenge and the standardised β value (0.290) recorded by *'fear'* indicates that the sub-construct best predicts performance in mathematics. Thus, the regression model generated between TSR variable and achievement scores $F(6, 2568) = 36.767$, $p<.05$ is:

Achievement scores = 21.658+ 0.183 (support) – 0.247 (unhealthy context) +0.180 (dialogue) + 0.001 (challenge) + 0.345 (fear) + 0.061 (disrespect for students' learning).

However, with the removal of 'challenge' the model with $F(5, 2569) = 44.138$, $p<.05$ becomes:

Achievement scores = 21.739+ 0.182 (support) – 0.247 (unhealthy context) + 0.180(dialogue) + 0.345 (fear) + 0.061 (disrespect for students' learning).

The model indicates that *'fear'* best predicts performance of students in mathematics. This is evidence from the submission made by some of the students during the interviews. It seemed some of the students comply with the teaching and learning of mathematics to avoid being caned or tongue-lashed by their teachers. Furthermore, the context within which some of the students learn can be said to be unhealthy. The negative coefficient (– 0.247) is poised to reduce the achievement scores by 0.187 if there is a unit increase in '*context*' scale. It could also be inferred that although disrespect for students' learning is making a positive gains, it could be because some of the students have learnt to cope with the situations. Finally, the constant value (21.739) is the achievement score when each of the sub-constructs equals zero, indicating that without some amount of dialogue, respect, and fear, the achievement score would be as small as approximately 22%.

Research Question Three: What are the levels of mathematics- related affect (anxiety, attitude and motivation) in students and their effect on students' achievement?

Level of mathematics anxiety in students

Table 20 and Table 21 give the frequencies, percentages, mean and standard deviations about the two sub constructs of anxiety.

Discomfort with Mathematics

Students expressed the views during the interview that fear, restlessness, impatience, nervousness, confusion, making mistakes and incomprehension were some of the words that described their relationship with mathematics. These made the learning of mathematics a hell for some of the students, instead of an adventure for them.

Table 20 presents the students' levels of agreement on items regarding their discomfort with mathematics.

Table 20: Distribution of Items regarding Discomfort with Mathematics

ITEMS	SD	D	N	A	SA	MEAN	STD
Mathematics makes me feel confused.	206 (8)	600 (23.3)	177 (6.9)	956 (37.1)	636 (24.7)	3.47	1.30
I get confused when working mathematics.	310 (12.0)	674 (26.2)	237 (9.2)	934 (36.3)	420 (16.3)	3.19	1.31
I am unable to think clearly when working mathematics.	221 (8.6)	617 (24)	154 (6)	1003 (39)	580 (22.5)	3.43	1.30
Mathematics makes me feel impatient.	203 (7.9)	614 (23.8)	146 (5.7)	970 (37.7)	642 (24.9)	3.48	1.30
Mathematics makes me feel uncomfortable.	159 (6.2)	533 (20.7)	106 (4.1)	906 (35.2)	871 (33.8)	3.70	1.29
Mathematics makes me feel nervous.	253 (9.8)	620 (24.1)	170 (6.6)	909 (35.3)	623 (24.2)	3.40	1.34
Mathematics makes me feel restless.	193 (7.5)	649 (25.2)	133 (5.2)	966 (37.5)	634 (24.6)	3.47	1.30
I am afraid of Mathematics.	124 (4.8)	393 (15.3)	141 (5.5)	947 (36.8)	970 (37.6)	3.87	1.21

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Table 20 reveals that each of the items has a mean above 3.0, indicating that the mean rating for mathematics in terms of anxiety is high. The percentages of the students indicating their agreement or strong agreement to 'discomfort with mathematics' items, ranges between 53% to 75% within the same range of variations.

Ease with Mathematics

During the interview, some students conveyed that calmness, relaxation, peacefulness, and easiness represent their relationship with mathematics. Table 21 presents respondents' levels of agreement about their ease with mathematics.

Table 21: Distribution of Items regarding Ease with Mathematics

ITEMS	SD	D	N	A	SA	MEAN	STD
I feel relaxed while taking mathematics tests.	413 (16)	741 (28.8)	198 (7.7)	968 (37.6)	255 (9.9)	2.97	1.30
I feel relax when taking mathematics tests.	368 (14.3)	712 (27.7)	248 (9.6)	969 (37.6)	278 (10.8)	3.03	1.29
I am often at ease in mathematics class.	194 (7.6)	606 (23.5)	204 (7.9)	1138 (44.2)	433 (16.8)	3.39	1.22
I feel very calm when working mathematics.	229 (8.90	632 (24.5)	225 (8.70	1114 (43.3)	275 (14.6)	3.30	1.24
I feel no stress when answering mathematics questions.	301 (11.7)	904 (35.1)	197 (7.7)	883 (34.3)	290 (11.3)	2.98	1.27
I relax in Mathematics class.	361 (14)	696 (27)	192 (7.5)	1026 (39.8)	300 (11.7)	3.08	1.31
A mathematics tests do not scare me.	320 (12.4)	649 (25.2)	210 (8.2)	932 (36.2)	464 (18)	3.22	1.34
I mostly feel peaceful when solving mathematics problems.	205 (8)	586 (22.7)	223 (8.7)	1137 (44.1)	424 (16.5)	3.38	1.22

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Table 21 shows that between 48% and 61% of the students agree or strongly agree to 'ease with mathematics items'. This is lower to those who agree or strongly agree to the negative items in Table 20. This is an indication of high anxiety for the respondents in general. It also suggests that there is an overlapping between the two thematic areas, that is, about 14% to 23% students who are at ease with mathematics suffer some level of discomfort with mathematics especially when it comes to writing tests.

In order to obtain clarifications on what causes the anxiety, the differences in students' feelings in mathematics class and their feelings when writing a mathematics test and how mathematics anxiety can be minimized were sought through focus group interviews. Regarding their feelings during their mathematics class lessons, some students claimed they feel uncomfortable due to the fact that they could not answer questions posed by the teacher, dull as a result of the smart colleagues answering all questions, uncomfortable due to the inadequacy of mathematics periods which were in the afternoons, ashamed and always hid their heads in corners to avoid been called by the teacher because their responses always sounded stupid. For instance, StuB2 stated:

> what a shame not to be able to contribute in mathematics class, I always have to hide my head in a corner to avoid being called by the teacher because my responses always sounded stupid and amusing for my mates. It is so sad.

Some of the students feel sad for not understanding what was been taught, and sense of guilt for being responsible for the mathematics teachers predicament because of certain comments from some teachers like 'don't worry me, I have not eaten since morning and I still have to come and teach you' All these produced intimidation and fear in students which prevented them from asking questions in class. Nonetheless, despite all odds, some students with determination shun every distraction in order to be comfortable and get the best from their mathematics class.

The researcher found out how students felt when taking mathematics test. Some students admitted that they failed most of their mathematics test, others felt nervous and were even frightened by the word 'test', some panicked, causing them to rush through the entire test and making mistakes, some forget important formulae which most of the time led to their failure, some felt uncomfortable and intimidated especially when other colleagues asked for more answer sheets while they (the weak ones) are yet to exhaust initial answer sheets provided and some just lost confidence in their ability to answer questions previously practiced. This finding corroborates Dreger and Aiken (1957) claims that mathematics anxiety is unique and high level of anxiety weaken performance.

One student recalled how nervous she always becomes while writing a test whenever she remembers her previous poor performances despite all her effort, thus she becomes confused, her thinking disrupted and she is unable to focus on the task at hand. She (StuF2) stated:

> you have no idea what it means to work very hard but earn so little marks in math, it is very painful, the thought of this get me confused and I often

> lose focus because it becomes very difficult to think straight at that moment.

Some of the students felt frustrated by their inability to do things right in mathematics. A student (StuG2) expressed dismay 'I just don't know what else to do, I learnt the formulas but they don't always work in every situation. The same formula that I used to answer a question correctly made me to fail another question'. The lamentation of this student is a confirmation of the fact that many of the students over relied on mathematical procedures as opposed to actually understanding the mathematics concept. When students resort to memorizing procedures, rules, and routines without much understanding, the concept is forgotten and fear sets in.

The students experienced mathematics anxiety in different ways such as 'I do get the understanding while in math class, but when I go home it's like I was never there' (StuE2), 'the mathematics flies out easily from my head and that gets me worried all the time'(StuD2), 'I'm afraid of being left behind, I am slow in understanding the math and not able to keep up with the rest of the class'(StuG3), 'I understand mathematics now, but I worry that it's going to get really difficult soon, especially in SS3 and at WASSCE' (StuB3). Another student (StuH4) had this to say:

> When I am called upon to solve a question on the board in class, the fear of not getting the right answer sometimes makes me forget the initial understanding that I had and I end up making mistakes. I feel better if I

> don't have to disgrace myself before everybody in class, but I always do well in tests and examinations.

Furthermore, some students do not do well in mathematics because they easily get distracted while answering mathematics questions. For example, student (StuD3) expressed disappointment over what he called his teacher's insensitivity to his plight:

> When writing a test, at some point I get distracted and make mistakes, as a result, I don't get the answer correctly and my teacher always crossed me out regardless of all my efforts…he does not have the time to study my steps.

The researcher found out that some of the students who were nervous about mathematics do not complete tasks assigned to them regularly or some tend to abandon the work completely. The experience of this student (StuD3) is in agreement with the position of Ashcraft (2002) and Maloney and Beilock (2012) that students who are nervous about mathematics may have their thinking interrupted while doing mathematics, thereby abandoning the work or recording poor performance in the subject

It is interesting to note that some of the students claimed they felt very comfortable writing mathematics tests but always failed them while ironically most of those who did not feel comfortable produced desirable results most of the time. For example one of the interviewees (stuE3) had this to say:

> I have no option than to learn math for me to gain admission into university for a programme of my choice. I must have A1 in math,

> although I would not like to study mathematics related programme in my life again.

Another student (StuF3) responded:

> Because I see math as a problem, I always attend extra lessons in the subject. I always need to work hard in the subject. I wish I don't have to learn math, although I always do well, the success in math for me comes with tears. Because I am afraid of failing math, I forced myself to learn math against my wish. I am determined to make A1 in Math.

Although Olaniyan and Salman (2015) posit that the feeling of uneasiness by the students could be so intense that it might result in math-phobia, this notwithstanding, the anxiety in this study is not a destructive type but an optimal level of anxiety.

Reflecting on the experiences of the two students seemed to suggest that even though anxiety is a negative construct, the anxiety compelled them to do what is right, that is, to learn mathematics. In order words, anxiety at relatively low to moderate levels can be constructive. This may explain the position of Newstead (1995) that depending on the individual and the task, a moderate amount of anxiety may actually facilitate performance but beyond a certain degree, anxiety impedes performance particularly in the case of higher mental activities and conceptual process.

However, the irony of this is that anxiety will influence a student's decisions about what classes or programmes to take, often leading to avoidance of mathematics or its related discipline in future (Maloney & Beilock, 2012) as indicated by the student (StuE3) in this study.

In order to help students name their feelings towards mathematics, they were asked for their understanding of anxiety in relation to learning of mathematics during the focus group interview session.

Some of the students on one hand saw anxiety as the eagerness to know the outcome of Mathematics questions and a strong desire for Mathematics, while on the other hand some were of the opinion that anxiety has to do with being afraid, scared, fearful, anxious and under pressure when working Mathematics. For example, StuF4 stated that 'I am never at peace whenever I write a test, until I see my result that I have done well, success is sweet, I continue to worry my math teacher to let me see my result'. This is an indication that some of the anxieties felt by the students were not propelled by fear but by expectation, eagerness or desire to do well in mathematics.

On the other hand, in order to determine if the teachers are aware of anxiety in their students, they were asked during the interview to state the symptoms of anxiety in their students. One of the teachers (TrA1) stated:

> Students who are anxious rush to give answers which do not exist, dodge classes, may not talk in class at all, may fail to bring their books for marking or recording, put up discouraging performances, like copy work, sleep in class, may not laugh after a joke, may not do class test and homework.

Another teacher (TrE1) stated 'they ask off target questions, their work shows rote learning, want the lesson to be over quickly, easily give up, may not revise and practice work'. Yet another teacher (TrF1) claimed 'they lack attention or concentration in class, wear sad facial expression, in haste to finish exams which may sometimes result in their failure, tensed when answering questions, and so on'.

Additionally, teachers believe that a good atmosphere helps to calm the spirit of everyone in the class for learning. It removes intimidation, promotes team work, and students learn better from peers. Conversely, tensed, noisy, filthy and stench filled environment hinders learning.

Large class size, bad desks, poor seating arrangement, unavailability of teaching and learning materials, interruption of lessons in order to collect school fees, negative attitude of students towards mathematics and placing mathematics periods in the afternoon are some of the factors that hinder learning. All these could affect the mood of the students and create unnecessary tensions in the classroom according to some of the teachers.

Furthermore, the researcher wanted to know where the anxiety emanated from and students were asked to identify some causes of their anxiety in mathematics class. In view of that, the previous results/ failure and fear of future failures, seemingly high expectations in mathematics already set by self or parents, the mindset that mathematics is difficult and their inability to understand what the teacher was teaching, were identified as some of the causes of anxiety. In addition, some students indicated the fear of being caned by their mathematics teacher for wrong answers. For example, StuG4 in a mixed school stated: 'I fear being disgraced by my math teacher in the presence of the girls who will be very happy to laugh at me whenever I cried, so I avoided math class most of the time'

Some of the students indicated that the teacher's unfriendliness in class, unfriendly utterances from the teacher, irregularity and bad attitude of some of the teachers, such as coming late to class and rushing through lessons were some of the causes of their anxiety in mathematics. A group of students (SchF) declared 'our teachers are unfair, they come late to class, they don't say sorry to us but they rush us to learn and insult us when we don't learn well'. Some of the students (SchE) claimed absenteeism of their teachers and unhealthy comparison by their teachers of them (the students) to students in other schools is disheartening. One student (StuE4) asked the researcher 'are your fingers equal, please tell him (our teacher) to stop comparing us with those from big schools, it hurts us'. Yet, some students recognize students' wrong assumption that students in certain schools know everything, the fear of always making mistakes and inadequacy of the number of years allocated to cover senior high school mathematics syllabus as some of the causes of anxiety in mathematics class. For example, stuB4 cautioned her classmates that 'we students should stop thinking that those other students are better than us. We should not be afraid after-all, we are learners. Besides, they should also help us increase the SHS to 4 year so that we can learn well'.

To minimize anxiety in the learning of mathematics, the following were suggested by the students: Encouragement /motivation from the teacher, need to disabuse the bad mindset of the students about mathematics, use of pleasant utterances on the weak students by the teacher, give and mark more exercises to build students' confidence, teachers to reduce the pace of teaching, be regular and punctual in school and class, humble to listen to students' opinions, approachable outside the classroom and diversifying their questions. For example, one of the students (StuI4) said:

> teachers should vary their questions so that the weak students like me can at least be happy to answer questions in class, they should also give chance to somebody like me to answer question, always the brilliant students dominate us, even when we don't understand, the teacher does not mind us because everybody says 'yes sir'.

Teachers should avoid stigmatizing the weak students, and provide constructive feedback, give room for students to ask questions. Meanwhile, students should pay attention in class, cultivate good relationship with the teacher, and learn ahead of the class. According to one of the students 'our teacher does not allow us to ask questions, he shouts us down but then when visitors are around like from wherever, he begged us to ask questions and pretend to be nice'.

Furthermore, majority of the students (SchA, SchC, SchF, SchH, SchI, SchJ) believe the number of years allocated to the teaching of the content of mathematics syllabus is grossly inadequate, they advocated for a change from 3-year programme to 4-year programme of senior high school or a cut down on the number of topics to be covered at the senior high school, might help to reduce the stress faced by both the teacher and the student in the coverage of the syllabus thereby making their learning of mathematics enjoyable and adventurous.

According to them, if the suggestions offered are considered, mathematics anxiety would be drastically reduced if not eliminated totally. This is in agreement with the position of Ertekin et al. (2009) that mathematics anxiety is not innate but acquired. This is an indication that anxiety can be unlearned.

Some of the teachers (TrA1, TrF1, TrD1, TrD2) blame high risk tests that value rote learning and memorization as the main source of mathematics anxiety since teachers and students alike are under pressure to meet the expectations of the educational authorities. The teachers' claim echoes the position of Geist (2010) on the sources of mathematics anxiety. Nonetheless, teachers equally believed that anxiety could be eradicated.

Consequently, they proffered possible solutions such as encouraging guided views in class, showing students love and friendliness, enlightening students about the usefulness of mathematics, encouraging and motivating students in every way possible. Some of the teachers are of the opinion that making lessons more practical, influencing the need and be willing to attend in-service training for teachers about anxiety will help to reduce anxiety in mathematics because, according to them, the more a teacher understands mathematics anxiety the more he/she would be able to prevent it and help students overcome it.

Majority of the teachers hold the views that promoting the need to make lessons more exciting at the basic level by their colleagues, changing students' mind set about the subject, provision of teaching and learning materials by the schools, varying teaching methods, avoiding learning strategies that rely on behaviourist models such as rote-memorisation of rules and the manipulation of symbols with little or no understanding will go a long way to reduce anxiety.

Some of the teachers claim giving lots of exercises for students to heighten their confidence while at the same time avoid complete reliance on learning mathematics through drill and practice, teaching students how to work faster on questions and calling for the need to run a 4-year programme in senior high school instead of the current 3-year programme (which in reality is just 2 years) will do justice to reduce anxiety in our schools.

One of the teachers suggested teaching methods based on constructivist models of learning such as problem-based learning, inquiry-based learning and guided discovery learning, nevertheless, he was quick to adjudge that those methods can never be implemented in Ghanaian public schools because of the large class sizes. That notwithstanding, the researcher was delighted when a teacher claimed he had been able to reduce mathematics anxiety in his classes through alternative instructional formats such as problem solving, co-operative learning and process-oriented methods of teaching and learning but the teacher teaches in one of the top schools in the metropolis and had 37 students in his class. According to the teacher 'I have been able to help my students overcome anxiety in mathematics class by making the good ones help the weak ones through group works, presentations, process-oriented methods…although it takes time initially, it pays off eventually….'

Effect of anxiety factors on students' achievement in mathematics

Regression analysis was carried out on the Anxiety variable, which is made of two subscales: *discomfort with mathematics* and *ease with mathematics*. Both sub constructs significantly correlated with achievement scores by .402 and .309 respectively and with each other by .760. Anxiety variable shared a variance of approximately16% with achievement scores (R square = .162 and Adjusted R Square = .161). The model reaches statistical significance ($p < .05$). 'Discomfort with mathematics' ($\beta = .397, p < .05$) makes the strongest unique and statistically significant contribution to explaining the dependent variable, when the variance explained by 'ease with mathematics' ($\beta = .007$, $p = 0.794$) in the model is controlled for. The variance uniquely explained in achievement scores by 'discomfort with mathematics' and 'ease with mathematics' were respectively 6.7% and .003%. Thus, the initial regression model generated between anxiety variable and achievement scores with $F(2, 2572) = 248.277$, $p<.05$ is

Achievement scores = 25.377 + 0.398 (discomfort with mathematics) +

0.008 (ease with mathematics).

However, with the removal of 'ease with mathematics', the Final model with $F(1, 2573) = 496.666$, $p<.05$ is:

Achievement scores = 25.497+ 0.403 (discomfort with mathematics).

The model indicates that in the absence of discomfort with mathematics, the achievement score would be 25%. The achievement score increases by 0.402 for every unit increase in '*discomfort*' scale.

As mentioned earlier, the anxiety in this study is not a destructive type but an optimal level of anxiety as can be inferred from StuE3 and StuF3 submissions (Conf. page 181).

That is, some of the anxieties felt by the students were not propelled by fear that could cripple but by expectation, eagerness or desire to do well in mathematics. Although anxiety is a negative construct, the anxiety compelled the students to do what is right, that is, to learn mathematics. This may be due to the fact that some mathematics worry/anxiety can act as a motivational force having positive effects on success in mathematics. Students who place importance and value on mathematics may experience higher levels of mathematics anxiety due to their desire to do well in mathematics, which in turn gives students more determination to study and do well (Sieber, 2015; Ho et al., 2000; Lee, 2009; Wigfield & Meece, 1988). In this study, for some of the students, the anxiety becomes a driving force for the amount of effort they put forth in mathematics, thus leading to positive results.

In order words, anxiety at relatively low to moderate levels can be constructive. This may explain the position of Newstead (1995) that depending on the individual and the task, a moderate amount of anxiety may actually facilitate performance but beyond a certain degree, anxiety impedes performance particularly in the case of higher mental activities and conceptual process.

However, the irony of this is that anxiety might influence a student's decisions about what classes or programmes to take, often leading to avoidance of mathematics or its related discipline in future (Maloney & Beilock, 2012) as indicated by the interviewee StuE3 in this study.

Level of attitude in students towards the learning of mathematics

Tables 22 to Table 25 give the frequencies, percentages, mean and standard deviations of the sub constructs of attitude.

Learned Helplessness

This has to do with beliefs about one's ability to perform specific tasks. When student confidence which is an internal factor is negative, it is otherwise referred to as learned helplessness by some scholars (Slavin, 2003). This has to do with students having doubts about their ability to learn or do well in mathematics. Table 22 presents the distribution of items on learned helplessness.

Table 22: Distribution of Items regarding Learned helplessness

ITEMS	SD	D	N	A	SA	MEAN	STD
I do badly in tests of mathematics as compared to that of my friends.	441 (17.1)	965 (37.4)	179 (7)	720 (28)	270 (10.5)	2.77	1.31
My friends do better than me in mathematics.	202 (7.9)	713 (27.7)	286 (11.1)	1031 (40)	343 (13.3)	3.23	1.21
I do not have the ability to do well in Mathematics.	1063 (41.3)	938 (36.4)	87 (3.4)	328 (12.7)	159 (6.2)	2.06	1.23
I do not see myself becoming successful in the learning of mathematics.	1065 (41.4)	897 (34.8)	100 (3.9)	357 (13.9)	156 (6.0)	2.08	1.24
In mathematics class, I see others to be better than me.	395 (15.3)	751 (29.2)	194 (7.5)	899 (34.9)	336 (13.1)	3.01	1.33
Mathematics is the most difficult subject for me.	866 (33.6)	787 (30.6)	101 (3.9)	467 (18.1)	354 (13.8)	2.48	1.45

Table 22 cont'd

I do not see myself to be good in mathematics.	787 (9.6)	1015 (39.4)	272 (10.6)	804 (31.2)	236 (9.2)	2.49	1.37
I am not good in the study of mathematics.	585 (22.7)	1024 (39.8)	146 (5.7)	638 (24.8)	182 (7.0)	2.54	1.27
Mathematics related subjects have been my worst subjects.	663 (25.7)	068 (37.6)	119 (4.6)	568 (22.1)	257 (10)	2.53	1.34
Even though I work hard on mathematics, it seems difficult for me.	353 (13.7)	874 (33.9)	127 (4.9)	895 (34.8)	326 (12.7)	2.99	1.32
Most subjects I can handle well, but I have problems with mathematics.	357 (13.9)	717 (27.80	126 (4.90	881 (34.2)	494 (19.2)	3.17	1.38
I do not enjoy learning mathematics.	924 (35.90	852 (33.1)	129 (5)	467 (18.1)	203 (7.9)	2.29	1.33
I feel I cannot do well in Mathematics.	1361 (52.8)	779 (30.3)	48 (1.9)	291 (11.3)	96 (3.7)	1.83	1.14

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Students expressed the struggles, challenges and difficulties that confront them in the study of mathematics as compared to other subjects and in comparison to their friends.

There was an even distribution of the students who agreed and disagreed with the fact that even though they work hard on mathematics, it seems difficult for them. Again 53.4% (1,375) of the students agreed or strongly agreed that they could handle most subjects well but have problems with mathematics. This is high thus indicating that majority of the students did not perceive mathematics in a good light. As many as 53.3% (1, 374) of the students did not perceive their personal ability to be adequate for the learning of mathematics, they rather saw their friends or others to be better endowed for the subject. This explains why about 32% of the students claimed they are not good in the study of mathematics.

Students who have good attitude towards mathematics have a propensity to spend more time on the subject and for this reason perform better. Conversely, students who have bad attitude towards mathematics tend to have negative feelings about the subject. That is the case in this study where about 15% to 53% of the respondents agree (or strongly agree) to each of the items that connote negatively perceived personal ability. Since studies have shown that attitude is based on value and belief, in addition to varying degree of factual knowledge (Mullis et al., 2001), and student beliefs and attitudes have the ability to either facilitate or hinder learning (Mata et al., 2012; Minato & Yanase, 1984; Randhawa & Beamer, 1992) then students who do not trust in their personal ability to succeed in the learning of mathematics are not likely to obtain quality results in mathematics. This negative perception of self-ability has implications for learning. It determines the extent to which an individual would be willing to go to accomplish the given task (Bandura, 1977, 1986).

Over 50% of the respondents in this study do not have confidence or believe in their ability to achieve success in mathematics. They have learnt helplessness through pessimistic comparison of self to others and of mathematics to other subjects. This is evident in the submission made by one of the respondents that 'I don't always do well in math but once in a while success comes my way by luck', another student said 'if I can be lucky to have 'C' (meaning credit) in math, I will be very glad because math have been my worst subject, I don't think I can ever learn it'. These findings are in line with the claims of Campbell and Hackett (1986), Singh et al. (2002), Winheller et al. (2013), and Huang (2011), in quoting Marsh and Craven, that irrespective of performance gains made by students who lack confidence in self, they would be short-lived unless practitioners improved participants' self-believe in their ability.

Perseverance

Students who persevere have goal-orientation, intellectual curiosity or inquisitiveness. They view learning as a meaningful activity and prefer challenging rather than easy task. Table 23 presents the distribution of items on perseverance.

Table 23: Distribution of Items regarding Perseverance

ITEMS	SD	D	N	A	SA	MEAN	STD
When I am faced with mathematics related problem that I cannot solve immediately I stick with it until I solve it.	459 (17.8)	1237 (48.1)	132 (5.1)	548 (21.3)	199 (7.7)	2.53	1.22
Even when a mathematics question is difficult, I keep working until I find an answer	556 (21.6)	1168 (45.4)	122 (4.7)	536 (20.8)	193 (7.5)	2.47	1.24
When I am left with a question that requires the use of Mathematics to answer, I will keep on trying until I answer it.	529 (20.5)	1213 (47.1)	130 (5)	519 (20.2)	184 (7.2)	2.46	1.22

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

In all, it can be seen from Table 23 that majority of the students easily give up hope of being successful in mathematics because of the challenges they are facing in terms of the understanding of the subject. It is observed that with a mean lower than 3.00, most of the students failed to persevere in the study of mathematics.

Just a handful of the students representing less than 30% keep trying until they obtained answers to problems when studying mathematics. This is an unpleasant attitude to the learning of mathematics. Over 70% of the students do not possessed the ability not to perceive unsuccessful first attempts as failures; rather they easily give up hope and succumb to defeat. These are the students that are not doing well in mathematics. One of the students noted that 'whenever I forced myself to learn math, I do better and have higher scores but it is always difficult to keep trying unsuccessfully, it's kind of boring'. Students who exhibited such negative characteristics are not likely to succeed in the study of mathematics. This student's experience resonates with research findings that claim that attitudes towards mathematics are positively and significantly associated with mathematics achievement in several countries and students without positive attitudes tend to achieve lower results (Else-Quest et al., 2010; House, 2006; Shen & Tam, 2008; Singh et al., 2002; Winheller et al., 2013).

Confidence

Table 24 presents the distribution of items on confidence which according to past studies (Lim & Chapman, 2015; Ma & Kishor, 1997a) was the highest correlate of achievement scores.

Table 24: Distribution of Items regarding Confidence

ITEMS	SD	D	N	A	SA	MEAN	STD
I am sure I can do advance work in mathematics.	325 (12.6)	797 (30.9)	149 (5.8)	944 (36.7)	360 (14)	3.08	1.32
I can learn advanced mathematics.	335 (13)	796 (30.9)	187 (7.3)	967 (37.5)	290 (11.3)	3.03	1.29
I can handle more difficult mathematics problems.	444 (17.2)	772 (30)	220 (8.50	983 (38.2)	156 (6.1)	2.86	1.26
I have a lot of confidence when it comes to mathematics.	317 (12.3)	814 (31.6)	201 (7.8)	867 (33.7)	376 (14.6)	3.07	1.31
I am capable of solving difficult mathematics questions.	353 (13.7)	787 (30.6)	202 (7.8)	984 (38.2)	249 (9.7)	3.00	1.27

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Responses from Table 24 revealed that, there was an almost even distribution between agreement and disagreement regarding the confidence that students have when it comes to the learning of mathematics. These are represented by frequencies of 1,243 and 1,131 respectively with corresponding percentages of 48.3 and 43.9. Also, there was an indication that, about half of the respondents represented by 48.9% with a frequency of 1,257 attested to the fact that they can learn advanced mathematics. In general, from Table 24 it can be seen that less than 50% of the respondents with mean of 3 and standard deviation of 1.2 had confidence in their ability to succeed in mathematics. An indication to the fact that more than 50% are unlikely to continue in the study of mathematics or its related disciplines because students who have little confidence in their ability to do mathematics are likely to take the minimum numbers of required mathematics courses (in higher institutions), thereby greatly limiting their career choice options (Garry, 2005).

Enjoyment

Enjoyment of mathematics has to do with 'the degree to which students enjoy working (on) mathematics' (Tapia & Marsh, 2000, p. 17), the satisfaction, equity, natural and positive consequences they experience by working mathematics. Table 25 presents the distribution of items on enjoyment.

Table 25: Distribution of Items regarding Enjoyment

ITEMS	SD	D	N	A	SA	MEAN	STD
I usually feel relax when solving mathematics questions.	248 (9.6)	1015 (39.4)	272 (10.6)	804 (31.2)	236 (9.2)	2.91	1.20
A mathematics test is always welcome by me.	284 (11)	966 (37.5)	264 (10.3)	821 (31.9)	240 (9.3)	2.91	1.23
I feel comfortable with Mathematics.	421 (16.3)	1122 (43.6)	219 (8.5)	633 (24.6)	180 (7)	2.62	1.21
I feel good solving Mathematics questions.	481 (18.7)	1155 (44.9)	235 (9.1)	544 (21.1)	160 (6.2)	2.51	1.19
I like Mathematics.	734 (28.5)	1089 (42.3)	183 (7.1)	437 (17)	132 (5.1)	2.28	1.19
Generally I feel secure about undertaking Mathematics related programme in future.	293 (11.4)	850 (33)	210 (8.2)	851 (33)	371 (14.4)	3.06	1.30

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

From Table 25, it can be seen that 27% of the students either agreed or strongly agreed whiles 64% either disagreed or strongly disagreed to the item on 'feeling good when solving mathematics questions', with a mean of 2.51 indicating that majority of the students are not interested in working mathematics. Furthermore, a lot of the students did not like mathematics. About 70% of the respondents with a mean of 2.28 declared their dislike of mathematics, likewise, majority of the students did not feel at home with mathematics as reflected in the percentage of students (60%) who disagreed or strongly disagreed with the item 'I feel comfortable with Mathematics'.

However, there was an almost even distribution of students to the item 'I usually feel relax when solving mathematics questions'. Almost half of the respondents (49%) disagreed to the statement. This is an indication of tension and anxiety during mathematics classes. It was difficult to understand what could possibly generate tension in regular classes in the absence of tests or examinations.

There could be some reasons to the unexpected result, but the observation data revealed that about 4% (Appendix A, Table 13, item 6) of the teachers lost their temper and shouted down the students, or were most times harsh or blamed the students for getting them angry all the time.

In general, Table 25 reveals that about 44% to 70% of the respondents with mean of approximately 3 and standard deviation of 1.2 have high level of dislike for mathematics. They do not feel good and comfortable with mathematics. However, about 40% of the respondents with mean of approximately 3.0 and standard deviation of 1.2 welcome mathematics tests and relax when solving mathematics problems. From this study, it can be deduced that it is not all those who welcome mathematics test (40%), comfortable with mathematics (32%) or feel relax when solving mathematics questions (40%) that equally like mathematics (22%).

The analysis of the items on the attitude questionnaire was followed with a focus group interview to obtain clarification on the respondents' ideas as indicated on the questionnaire using items 14 to 21 of the interview guide. The following are some of the ways respondents portrayed their attitude towards mathematics.

Students were asked for what they will do when answering a mathematics question that proves difficult to them in class or assignment. StuA4 declared:

> I happen to be one of the students who don't cherish mathematics as a subject. This subjects me to many challenges when it comes to the understanding of mathematics, particularly, answering mathematics questions. In view of this I adopted alternative means to help me fathom the subject. I have always deemed it fit to approach friends who in one way or another have adequate understanding of the subject to help me in solving the questions. On matters of urgency, I consult teachers who on the basis of their benevolence give me further explanations and clarification to answering the questions. However, in times of difficulty where there happen to be no hope in gaining understanding to answering the questions, I copied from friends to avoid being caned.

Another respondent (StuB5) had this to say "More often than not, I brush off some questions and move on to other ones. On rare cases, I give it up after trying it twice and consequently avoid submitting my book". Yet StuD4 stated that "Sometimes I search in some textbooks for understanding or just to follow the steps whether I understand it or not" and lastly one StuE5 claimed:

> I move on to another thing and later come back to it or copy from a friend but where all efforts failed, I stay away from school until the submission date is over to avoid being caned or punished severely, although the teacher never mark the work.

These were the responses from some of the focus group interviews. Responses from the other groups were similar with little variations. Furthermore, considering the fact that consultation may not be possible during examinations as it is possible for assignment and class work, students were asked for what they will do when answering a question that proved difficult to them in a test or examination and StuG5 said "I either copy from friends to get good grades, move on to other questions or feel sad when there seem to be no hope".

According to the students, there were many ways of cheating in examination, especially when multiple choice items are involved. It ranges from using the school uniform button arrangement, clearing ones' throat a number of times, using body parts (head, eyes, nose, mouth and ears) to communicate the different alphabets as the answer. Better still, punching some holes on the pencil and throwing it on the floor as an exchange for a friend's pencil could also help when in desperate situations. This suggests that students did not really learn well the mathematics they were taught and tests or examination results may not be the true reflections of students' abilities. They have adapted different means of survival: memorized formulae, hide their weaknesses and exaggerate their strength, rote learning, or cheating in worst scenario.

Perhaps, teacher's confidence or trust in the students might have helped in such situations. Regrettably, the observation data showed that some teachers' lacked confidence in the students because they failed to demonstrate that students could improve. About 2% (Appendix A, Table 13, item 13) of the teachers communicated either directly or indirectly that they could neither learn from the students nor made mistakes. For example, TrC1 while teaching stated that "WAEC is not interested in your ideas neither am I, if you think you have better ideas, keep them to yourself but follow what I teach you because if you deviate or make mistakes WAEC will not pardon you"

In addition, about 4% teachers did not exhibit professionalism (Appendix A, Table 13, Item 15). They either did not show positive attitude towards teaching, failed to relax while teaching, complained about teaching, eagerly left the class before the period was over or failed to interact with the students. Also, about 14% (Appendix A, Table 13, Item 17) of the teachers gave few examples to support their teaching, although majority of them exhibited good command of the subject matter.

Students were asked to explain how useful mathematics was to them at the moment. One of the students (StuI5) stated that:

> Irrespective of the challenges I face in mathematics, it is useful to me in my day to day activities. These include but are not limited to helping our illiterate parents in running their day to day businesses. It also helps in understanding other subjects. Conversely, some topics like trigonometry and surd are not useful to us. I even wonder why we have to suffer to learn them. Of what use are they to us?

I was taken aback by StuI5 submission because she is a science student in one of the prestigious schools in the Metropolis.

Another question that was put forward to the respondents was, how useful will mathematics be for them in the future. To that StuH5 responded:

> Mathematics however will be useful for me in the future as it will help me in the management of resources like calculating how many wedding cakes I can bake from a 25kg flour, the right quantity of salt, the exact measurement of yeast and sugar; it will help me in banking negotiation if I want to take a loan; it will help me in business activities like calculating profit and adding it to the cost of materials before billing customers in a business proposal. On the other hand, it is not useful to me beyond senior high school. I don't see how angle of elevation and depression or bearing will help me in my business. Those of us who are into Home Economics or Visual Arts should rather be exempted from such topics and focus more on our practical work.

A Visual Arts student (StuF5) was disturbed about the topic 'Variation', according to him, the topic sounds so simple but difficult to understand. He lamented: "Why do my parents have to pay water bill if for two months nobody was in the house, we had gone on vacation, the idea of constant of variation in indirect variation is very confusing and unjust"

Another respondent (StuD5) stated that "It will help me to further my career in mathematics related programmes as well as gaining admission into the University". Nearly all the interviewees in Home Economics, General Arts and Visual Arts felt unjustly treated for having to learn mathematics. Only the Science, Business and few of the Technical students appreciated the study of mathematics. Even then, some of the science students felt some topics ought not to have been included in the mathematics syllabus, such topics like Logarithms, Trigonometry, Rigid motion, Vectors, Circle theorem, Bearings, and so on.

Furthermore, the students were asked to state how confident they were to succeed in the learning of mathematics. One of the respondents (StuJ5) declared:

> I was not confident in mathematics. This is buttressed by the fact that I always forget what I learn in mathematics and also find it difficult to learn mathematics. I must however emphasize that being able to do exercises and tests give me confidence. It is also significant to note that, this interview has given me some sort of confidence. I have now come to realize that, once others have done it before, I could also do it.

When the respondents were asked to indicate how much time they individually spend in learning mathematics all by themselves, there were variations in their responses. Some spent as much as three hours per week while others spent no time on their own to learn mathematics. In such situations, they claimed that their electives robbed them of mathematics as the practical aspect of their programmes demanded more attention especially Home Economics and Visual Arts. Some of their responses were "I spend three hours on mathematics in a week" (StuA5), "I have little time for mathematics because of my electives. As a result, I have it only twice on my timetable in a week for one hour" (StuJ6), "Sometimes I abandon it when it proves difficult. I mostly do not solve mathematics on my own. What makes it worse is that, it makes me sleepy " (StuF6).

The researcher was a witness to how Home Economics practical could take two to three days completely in a week from the students in a particular school (SchF). Starting from when planning for practical, making the list of the ingredients or condiments, getting the utensils ready at least two days before the practical, going to organize the venue of the practical at least a day to the actual event. Of course, on the practical day, students cannot participate in any other event in the school. Every other subject is cheated of its periods. Although the mathematics teacher whose teaching periods were taken was bitter, there was nothing he could do about the situation.

In addition, students were asked to arrange the subjects of their programmes in order of preference. To the amazement of the researcher, mathematics came either last or second to the last position for most of the students.

> I tend to like social studies as my best subject because the teacher is friendly and I can identify with the subject, in fact without learning I can

still pass the subject in a test but mathematics is at the last position, I don't know, I like the subject but I don't enjoy learning it (StuD5).

StuD5 threw up his hands in despair. He wished to have better relationship with mathematics but there are too many obstacles in his way. Another student (StuG6) responded "Geography is my best subject because the teacher is approachable. The subject is about my environment whereas mathematics is the second to last position because it gives me so much pain and the teacher too is wicked". StuI5 would probably have felt better if only she knew what each of the topics is used for. She exclaimed "I like mathematics but it is too difficult for me. Why do I have to learn all those topics when I really don't know how they are useful to me, well I will place it sixth best" Almost all the interviewees (98%) shared this same sentiment that knowing the usefulness or usage of every topic to be learnt would go a long way to entice them to learn.

Furthermore, the students were asked about their understanding of attitude in relation to the learning of mathematics. Some saw it to be about their responses or reactions to mathematics, their opinions about or behavior towards mathematics, the level of their confidence in mathematics as well as the value they attached to mathematics. From their responses, it could be established that the students were aware of their attitude towards mathematics as well as the implication of such attitude. In fact, StuH6 said 'I know I don't have good attitude towards mathematics, I spend less time with mathematics than I do with other subjects that is why I don't do well but I can't help it'.

Consequently, when teachers were asked to describe the attitude of their students, some of them stated: refusal to do homework / class exercises, lack of interest due to JHS experiences, dodging lessons, absenteeism, entrenched belief that it is normal for girls to perform badly in mathematics, lack of readiness and attention in class, low self-confidence and negative mind set. On the contrary, some teachers claimed that their students take over and teach in their absence, are always eager to learn and submit assignments on time. For example, TrI stated:

> I am very lucky to have zealous students; they are willing to take over teaching responsibilities whenever I am unavoidably absent. Many of them are very curious, always asking questions in class, sometime they scout for questions before our lessons and bombard me with them. They have made me a better teacher because I always have to do in-depth research on every topic that I teach them.

Some teachers (SchA, SchB, SchC, SchD, SchH, and SchI) said their students show confidence to succeed, appreciate practical lessons and inquire about the usefulness of mathematics topics. Disappointedly however, most of the teachers admitted to not knowing the usage of many of the topics such as rigid motion, relation and functions, surds, number bases, vectors, indices and logarithms, trigonometry, and so on. As the popular saying goes 'you cannot give what you do not have', the teachers probably could not sustain students' interest in mathematics because they lacked information on some important concepts that could have aided their understanding of these topics.

Additionally, teachers were asked to proffer possible solutions that could help to boost the confidence of students in mathematics. Some of them were of the opinion that teachers should praise and encourage both weak and good students alike, follow guided principles with students to answer questions, give topics to research on prior to the lesson time, give lots of exercises and practical lessons, subject specialists teachers should be put at the basic level, give each student unique assignment based on their needs, engage and pay attention to all the students, show videos on 3 dimensional objects for better understanding, create awareness on mathematically successful ladies, etcetera.

Effect of attitudinal factors on the performance of students in mathematics

Regression analysis was carried out on the Attitude variable, which is made of four subscales: *learned helplessness*, *perseverance*, *confidence* and *enjoyment* with statistically significant correlation coefficients of – .516, –.310, .607, and –.383 respectively. Attitude variable shared a variance of approximately 40% with achievement scores (R square = .399 and Adjusted R Square = .398). The model reaches statistical significance ($p < .05$).

Evaluating the four subscales revealed (β = 0.541, p = 0.000) for 'confidence', followed by (β = –0.305, p = 0.000) for 'learned helplessness', (β = 0.206, p = 0.000) for 'enjoyment', and (β = 0.027, p = 0.145) for 'perseverance' meaning that confidence made the strongest unique contribution to explaining the dependent variable, when the variance explained by all others in the model is controlled for. This is followed by learned helplessness, enjoyment and perseverance respectively. The p value is significant for three of the sub constructs ($p < .05$) excluding perseverance ($p > 0.05$). This is an indication that, with the exception of perseverance, each of the sub constructs of the attitude variable made a significant unique contribution to the prediction of the achievement test scores. The variance uniquely explained in achievement scores by the sub constructs are 29.3%, 9.3%, 4.2%, 0.07%, for confidence, learned helplessness, enjoyment and perseverance respectively. The p-value is significant for all the sub constructs ($p < .05$) with the exception of perseverance and the standardised β-value (0.541) recorded by *'confidence'* indicates that the sub-construct best predicts performance in mathematics. Thus, the regression model generated between attitude variable and achievement scores with $F(4, 2570) = 425.782$, $p<.05$ is:

Achievement scores = 29.883 – .326 (learned helplessness) + .024 (perseverance) + 0.456(confidence) + .222 (enjoyment)

However, with the removal of 'perseverance', the Final model with $F(3, 2571) = 566.755$, $p = 0.000 < .05$ is:

Achievement scores = 30.700+ .451 confidence – .319 learned helplessness + .227 enjoyment

The model indicates that *'confidence'* best predicts performance of students in mathematics. Despite confidence's small coefficient (0.451), if there is a unit increase in 'confidence', we can expect an increase of 0.535 in achievement score. This is followed by learned helplessness with a negative coefficient, an indication that achievement scores will reduce by 0.299 for every unit increase in the 'learned helplessness' scale. It could also be inferred that the level of enjoyment of mathematics by the students is at barest minimal. Finally, the constant value (30.70) is the achievement score when each of the sub-constructs equals zero.

Level of motivation in students towards the learning of mathematics

Motivation plays a large part in students' interest in and enjoyment of school. Andrew (2003) conceptualises motivation as students' energy and drive to learn, work effectively, and achieve to their potential at school and the behaviours that follow from this energy and drive. Table 26 to Table 30 give the frequencies, percentages, mean and standard deviations of the sub constructs of motivation.

Amotivation

Table 26 presents data on how students are amotivated in the schools.

Table 26: Distribution of Items regarding Amotivation

ITEMS	SD	D	N	A	SA	MEAN	STD
Solving mathematics problems is boring.	153 (5.9)	269 (10.4)	177 (6.9)	939 (36.5)	1037 (40.3)	3.95	1.19
I do not see how mathematics is of value to me.	68 (2.6)	177 (6.9)	66 (2.6)	889 (34.5)	1375 (53.4)	4.29	.99
Trying to solve mathematics related problems does not appeal to me.	122 (4.7)	415 (16.1)	216 (8.4)	1099 (42.7)	723 (28.1)	3.73	1.17
The subjects which require mathematics are waste of time.	78 (3)	116 (4.5)	78 (3.1)	876 (34)	1427 (55.4)	4.34	.96
I would rather have someone give me an answer to mathematics questions than to solve it by myself.	101 (3.9)	262 (10.2)	128 (5)	942 (36.6)	1142 (44.3)	4.07	1.12

Table 26 cont'd

	SD	D	N	A	SA	Mean	SD
I do not enjoy doing mathematics.	119 (4.6)	322 (12.5)	212 (8.2)	1129 (43.9)	793 (30.8)	3.84	1.13
I feel that it is a waste of time studying mathematics.	51 (2)	95 (3.7)	49 (1.9)	631 (24.5)	1749 (67.9)	4.53	.86
I cannot see why I should study mathematics.	96 (3.7)	162 (6.3)	92 (3.6)	844 (32.8)	1381 (53.6)	4.26	1.04
It does not make any difference whether I learn mathematics or not.	91 (3.5)	293 (11.4)	171 (6.6)	1088 (42.3)	932 (36.2)	3.96	1.10
I feel helpless studying mathematics.	106 (4.0)	249 (9.7)	154 (6)	1269 (49.3)	797 (31)	3.93	1.06
For me, solving mathematics problems is a waste of time.	106 (4.1)	228 (8.9)	146 (5.7)	1121 (43.5)	974 (37.8)	4.02	1.08
Mathematics will not be important for the rest of my life.	63 (2.4)	129 (5)	89 (3.5)	730 (28.4)	1564 (60.7)	4.40	.95
Mathematics is not useful to me.	92 (3.6)	322 (12.5)	214 (8.3)	1216 (47.2)	731 (28.4)	3.84	1.08
I am studying mathematics because it is a compulsory subject in senior high school.	417 (16.2)	671 (26.1)	158 (6.1)	838 (32.5)	491 (19.1)	2.88	1.40

SD: Strongly disagree, D: Disagree, N: Neutral, A: Agree, SA: Strongly agree

Table 26 reveals that, majority of the respondents (92.4%) either agreed or strongly agreed to the opinion that it is a waste of time studying mathematics. This is represented by a frequency of 631 and 1749 with the corresponding percentages of 24.5 and 67.9 respectively. In addition, as many as 2,294 respondents representing 89% agreed or strongly agreed that mathematics will not be important for the rest of their life. Furthermore, about 76% claimed that mathematics is not useful to them, but just 6% to 17 % of the respondents either disagreed or strongly disagreed to all the items that negated the usefulness of mathematics. This means that less than 20% of the students identified with the usefulness of mathematics. In fact, over 50% respondents' are in agreement or strong agreement to the idea that 'I am studying mathematics because it is a compulsory subject in senior high school'. This is an indication that they are not motivated to study mathematics and would be pleased to discard of it at any opportune time.

A student declared 'the day I complete my SHS would be the day I bid farewell to math, give me three or four reading subjects in place of math, I would gladly accept, what!, oh no, I am tired of mathematics' This is in line with Vallerand et al. (1992) where they explained that —individuals are amotivated when they perceive a lack of contingency between their behaviour and outcomes. According to them, amotivated behaviours are not intrinsically or extrinsically motivated but are non-motivated. It is associated with feelings of incompetence to complete a task, the inability to see value in an activity or absence of intent to pursue an activity (Fairchild et al., 2005).

External regulation motivation

External regulation is the least autonomous motivation. It is performed because of external demand or possible reward (Deci, 1972; Vallerand et al., 1992). Individuals would only take action in order to obtain a reward or an outcome and not just for fun. It is dictated by the desire to satisfy external pressures such as parents and teachers. Table 27 presents reactions to items on external regulation motivation.

Table 27: Distribution of Items regarding External Regulation Motivation

ITEMS	SD	D	N	A	SA	MEAN	STD
I am doing my best in mathematics so that I can have the best grade at WASSCE.Q21d	31 (1.2)	52 (2)	49 (1.9)	708 (27.5)	1735 (67.4)	4.58	.74
I am studying mathematics because I plan to major in a mathematics related programme at the university.	309 (12)	590 (22.9)	171 (6.6)	842 (32.7)	663 (25.8)	3.37	1.39
I will need a firm mastery of mathematics in my future work.	124 (4.8)	411 (16)	243 (9.4)	1017 (39.5)	780 (30.3)	3.74	1.19

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

A look at Table 27 suggests that majority of the respondents (69.8%) believed they would need a firm mastery of mathematics in the future, while as many as 58.4% planned to major in a mathematics related programme at the university. An outstanding number of the respondents, about 95%, with a high mean of 4.58 and a standard deviation of 0.74 are learning mathematics in order to get a best grade in WASSCE. This is a pure external regulation motivation which has to do with the force behind doing something for some consequence separate from the immediate action. Their stimulation depends on external incentive to initiate actions towards a set goal. The respondents are driven or propelled by reward in the form of a grade from WASSCE; this is likely to end in the absence of the reward.

For instance one student claimed 'I am learning math because I want good grade or mark, nothing else matter to me. Joy or no joy, my goal is to earn good grade at WASSCE, I will work very hard to achieve this'. People with external regulation motivation are target oriented; personal pleasure, joy, growth and development have no meaning to them. The student's opinion is in accordance with Ryan and Deci (2000a) position that extrinsic motivation is a construct that pertains whenever an activity is done in order to attain some separable outcome. Extrinsic motivation is subject to modification and adaptation with value of the reward. Such people are discouraged when the reward is not present and a bigger reward may call for greater commitment than a smaller reward. Although intrinsic motivation plays a critical role in SDT, according to (Reeve et al., 2004) extrinsic motivation is also necessary in the educational setting.

Furthermore, to clarify the seemingly contradictory claims of the respondents on the questionnaire, a focus group interview was conducted and to be sure that the respondents and the researcher were on the same wavelength, the students were asked to express their understanding of motivation. Some of the respondents saw motivation in relation to the learning of mathematics as being appreciated, encouraged and supported or appreciating someone's effort in learning mathematics. Others perceived motivation to include having the courage to face mathematics; bringing up someone's spirit to learn mathematics as well as to be enthusiastic and knowing the reasons for learning mathematics. It could be inferred from the respondents' views that motivation could be intrinsic or extrinsic.

Furthermore, the students were asked to indicate their reasons for studying mathematics. The reasons stated included but not limited to the fact that it was a compulsory subject, for future professional aspiration; for flexibility of mathematics that students can branch into any field of study later in life and for the opportunities students gain from learning mathematics. Others include to pave way for admission into the university, for running businesses in future, for its utilitarian usage and to improve upon learners' thinking ability.

Consequently, when the respondents were asked to specify what could motivate them to study mathematics better, some of them indicated that teachers' motivation and academic awards for best student in mathematics could play a major role. Other factors include encouragement from friends or group discussion and award for best improved students in mathematics.

Majority of the students claimed that university admission motivates them to learn mathematics as it is one of the basic requirements for entry into the university. A few of the students emphasized the importance of role models. For example, one of the students stated "My role models play a significant role in motivating me to learning mathematics as I always want to excel like them. This goes a long way to make me love mathematics" The students' expectations of teachers regarding motivation are in line with some of the understanding of teachers about motivation.

Teachers enumerated the use of encouraging words, verbally and in their books, through style of lesson delivery, through handling their responses, through the use of TLMs / Practical lessons, giving a lot of exercises, through praises / prizes / clapping, pairing weak and good students, commenting and commending students for every improvement made, giving opportunity for students to express themselves, and providing prompt feedback after tests / assignments. Although, some teachers stated the use of encouraging words in the students' exercise books is one of the ways to motivate students, some of the teachers were too harsh in their comments to weak students. For instance, a teacher wrote "fail" in red pen on any exercise where the students scored less than halve of the total mark (Appendix C, exhibit 5 and 16) and the same teacher did not comment when another student scored $8\frac{1}{2}$ out of 10.

In addition, during the verification of students' exercise books by the researcher, it was realized that some teachers completely discouraged the usage of certain methods with the excuse that they were not clear (Appendix C, exhibit 14) instead of taking time to investigate the methods by either inviting the students for discussions or consulting other colleagues. Nevertheless, some teachers parted with as much as GH₵5 during their teachings as a bait to force the students to think critically on solving some mathematical problems.

Introjected regulation motivation

Extrinsic motivation that is driven by introjected regulation describes taking on regulations to behaviour but not fully accepting said regulations as your own. Deci and Ryan (1995) claim such behaviour normally represents regulation by contingent self-esteem, citing ego involvement as a classic form of introjections. This is the kind of behaviour where people feel motivated to demonstrate ability to maintain self-worth. Hence, Table 28 presents data on the introjections regulation motivation.

Table 28: Distribution of Items regarding Introjected Regulation Motivation

ITEMS	SD	D	N	A	SA	MEAN	STD
I am studying mathematics to show myself that I am an intelligent person.	264 (10.3)	713 (27.7)	208 (8.1)	887 (34.4)	503 (19.5)	3.25	1.32
I am studying mathematics because I want to show myself that I can do well in mathematics.	270 (10.5)	417 (16.2)	129 (5)	1023 (39.7)	736 (28.6)	3.60	1.33
I am studying mathematics because I want to show to others (e.g., teachers, family, and friends) that I can do mathematics.	789 (30.6)	1017 (39.5)	129 (5)	420 (16.3)	220 (8.6)	2.33	1.29
I work very hard in mathematics because I want to be respected as an intelligent student.	219 (8.5)	615 (23.9)	242 (9.4)	954 (37)	545 (21.2)	3.38	1.28
I am studying mathematics because of the fact that when I do well in mathematics, I feel important.	250 (9.7)	714 (27.8)	233 (9)	925 (35.9)	453 (17.6)	3.24	1.29

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

Although Table 28 revealed that only 640 (24.8%) of the respondents claimed they are studying mathematics because they want to show to others such as teachers, family, and friends that they can do mathematics but as many as 1,378 respondents, representing 53.5% revealed that they are studying mathematics because of the fact that, when they do well in mathematics, they feel important. Similarly, as many as 1,399 representing 58.2% respondents agreed that, they work very hard in mathematics because they want to be respected as intelligent students. With means between 3.2 and 3.6 and standard deviation of 1.3, majority of the respondents portrayed great feeling of self-importance and ability as the main reason for studying mathematics. In other words, studying of mathematics is driven by ego, wherein a failure to perform well or to study hard results in a sense of guilt or anxiety. It is meant to maintain self-esteem or pride or to avoid guilt or anxiety. While this is internally driven, Ryan and Deci (2000b) claim introjected behaviour is an externally perceived locus of control because they are not perceived as part of self. Introjected behaviour are not fully accepted as part of oneself, for instance the rules are adopted but not incorporated into the sense of self. This indicates that people go along with a task because they think they should, and feel guilty if they do not or in a worst scenario, feel worthless if they do not.

Extrinsic-identified regulation

Extrinsic motivation driven by identified regulation is strongly associated with the student's personal goals. With identified regulation, action begins to be integrated within the student's sense of self. Table 29 presents data on the extrinsic-identified motivation.

Table 29: Distribution of Items regarding Extrinsic-identified regulation

ITEMS	SD	D	N	A	SA	MEAN	STD
I am studying mathematics because I think that mathematics will help me better prepare for my future career.	50 (1.9)	135 (5.2)	92 (3.6)	1070 (41.6)	1228 (47.7)	4.28	.91
I am studying mathematics because studying mathematics will be useful for me in the future.	54 (2.1)	94 (3.6)	61 (2.4)	938 (36.4)	1428 (55.5)	4.39	.87
I am studying mathematics because what I learn in mathematics now will be useful for the course of my choice in university.	92 (3.60	232 (9)	112 (4.3)	937 (36.4)	1202 (46.7)	4.14	1.08
I am studying mathematics because I want to have "the good life" later on.	58 (2.2)	203 (7.9)	141 (5.5)	1220 (47.4)	953 (37)	4.09	.97
I am studying mathematics in order to have an opportunity to study a programme of my choice later on.	60 (2.3)	212 (8.3)	111 (4.3)	1092 (42.4)	1100 (42.7)	4.15	.99
I am studying mathematics in order to obtain a more prestigious job later on in life.	76 (3)	255 (9.9)	149 (5.8)	1093 (42.4)	1002 (38.9)	4.04	1.05
I am studying mathematics because I believe that mathematics will improve my work competence in future.	47 (1.8)	112 (4.4)	83 (3.2)	858 (33.3)	1475 (57.3)	4.40	.89

Table 29 cont'd

Using mathematics effectively will help me in my future studies.	55 (2.1)	123 (4.8)	102 (4)	1128 (43.8)	1167 (45.3)	4.25	.90
I am studying mathematics because I am sure I can use mathematics in the future.	82 (3.2)	155 (6)	96 (3.7)	1138 (44.2)	1104 (42.9)	4.18	.98
I am studying mathematics so as to broaden my knowledge.	51 (2)	122 (4.8)	78 (3)	1237 (48)	1087 (42.2)	4.24	.87

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

From Table 29, it could be observed that 2,333 respondents representing 90.6% claimed that they are studying mathematics because they believe it will improve their work competence in future. It was also observed that majority of the respondents 2,139 representing 83.1% agreed or strongly agreed to the statement 'I am studying mathematics because what I learn in mathematics now will be useful for the course of my choice in university'. In a nutshell, almost all the respondents in this study are learning mathematics for the sole purpose of its futuristic usefulness. They are studying mathematics because it identified with their personal goals. This discovery is in line with Wang et al. (2009) that individual may want to participate in an activity due to an unrelated consequence.

Although the student may make the benefit of the object his/her own, understands its rationale and experiences a sense of self-determination in acting in line with it, identified regulation differs from intrinsic motivation in that it is instrumental, the behaviours it leads to are not for mere interest in the task.

Intrinsic motivation

This has to do with engaging in activity for the inherent enjoyment or interest in the task. It has to do with the self-selection of activities and the competence that individuals feel while engaging in them. It is the most self-determined motivation (Vallerand et al., 1992). Table 30 presents data on the intrinsic motivation.

Table 30: Distribution of Items regarding Intrinsic Motivation

ITEMS	SD	D	N	A	SA	MEAN	STD
I am studying mathematics for the pleasure that I experience when I learn how things in life work because of mathematics.	147 (5.7)	469 (18.2)	257 (10)	1179 (45.8)	523 (20.3)	3.57	1.17
I am studying mathematics for the pleasure that I experience when I am able to solve questions.	210 (8.1)	685 (26.6)	249 (9.7)	997 (38.7)	434 (16.9)	3.30	1.25
I am studying mathematics because I want to feel the personal satisfaction of understanding mathematics.	126 (4.9)	349 (13.5)	159 (6.2)	1223 (47.5)	718 (27.9)	3.80	1.13

SD: Strongly disagree, D: Disagree, N: Neutral, A: agree, SA: Strongly agree

It is observed from Table 30 that, majority (1,431) of the respondents representing 56% either agreed or strongly agreed that they are studying mathematics for the pleasure that they experience when they are able to solve questions. However, about 895 (35%) hold contrary views.

It was also revealed that, majority (75.4%) of the respondents agreed that they are studying mathematics because they want to feel the personal satisfaction of understanding mathematics. Respondents represented by 1702 (66.1%) also indicated that they are studying mathematics for the pleasure that they experience when they learn how things in life work because of mathematics. This seems to support the earlier claim by some of the respondents where less than 20% claimed amotivated and majority seemed to have zest for mathematics despite the various challenges encountered. In general, between 56 to 75% of the respondents claimed to be acting with a full sense of volition and choice in studying mathematics, that is, they are intrinsically motivated. These groups of students are learning mathematics for the pleasure and satisfaction it brings (Deci & Ryan, 1985; Vallerand et al., 1992) hence perseverance should be expected from them as suggested by Vallerand and Bissonnette (1992).

Intrinsic motivation internally coerces a person to engage in an activity for the sake of satisfaction and its value can last in a person for life. Intrinsically motivated students take on assignments because they find it exciting and pleasurable. They seem to be driven by an increased inquisitiveness, driven by a need to investigate, interact with surroundings and to make sense of it. However, if 56 to 75% of the respondents in this study are intrinsically motivated, why do they still have problems of low achievements in mathematics? The focus group interviews helped to throw light on the issue at hand.

Consequently, the researcher inquired after what could prevent the respondents from studying mathematics despite their high level of intrinsic motivation. Some stated over ambition of their parents, lack of attention or encouragement from mathematics teachers in class, attitude of mathematics teachers to the weak students, teacher rushing through the topics and unfriendly learning environment. These ideas aligned with attachment theory of Ainsworth (1982) and Bowlby (1969) that positive teacher-student relationship enable students to feel safe and secure in their learning environments and provide scaffolding for important social and academic skills (Baker et al., 2008; McCormick et al., 2013; Silver et al., 2005).

Another group of students (SchJ) claimed:

> our math teacher hinders our learning because he often comes into class looking sad and worn out that we fear to ask him questions, he gets angry at the slightest provocation, hence we only sit and wait for math lesson to be over in other to breath fresh air.

This is an indication that teacher-student interaction play significant roles in the teaching and learning of the students, from the students' point of view. The type of relationship teachers develop with students could directly impact positively or negatively on the latter's learning outcomes (Agezo, 2010; Dolton & Marcenaro-Gutierrez, 2011). This is why teachers should become friends with their students. Friends bring a high degree of unconditional positive regard. Critics are, at first sight at least, conditional, negative and intolerant of failure.

On the other hand, some indicated that laziness, procrastination, complacency, not seeking for help from friends when necessary, continuous failure, fear of cane, fear of 'falling behind' or difficulty in solving questions, could hinder their learning of mathematics. Learning like any other achievement in life, is not necessarily an easy or straightforward endeavour and every learner is likely to find difficulties with some aspects, or at some stages of their schooling.

But with motivation in the form of encouragement and counseling, students' academic challenges may be nipped in the bud. For example, fear of 'falling behind', which is a recurrent concern for young learners, sometimes increases a student's motivation to work harder but it may, conversely, lead to a student adopting other, less positive, means of preserving his or her self-esteem– i.e. through behaviours which have a negative effect not only on the student's own learning but on the learning of those around him/her as suggested by Flutter and Rudduck (2004).

From the aforementioned, it could be deduced that in as much as about 56 to 75% students are intrinsically motivated, circumstances are preventing them from reaping the fruits of their motivation. Those circumstances perhaps made the students to exhibit negligence attitude towards the learning of mathematics thereby recording high percentage in 'learned helplessness'.

Effect of motivational factors on the performance of students in mathematics

Regression analysis was carried out on the motivation variable, which is made of five sub constructs: *amotivation*, *identified regulation*, *introjections*, *intrinsic* and *external regulation* with statistically significant correlation coefficients of –.333, .182, – .126, .073 and .138 respectively with (β_1= –.334, β_2 = 016, β_3 = – .190, β_4= .019, β_5 = .014) accordingly. Motivation variable shared a variance of approximately 14.2% with achievement scores (R square = .142 and Adjusted R Square = .140). The model reaches statistical significance (p <.05). Amotivation made the strongest unique contribution of 6.5% to explaining the dependent variable, while introjections made a unique contribution of 2.5%.

Meanwhile, only amotivation and introjections recorded statistically significant contributions ($p < .05$).

Thus, the initial regression model generated between attitude variable and achievement scores with $F(5, 2569) = 84.700$, $p <.05$ is:

Achievement scores = 18.112 – 0.907 (amotivation) + 0.025 (identified regulation) – 0.206 (introjections) + 0.025 (intrinsic) – 0.013 (external regulation).

With the removal of the sub constructs that were not making significant contribution, the model with $F(2, 2572) = 210.645$, $p<.05$ becomes:

Achievement scores = 19.042 – 0.645 (amotivation) – 0.189 (introjections).

The model indicates that *'amotivation'* best predicts performance of students in mathematics. Furthermore, some of the students learn mathematics in order to protect their ego or self-esteem. This is evidence from the submission made by some of the students during the interviews. For example, StuH6 declared: Learning math bring joy if you succeed but pains if you don't…great joy within me whenever I succeeded in math… unfortunately my teacher wouldn't acknowledge me because I always score less than half of the total marks" and StuI1 stated "I just must do well in mathematics to make my parents proud…"

Furthermore, some of the students learn mathematics without passion, or have no intent of learning mathematics. Thus, *amotivation* and *introjection* have negative coefficients that bring down achievement scores but their absence produce 19% of achievement score. This means that if educators want to improve performance through motivation, they should help students to believe in themselves and learn mathematics as an end in itself but not for some separable consequences.

Research Question Four: Which of the sub-constructs of affective variables and teacher-student relationship predicts student performance in mathematics?

The relationship between sub-constructs of the independent variables and the performance of students in mathematics was determined by calculating the Pearson Correlation coefficient using the scores from the responses to the sub constructs of the four variables and the achievement test. Table 31 presents the correlation coefficients of the various relationships.

Table 31: Correlation Coefficients (r), Beta values (β) and Parameter estimates (B) of all the Sub constructs and the Achievement scores

Subscales	Achievement test			
	B	B	Part	Pearson (*r*)
(Constant)	5.412			
Discomfort with Maths	.107	.106	.061	.402**
Ease with Mathematics	–.067	–.061	–.036	.309**
Learned helplessness	–.251	–.234	–.121	–.516**
Perseverance	.009	.010	.008	–.310**
Confidence	.414	.491	.321	.607**
Enjoyment	.191	.177	.092	–.383**
Support	.273	.200	.120	.000
Unhealthy Context	–.087	–.065	–.046	–.030

Table 31 cont'd

Dialogue	.169	.122	.084	.088
Challenge	–.016	–.012	–.010	.013**
Fear	.106	.089	.070	.207**
Disrespect for students' learning	.049	.038	.031	.043*
Amotivation	–.196	–.067	–.043	–.333**
Identified regulation	.051	.033	.022	.182**
Introjections	–.097	–.090	–.073	–.126**
Intrinsic	.006	.004	.003	.073**
External regulation	–.011	–.012	–.009	.138**

**. Correlation is significant at the 0.05 level (2-tailed).

Table 31 shows that the best six correlates of achievement scores in descending order are: confidence (.607), learned helplessness (–.516), discomfort with mathematics (.402), enjoyment (–.383) amotivation (–.333) and perseverance (–.310). Confidence, a sub-construct of attitude better predicts performance in mathematics. This strong correlation between confidence and achievement concurred with past findings of Lim and Chapman (2015) and suggested the importance of confidence to obtain better mathematics results. It suggests that if student's attitude towards mathematics is enhanced, the performance of the student is likely to improve.

Regression analysis was conducted on all the 17 sub constructs and the achievement scores. The sub constructs are discomfort with mathematics, ease with mathematics, learned helplessness, perseverance, confidence, enjoyment, support, unhealthy context, dialogue, challenge, fear, disrespect for students' learning, amotivation, identified regulation, introjections, intrinsic and external regulation.

The various beta values are shown on Table 31. The five largest statistically significant beta values are 0.491, –.234, .200, 0.177, 0.122, and 0.106, 0.150 for confidence, learned helplessness, support, enjoyment, dialogue and discomfort with mathematics accordingly. The subscales altogether shared a variance of 44% with achievement scores (R square = .443 and Adjusted R Square = .440). The model reaches statistical significance ($p < .05$). Confidence made the strongest unique contribution of 10.3% to explaining the dependent variable, support 4.0%, learned helplessness made a unique contribution of 1.5%, dialogue 0.71% and enjoyment 0.85%.

Thus, the regression model generated between all the sub constructs together and achievement scores with $F(17, 2557) = 119.761$, $p < .05$ is:

Achievement scores = 7.765+ 0.107 (discomfort) – 0.067 (ease) –0.251 (learned helplessness) + 0.009(perseverance) + 0.191(enjoyment) + 0.414 (confidence) + 0.273 (support) – 0.087 (unhealthy context) + 0.169 (dialogue) – 0.016 (challenge) + 0.106(fear) + 0.049(disrespect for students' learning) – 0.196(amotivation) + 0.051(identified regulations) – 0.097(introjections) + 0.006 (intrinsic) – 0.011 (external regulation)

However, with the removal of constructs that were not making significant contributions, the model with $F(12, 2562) = 169.525$, $p < .05$ becomes:

Achievement scores = 9.057 + 0.106 (discomfort) + 0.414 (confidence) + 0.193 (enjoyment) – 0.246(learned helplessness) + 0.279 (support) – 0.090 (unhealthy context) + 0.169 (dialogue) + 0.106(fear) + 0.05(disrespect for students' learning) – 0.190(amotivation) – 0.090(introjections) – 0.70(ease).

Research Hypothesis

H_0: There is no significant influence of anxiety, attitude, motivation and teacher-student relationship individually or collectively on performance of students in mathematics.

In order to find out if there is a significant influence in the factor(s) that influence (s) the performance of students in mathematics, the reactions of students to each of the questionnaires A1 to A4 were aggregated. The responses were subjected to various diagnostic tests and analysed quantitatively using multiple regression analysis.

Although the data passed all the parametric tests necessary for multiple regression analysis to be carried out, given the size of the data file, it is not unusual for a few outliers to appear, the unusual cases is in the Table titled Casewise Diagnostics (Appendix A, Table 20). This presents information about cases that have standardized residual values above 3.0 or below –3.0. In a normally distributed sample, only 1 per cent of cases is expected to fall outside this range. In this sample, 0.27% cases (cases number 53, 197, 1299, 1497, 2034, 2243 and 2266) were found with residual values of –3.354 to 3.336. To determine whether these strange cases are having any undue influence on the results for the model as a whole, the value for Cook's Distance were checked (given towards the bottom of the Residuals Statistics Table, Appendix A, Table 21). According to Tabachnick and Fidell (2007, p. 75), cases with values larger than 1 are a potential problem. In this study, the Maximum value for Cook's Distance is .022, suggesting no problems.

Evaluating the model

By inspection of the Model Summary box, R Square tells how much of the variance in the dependent variable (achievement test) is explained by the model (which includes the variables of student factors & teacher-student relationship). In this case, the value is .188 and that of the adjusted R Square is .187, which is very close. In fact, the difference for the final model is small (the difference between the values is .179 – .177 = .002 or 0.2%). This shrinkage means that if the model were derived from the population rather than a sample it would account for approximately 0.2% less variance in the outcome.

Expressed as a percentage, the model explains 17.9 per cent of the variance in achievement test. The statistical significance of the result was assessed using ANOVA Table (Appendix A, Table 22). The model reaches statistical significance (p<.05).

Evaluating each of the independent variables

To know which of the variables included in the model contributed to the prediction of the dependent variable, Coefficients Table was inspected (Appendix A, Table 23) and comparison of Beta values revealed that the largest beta coefficient is –.225, which is for Attitude (A2). This means that this variable makes the strongest unique contribution to explaining the dependent variable, when the variance explained by all other variables in the model is controlled for. The Beta values for other variables are far lower (.207, .062, –.026), indicating that they each made less of unique contributions. Each of these variables made a statistically significant *unique* contribution to the equation. In order to get an indication of the contribution of each of the variables to the total R square or to establish how much R square would drop if each of the variables was not included in the model, the part correlation coefficients were squared. The Attitude Scale has a part correlation co-efficient of –.153 indicating that Attitude uniquely explains 2.3 per cent of the variance in Achievement scores. For each of the other variables A1, A3 and A4, unique contributions were 2 per cent, .4 per cent and .1 per cent respectively.

The total R square value for the model (.179, or 17.9 percent explained variance) does not equal all the squared part correlation values added up because the part correlation values represent only the unique contribution of each variable, with any overlap or shared variance removed. This is an indication that some of the independent variables are reasonably strongly correlated therefore there is a lot of shared variance that is statistically removed when they are both included in the model.

The model, which includes Anxiety (A1), Attitude (A2), Teacher-Student relationship (A3) and Motivation (A4), explains 17.9 per cent of the variance in performance in mathematics. Of these variables, Attitude makes the largest and statistically unique contribution (β = –.225), anxiety (A1), teacher-student relationship (A3) and motivation (A4), make statistically significant contributions of .207, .062 and –.026 respectively.

The regression model generated with $F(4, 2570) = 139.735, p<.05$:

Achievement score = 41.164 + 0.231Anxiety – 0.402 Attitude

+ 0.225 Relationship – 0.962 Motivation

The intercept (b = 41.164) is the estimated mean of performance in mathematics when the values of all independent variables are zero. As in many applications, this coefficient has no practical use but it is necessary in order to specify the equation.

The coefficient for Anxiety, Attitude and motivation appear to contradict expectation, as one would expect anxiety to decrease the performance while attitude and motivation should increase the performance in mathematics. Nevertheless, Anxiety (b = 0.231): indicates that if there is a unit increase in anxiety scale, we can expect an increase of .207 in achievement score. As mentioned earlier, the anxiety level in this study is optimal because most students seem to perform better at the current level because of the compulsion to pass mathematics at WASSCE and failure of which would spelt doom for their future career, since mathematics had become a barrier which filters out quite a number of students from careers that require a good grasp of mathematics (Russell, 1996). However, beyond this level the students' performance in mathematics is likely to drop.

Attitude (b = – 0.402): indicates that if there is a unit higher in attitude scale, we can expect a reduction of – 0.225 units in achievement test scores in mathematics. Therefore, every unit increase in the attitude of the students is associated with a decrease in performance in mathematics.

This interpretation would be true if the effects of anxiety, teacher-student relationship and motivation are held constant. This is an irony, even though confidence made the largest unique contribution to the variable (Attitude), other sub constructs such as 'enjoyment' and 'perseverance' do not translate into good grades in achievement, hence 'learned helplessness' wield all the influence, thereby resulting in a negative coefficient for the Attitude variable.

Teacher-student relationship (b = 0.225): indicates that if there is a unit increase in the relationship between teacher and students, the respondents performance in mathematics is expected to increase by 0.062 units, all things being equal.

Motivation (b = – 0.962): indicates that if there is a unit increase in motivation scale, we can expect a drop of 0.026 units in achievement scores in mathematics. This should be expected because among the sub constructs of motivation, '*amotivation*', with a negative coefficient, made the strongest unique contribution to explaining the dependent variable. Thus, the effect of '*amotivation*' could be neutralized if there is an increase in intrinsic and extrinsic motivation in students in order to improve achievement scores.

Conclusion

In conclusion, with a sample size of 2, 575 Form Two students (grade eleven) of the ten senior high schools in the Cape Coast Metropolis, Attitude, Anxiety, Relationship and Motivation explained 18% of the variance in achievement scores and Attitude is the highest predictor of performance in mathematics.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to investigate the influence of teacher-student relationship and student factors on student performance in mathematics in the ten public senior high schools in the Cape Coast Metropolis in order to ascertain which of the factors (if any) could be concentrated upon with the view to improving student performance in mathematics.

Using a sample of 3,342 randomly chosen students and their 57 teachers that were responsible for the 69 classes of the Form Two students (grade eleven) of the ten Senior High Schools in the Cape Coast Metropolis, the influence of student anxiety, student attitude, student motivation and teacher-student relationship were investigated jointly and individually. The response rates for students and teachers were 77% and 86% respectively, indicating that 2,575 students and 49 teachers participated in the study.

This research followed a mixed methods design where quantitative and qualitative approaches, including surveys, focus group interviews with students, students' test scores, lesson observations, and interviews with teachers were used. The diagnostic analysis conducted included parametric tests and factor analysis, while other analysis includes frequencies, percentages, mean, standard deviation, correlation, and multiple regression. Findings revealed that the variables: student anxiety, student attitude, student motivation and teacher-student relationship jointly explained 18% of the variance in achievement scores and attitude emerged as salient predictor of student achievement in mathematics.

All the variables made statistically significant contributions to predicting achievement scores. In addition, the sub constructs of the four variables collectively explained 44% of the variance in achievement scores. The following is the summary of the key findings, conclusions and recommendations of the study.

Summary of the Key Findings

The two sub constructs of anxiety: *discomfort with mathematics* and *ease with mathematics* significantly correlated with achievement scores by .402 and .309 respectively and jointly shared a variance of approximately 16% with achievement scores. Although, this is a deviation from Karimi and Venkatesan (2009) and Lim and Chapman (2015) both groups found a negatively significant correlation between mathematics anxiety and academic performance, nevertheless, this study corroborates some literatures that suggest that there is a positive correlation between anxiety and academic achievement (e.g. Ho et al., 2000; Lee, 2009; Wigfield & Meece, 1988).

The four sub constructs of attitude significantly correlated with achievement scores, and collectively shared a variance of approximately 40% with achievement scores. However, confidence correlated more robustly (.607) with achievement scores and recorded the largest beta value of .541, this was followed by learned helplessness with beta value of – .305. This strong correlation between self-confidence and achievement concurred with past findings (Lim & Chapman, 2015).

There seems to be a gap in the understanding of the teachers and students about learning. For the students, learning includes exchange of ideas during lessons and that helps them to remember knowledge gained in examinations, whereas for the teachers despite the fact that social interaction was mentioned while explaining their understanding of learning, the 'social interaction' in the teachers' understanding of learning seem not to include exchange of ideas in the classroom as they often prevent students from making contributions during lessons. The emphasis seems to be on transmissions of knowledge from the teachers to the students. In addition, *dialogue*, *fear* and dis*respect for students' learning* negligibly and statistically correlated with achievement scores, *unhealthy context* and *challenge* negligibly but not statistically correlated, while *support* did not correlate with achievement scores and the sub-constructs jointly shared a variance of approximately 8% with achievement scores.

Furthermore, this study revealed that of the five sub constructs of motivation that significantly correlated with achievement scores, amotivation and introjections made the largest unique contributions to the achievement scores and the sub constructs of motivation variable collectively shared a variance of approximately 14.1% with achievement scores, although Lim and Chapman (2015a) reported that amotivation and intrinsic motivation were the strongest correlates of mathematics performance.

Conclusions

In conclusion, even though anxiety explained 16% of the variance in achievement scores, the anxieties in this study were not the destructive type but an optimal level of anxiety that were propelled by expectation, eagerness or desire to do well in mathematics. Some of the students in this study hid their weaknesses and exaggerated their strength. They learned to tolerate the learning of mathematics while the uncomfortable feelings and fear persisted.

Eventually, this might lead to loss of interest and drives in doing mathematics, which might result in poor performance. It might also influence their decisions about what classes or programmes to take, which might lead to avoidance of mathematics or its related discipline in future.

Over 50% of students in the senior high schools in the Cape Coast Metropolis are intrinsically motivated but circumstances such as the over loaded syllabus leading to high speed by the teacher while teaching, unfriendly comments orally or written by the teacher on the weak students, use of cane by the teacher, procrastination, laziness, complacency, fear of cane, etcetera by the students hinder the manifestation of intrinsic motivation, giving way to amotivation. Furthermore, the desire to maintain self-worth by the students propelled them to learn mathematics. Hence, amotivation and introjections significantly predict performance in mathematics in the metropolis.

In addition, confidence had emerged as salient predictors of achievement in mathematics. Unfortunately, about 40% and 30% claimed they enjoyed and persevered in mathematics respectively, while less than 50% have confidence to succeed in mathematics and between 14% to 54% do not trust their personal ability to do well in mathematics, hence some of them resort to rote learning and cheating in order to hide their weaknesses. Therefore, there is a need to help students to cultivate the right attitude to mathematics in order to increase performance in the subject.

The expectations of the students in this study regarding teacher-student relationship were that mathematics teacher should be friendly, supportive, respectful, trust and challenged them. Unfortunately, their relationship with their mathematics teachers was characterized mostly by fear, which also is the best predictor of performance in mathematics.

Implications for practice and Policy

The study found out that there is high level of anxiety in the students. Although this is productive as reflected by the anxiety model, it may have a dire consequence such as the avoidance of mathematics or its related programmes in the future. Hence teachers could seek for ways of making the teaching and learning of mathematics more interesting to capture students' attention and reduce or eliminate anxiety or fear. For example, by helping students to appreciate the present and future usefulness of each of the topics in the mathematics syllabus to inspire them to learn better.

Furthermore, the negative attitude of students towards the learning of mathematics is detrimental to the individual and national development hence the Guidance and Counselling units of schools could assist the students through academic counseling to appreciate developing intrinsic motivation that comes with liking what they do including the learning of mathematics.

Teachers, parents and counselors could explore and employ all strategies including persuasion to get students to develop positive attitude towards the subject. For example, students could be helped through debates and occasional talks on how to cultivate the right attitude towards the learning of mathematics. Getting students not to allow past failure to hinder the present or future successes is essential to building their confidence in the subject. Thus, they should be encouraged to practice mathematics daily especially by going through what is learnt during lessons daily. This will help to retain what is learnt as well as boost their confidence.

Teachers could also create opportunity for students to work in mixed ability group to create room for smart students to help the poor students. It may be helpful if teachers could avoid forcing timid and academically weak students in mathematics to work on the board until the students have been counseled and assisted to accept that everyone including the teacher makes mistakes. Furthermore, teachers should mark assigned exercises and be circumspect in the use of words while providing feedback. In addition, the study suggests that the students attached great importance to how their teachers relate to them. Such relationship could be improved by teachers becoming more patience and accommodating of their students. Lastly, Heads of senior high schools should enforce the guidelines approved by Ghana Educational service regarding the use of cane in schools.

Recommendations for Policy and Practice

1. Teachers need to know students' expectations and also make their own expectations known to their students at the beginning of every term to help promote good relationships between them.

2. To make the teaching and learning of mathematics fun, meaningful and inspiring, teachers should avoid those practices that promote fear in students and make mathematics more applicable to students' lives.
3. There could be seminars and workshops for teachers by the schools, on mathematics related affects (anxiety, attitude and motivation) to equip them on handling affect related issues.
4. Students could be enlightened and counselled on the benefits of self confidence in their learning of mathematics.
5. Students could be helped through debates and occasional talks on how to cultivate the right attitude towards the learning of mathematics.

Contribution to Knowledge

This study provides ecological and empirical data into the discourse about the teaching and learning of mathematics at the senior high school level. Of the 4 variables; student anxiety, student attitude, student motivation and teacher-student relationship, student attitude best predicts performance in mathematics. The contextual data suggests that teacher-student relationship counts in the teaching and learning of mathematics even at the senior high level. Furthermore, of all the sub-constructs of affective variables, confidence best predicts performance in mathematics. Finally, it was discovered that amotivation is not just a construct, it is made up of other sub-constructs that are yet to be named by researchers because students' narratives suggested that some students lack the intent to learn, some learn without passion, while others act with feelings of incompetence or fail to see value in the activity.

Suggestion for Future Research

The focus of this research was not on establishing relationships between attitude, anxiety, motivation and teacher-student relationship, rather it was on how these variables relate individually or collectively to performance in mathematics hence these could be researched into in future.

If this or any other study that involves the filling of more than one questionnaires is to be replicated in future, it could be done in the context of a workshop whereby the filling of all the separate questionnaires (four) by the students are done on the same day but with break in-between and refreshment for all the participating students and teachers, together with some souvenirs. This might reduce wastage in terms of money, time and other resources, and increase the quality of the data and commitment from the participants. Observation of the lessons could also be scheduled for second term (in Ghana) when there would be no sandwich programme for teachers to attend.

There is a need for more studies to be conducted in basic schools in order to better understand how anxiety started and develop, prior to its manifestation at the senior high schools to broaden the understanding of educators on how mathematics anxiety came into the students who were yet to enter senior high. Subject specialist's teachers in basic schools might also help to lay a sound foundation for mathematics as early as possible.

The study could be replicated in other metropolis and districts across the country and where similar results abound, if possible, the Ghana Education Service could consider going back to the 4-year syllabus for second cycle institution or cut down on the number of topics in the current syllabus.

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APPENDICES

APPENDIX A TABLES RELATED TO FACTOR AND DESCRIPTIVE ANALYSIS OF DATA

Table 1: Descriptive Statistics for Achievement scores

		Statistic	Std. Error
Mean		53.72	.400
95% Confidence Interval for Mean	Lower Bound	52.94	
	Upper Bound	54.51	
5% Trimmed Mean		53.90	
Median		55.00	
Variance		411.149	
Std. Deviation		20.277	
Minimum		0	
Maximum		100	
Range		100	
Interquartile Range		32	
Skewness		-.092	.048
Kurtosis		-.708	.096

Table 2: KMO and Bartlett's Test for Anxiety variable

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.957
Bartlett's Test of Sphericity	Approx. Chi-Square	22227.959
	Df	120
	Sig.	.000

Table 3: Total variance explained for Anxiety Variable (3 Factors)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	8.218	45.658	45.658	8.218	45.658	45.658	6.912
2	1.165	6.473	52.131	1.165	6.473	52.131	6.584
3	1.073	5.962	58.093	1.073	5.962	58.093	1.109
4	.941	5.226	63.319				
5	.858	4.765	68.084				
6	.613	3.403	71.488				
7	.586	3.255	74.743				
8	.582	3.235	77.977				
9	.548	3.047	81.024				
10	.482	2.678	83.703				
11	.439	2.438	86.140				
12	.428	2.376	88.516				

13	.410	2.280	90.796
14	.398	2.213	93.008
15	.371	2.061	95.069
16	.325	1.806	96.876
17	.287	1.593	98.468
18	.276	1.532	100.000

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 4: Total variance explained for Anxiety Variable (2 Factors)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	8.042	50.264	50.264	8.042	50.264	50.264	7.252
2	1.139	7.116	57.380	1.139	7.116	57.380	6.774
3	.933	5.830	63.210				
4	.698	4.362	67.572				
5	.624	3.902	71.474				
6	.584	3.652	75.126				
7	.551	3.444	78.570				
8	.489	3.059	81.628				
9	.441	2.754	84.382				
10	.428	2.677	87.059				

11	.412	2.574	89.633
12	.399	2.493	92.126
13	.371	2.321	94.447
14	.326	2.035	96.482
15	.287	1.794	98.276
16	.276	1.724	100.000

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 5: Mean and Standard deviation for all the sub constructs of the Independent Variables

Variables	Mean	Std. Deviation	Cronbach Alpha
a1 discomfort mean	3.5002	1.01141	.908
a2 ease mean	3.1698	.92064	.870
Anxiety mean	**3.3350**	**.90643**	**.933**
b1 perceived personal ability mean	2.5746	.94830	.926
b2 perseverance mean	2.4885	1.17675	.954
b3 confidence mean	3.0072	1.20235	.962
b4 enjoyment mean	2.7158	.94138	.863
Attitude mean	**2.6965**	**.56927**	**.845**
c1 support mean	2.1441	.73959	.860
c2 unhealthy context mean	3.8136	.76646	.755
c3 dialogue mean	4.0377	.72761	.751

c4 challenge mean	3.7919	.78866	.642
c5 fear mean	3.4037	.85323	.564
c6 disrespect mean	4.0995	.78851	.547
Teacher-Student Relationship mean	**3.3153**	**.27925**	
d1 amotivation mean	4.0035	.62121	.841
d2 identified mean	4.2159	.66889	.885
d3 introjection mean	3.1602	.93462	.763
d4 intrinsic mean	3.8101	.76770	.661
d5 external regulated mean	3.5588	1.11774	.666
Motivation mean	**3.0934**	**.30830**	**.655**
Overall mean	**3.0928**	**.15750**	

Table 6: KMO and Bartlett's Test of attitude variable

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.969
Bartlett's Test of Sphericity	Approx. Chi-Square	55101.490
	Df	351
	Sig.	.000

Table 7: Total Variance Explained of Attitude Variable

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	13.413	49.677	49.677	13.413	49.677	49.677	10.825
2	1.797	6.657	56.333	1.797	6.657	56.333	7.077
3	1.549	5.737	62.070	1.549	5.737	62.070	10.289
4	1.142	4.230	66.301	1.142	4.230	66.301	6.341
5	1.013	3.753	70.054				
6	.740	2.740	72.794				
7	.723	2.679	75.473				
8	.600	2.224	77.696				
9	.523	1.938	79.634				
10	.503	1.862	81.497				
11	.471	1.746	83.243				
12	.456	1.688	84.931				
13	.434	1.606	86.537				
14	.398	1.475	88.013				
15	.391	1.446	89.459				
16	.382	1.416	90.875				
17	.377	1.396	92.272				
18	.336	1.244	93.516				
19	.309	1.146	94.662				

20	.288	1.065	95.727
21	.268	.993	96.720
22	.227	.839	97.558
23	.171	.635	98.193
24	.155	.575	98.768
25	.141	.524	99.292
26	.110	.408	99.701
27	.081	.299	100.000

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 8: KMO and Bartlett's Test for Teacher-student relationship

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.953
Bartlett's Test of Sphericity	Approx. Chi-Square	26966.978
	Df	528
	Sig.	.000

Table 9: Total Variance Explained of Teacher-student relationship Variable

Component	Initial Eigenvalues			traction Sums of Squared Loadings			tation Sums of Squared Loadings		
	Total	% of Variance	umulative %	Total	of Variance	umulative %	Total	of Variance	mulative %
1	9.778	29.630	29.630	9.778	29.630	29.630	4.297	13.022	13.022
2	1.726	5.229	34.859	1.726	5.229	34.859	2.914	8.831	21.853
3	1.301	3.943	38.802	1.301	3.943	38.802	2.607	7.901	29.755
4	1.282	3.885	42.687	1.282	3.885	42.687	2.298	6.964	36.719
5	1.157	3.506	46.193	1.157	3.506	46.193	2.276	6.898	43.616
6	1.092	3.310	49.503	1.092	3.310	49.503	1.943	5.887	49.503
7	.989	2.998	52.501						
8	.929	2.815	55.316						
9	.843	2.553	57.869						
10	.818	2.479	60.348						
11	.787	2.386	62.734						
12	.776	2.353	65.086						
13	.763	2.312	67.398						
14	.729	2.210	69.608						
15	.717	2.171	71.779						
16	.686	2.077	73.857						
17	.672	2.037	75.894						
18	.632	1.915	77.809						
19	.619	1.876	79.686						

20	.614	1.862	81.548
21	.597	1.810	83.358
22	.563	1.707	85.065
23	.547	1.657	86.722
24	.522	1.582	88.304
25	.509	1.542	89.847
26	.492	1.491	91.337
27	.462	1.399	92.737
28	.447	1.356	94.092
29	.415	1.258	95.351
30	.409	1.240	96.591
31	.401	1.214	97.805
32	.390	1.181	98.986
33	.335	1.014	100.000

Extraction Method: Principal Component Analysis.

Table 10: KMO and Bartlett's Test for Motivation variable

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.953
Bartlett's Test of Sphericity	Approx. Chi-Square	35549.013
	Df	595
	Sig.	.000

Table 11: Total Variance Explained of Motivation Variable

›mponent	Initial Eigenvalues			traction Sums of Squared Loadings			›tation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	of Variance	'umulative %	Total	of Variance	Cumulative %
1	10.382	29.662	29.662	10.382	29.662	29.662	5.856	16.732	16.732
2	3.412	9.749	39.412	3.412	9.749	39.412	5.412	15.464	32.196
3	1.979	5.654	45.066	1.979	5.654	45.066	2.761	7.888	40.084
4	1.186	3.388	48.453	1.186	3.388	48.453	2.526	7.216	47.301
5	1.076	3.076	51.529	1.076	3.076	51.529	1.480	4.228	51.529
6	.973	2.780	54.309						
7	.867	2.477	56.786						
8	.850	2.428	59.214						
9	.834	2.383	61.598						
10	.779	2.227	63.825						
11	.715	2.042	65.867						
12	.708	2.022	67.889						
13	.666	1.903	69.791						
14	.641	1.831	71.623						
15	.619	1.767	73.390						
16	.590	1.687	75.077						
17	.571	1.630	76.707						
18	.565	1.615	78.322						
19	.552	1.576	79.898						
20	.538	1.538	81.436						

21	.523	1.494	82.930
22	.510	1.458	84.388
23	.496	1.417	85.805
24	.482	1.377	87.182
25	.480	1.373	88.555
26	.474	1.353	89.908
27	.469	1.339	91.247
28	.445	1.272	92.519
29	.436	1.247	93.766
30	.412	1.176	94.942
31	.394	1.127	96.069
32	.376	1.074	97.143
33	.342	.978	98.121
34	.339	.970	99.090
35	.318	.910	100.000

Extraction Method: Principal Component Analysis.

Table 12: Distribution of items regarding friendship

ITEMS	SD	D	N	A	SA	MEAN	STD
Friendship with the students when teaching mathematics helps them to learn.	0	2	8	26	13	4.02	0.78
	0	(4.1)	(16.3)	(53.1)	(26.5)		
Friendship and learning go hand in hand in mathematics class.	0	3	6	30	10	3.96	0.76
	0	(6.1)	(12.2)	(61.2)	(20.4)		
Friendship makes the class room atmosphere cordial and everyone feels at home in	0	1	5	24	19	4.24	0.72
	0	(2.0)	(10.2)	(49.0)	(38.8)		

mathematics class.							
Building relationship in mathematics class will prevent teachers from finishing their syllabus.	1 (2.0)	3 (6.1)	12 (24.5)	21 (42.9)	12 (24.5)	3.82	0.95
Friendship and learning are linked because when the students consider you as a friend, they learn better, especially in mathematics class.	1 (2.0)	4 (8.2)	1 (2.0)	26 (53.1)	17 (34.7)	4.08	0.94
I see the students as my friends in mathematics class.	1 (2.0)	5 (10.2)	1 (2.0)	25 (51.0)	17 (34.7)	4.06	0.99

Table 13: Distribution of items on observation

S/N	ITEM	1	2	3	4	5	MEAN	STD.
1	Conducive environment	0	3 (5.8)	6 (11.5)	33 (63.5)	10 (19.2)	3.96	0.74
2	Friendliness	0 0	3 (5.8)	16 (30.8)	18 (34.6)	15 (28.8)	3.87	0.91
3	Interactiveness	2 (3.8)	7 (13.5)	8 (15.4)	28 (53.8)	7 (13.5)	3.60	1.02
4	Response to teacher's presence	0 0	0 0	10 (19.2)	21 (40.4)	21 (40.4)	4.21	0.75
5	Class control	0 0	1 (1.9)	10 (19.2)	17 (32.7)	24 (46.2)	4.23	0.83
6	Teacher's behaviour	0 0	2 (3.8)	17 (32.7)	20 (38.5)	13 (25.0)	3.85	0.85
7	Presentation-teaching and learning activities	1 (1.9)	0 0	3 (5.8)	14 (26.9)	34 (65.4)	4.54	0.78
8	Challenge	1 (1.9)	4 (7.7)	11 (21.2)	11 (21.2)	25 (48.1)	4.06	1.09
9	Support	0 0	3 (5.8)	7 (13.5)	31 (59.6)	11 (21.2)	3.96	0.77
10	Interest in students' performance	1 (1.9)	0 0	9 (17.3)	22 (42.3)	20 (38.5)	4.25	0.85
11	Promoting students' enquiry	3 (5.8)	1 (1.9)	19 (36.5)	18 (34.6)	11 (21.2)	3.63	1.03
12	Teacher's disposition towards students	1 (1.9)	0 0	1 (1.9)	27 (51.9)	23 (44.2)	4.37	0.72
13	Teacher's confidence in	1 (1.9)	0 0	5 (9.6)	37 (71.2)	9 (17.3)	4.02	0.67

	students							
14	Dialogue	0	1	2	32	17	4.25	0.62
		0	(1.9)	(3.8)	(61.5)	(32.7)		
15	Teacher's professionalism	1	0	1	21	29	4.48	0.73
		(1.9)	0	(1.9)	(40.4)	(55.8)		
16	Student's participation	3	4	12	29	4	3.52	0.96
		(5.8)	(7.7)	(23.1)	(55.8)	(7.7)		
17	Mastery of subject matter	0	7	20	17	8	3.50	0.92
		0	(13.5)	(38.50	(32.7)	(15.4)		
18	Time management	4	1	0	45	2	3.77	0.88
		(7.7)	(1.9)	0	(86.5)	(3.8)		
19	Teacher's tolerance of students	0	1	3	10	38	4.63	0.69
		0	(1.9)	(5.8)	(19.2)	(73.1)		
20	Respect	1	0	9	17	25	4.25	0.88
		(1.9)	0	(17.3)	(32.7)	(48.1)		

1= Poor, 2 = Satisfactory, 3= Good, 4 = Very good, 5 = Outstanding

Table 14: Distribution of items regarding support

ITEMS	SD	D	N	A	SA	MEAN	STD
I pay attention to every question student poses in my mathematics class	2	0	0	25	22	4.33	0.85
	(4.1)	0	0	(51.0)	(44.9)		
Students do not have to understand everything about mathematics during my teaching.	1	12	8	19	9	3.47	1.19
	(2.0)	(24.5)	(16.3)	(38.8)	(18.4)		
It is sometimes difficult to treat all students fairly in my mathematics class.	2	16	6	20	5	3.20	1.14
	(4.1)	(32.7)	(12.2)	(40.8)	(10.2)		
It is not helpful to waste time on a recalcitrant student when teaching mathematics.	2	14	2	21	10	3.47	1.23
	(4.1)	(28.6)	(4.1)	(42.9)	(20.4)		
Students are too afraid to learn mathematics because they are lazy.	4	8	11	24	2	3.24	1.05
	(8.2)	(16.3)	(22.4)	(49.00	(4.1)		
Every student should be able to learn mathematics.	22	24	1	2	0	1.65	0.72
	(44.9)	(49.0)	(2.0)	(4.1)	0		
Students' dislike of mathematics is the cause of mathematics	11	24	7	7	0	2.20	0.96

anxiety.	(22.4)	(49.0)	(14.3)	(14.3)	0		
The understanding of mathematics may come later after the classroom encounter.	1 (2.00	19 (38.8)	7 (14.3)	20 (40.8)	2 (4.1)	3.06	1.03
If a student is appreciated for his/her contributions, he/she will be encouraged to do more.	0 0	0 0	1 (2.0)	18 (36.7)	30 (61.2)	4.59	0.54
Mathematics should not be compulsory for every student.	5 (10.2)	4 (8.2)	2 (4.1)	16 (32.7)	22 (44.9)	3.94	1.33
Some students see me after the class for clarification of some points in mathematics.	1 (2.0)	2 (4.1)	3 (6.1)	29 (59.2)	14 (28.6)	4.08	0.84
Students do not see the usefulness of mathematics to them.	8 (16.3)	19 (38.8)	8 (16.3)	14 (28.6)	0 0	2.57	1.08
Students are too anxious when solving mathematics problems because they lack the ability to be successful in the subject.	0 0	15 (30.6)	8 (16.3)	26 (53.1)	0 0	3.22	0.90
Students who are too often confused in mathematics class are not intelligent enough to study the subject.	9 (18.4)	31 (63.3)	2 (4.1)	5 (10.2)	2 (4.1)	2.18	0.99
Students make too many mistakes when solving mathematics problems due to lack of practice	1 (2.0)	6 (12.2)	0 0	27 (55.1)	15 (30.6)	4.00	1.00
Some students are too boring to be taught mathematics.	0 0	14 (28.6)	9 (18.4)	20 (40.8)	6 (12.2)	3.37	1.04
Mathematics would be useful for only a few of the students.	14 (28.6)	30 (61.2)	0 0	1 (2.0)	4 (8.2)	2.00	1.06
Students who do not ask questions in	3	24	8	12	2	2.71	1.04

mathematics class have low self esteem.	(6.1)	(49.0)	(16.3)	(24.5)	(4.1)		
Allowing students to be free enhances the class room atmosphere for learning mathematics.	0	0	2	38	9	4.14	0.46
	0	0	(4.1)	(77.6)	(18.4)		
Mathematics is not useful for every student.	1	1	0	23	24	4.39	0.79
	(2.0)	(2.0)	0	(46.9)	(49.0)		
Some students do not want to learn mathematics.	6	35	4	2	2	2.16	0.85
	(12.2)	(71.4)	(8.2)	(4.1)	(4.1)		
Not every student can learn mathematics because it is a difficult subject	1	5	5	22	16	3.96	1.02
	(2.0)	(10.2)	(10.2)	(44.9)	(32.7)		
Mathematics is too difficult to be understood by all the students.	14	25	5	5	0	2.02	0.90
	(28.6)	(51.0)	(10.2)	(10.2)	0		

Table 15: Distribution of items regarding obedience

ITEMS	SD	D	N	A	SA	MEAN	STD
Students should obey their teachers no matter the situation in order to understand mathematics.	8 (16.3)	19 (38.8)	8 (16.3)	13 (26.5)	1 (2.0)	2.59	1.12
Students must abide by rules and regulations.	18 (36.7)	25 (51.0)	4 (8.2)	0 0	1 (2.0)	1.77	0.78
My students are doing well in mathematics because they just follow my instructions.	3 (6.1)	22 (44.9)	18 (36.7)	5 (10.2)	1 (2.00	2.59	0.84
My students have so much confidence and trust in me that many of them simply take what I give them in mathematics class.	0 0	8 (16.3)	10 (20.4)	25 (51.0)	6 (12.2)	3.59	0.91

Table 16: Distribution of items regarding unhealthy context

ITEMS	SD	D	N	A	SA	MEAN	STD
Some students are too shy to answer questions in my mathematics class.	3 (6.1)	15 (30.6)	7 (14.3)	16 (32.7)	8 (16.3)	3.22	1.23
Some students are too afraid to make contribution in my mathematics class.	7 (14.3)	28 (57.1)	1 (2.0)	9 (18.4)	4 (8.2)	2.49	1.19
My students do not ask enough questions in mathematics class.	1 (2.0)	9 (18.4)	8 (16.3)	27 (55.1)	4 (8.2)	3.49	0.96
Students do not ask questions in mathematics class for fear of being shut down by peers.	1 (2.0)	18 (36.7)	3 (6.1)	21 (42.9)	6 (12.2)	3.27	1.15
Teachers sometimes perceive students who challenge their ideas in mathematics class as disrespectful.	5 (10.2)	24 (49.0)	3 (6.1)	15 (30.6)	2 (4.1)	2.69	1.14

Table 17: Distribution of items regarding challenge

ITEMS	SD	D	N	A	SA	MEAN	STD
I give students difficult questions to inspire them to think in mathematics class.	2 (4.1)	16 (32.7)	9 (18.4)	21 (42.9)	1 (2.0)	3.06	1.01
Students who ask questions in mathematics class are those whom are able to articulate their ideas.	7 (14.3)	17 (34.7)	7 (14.3)	16 (32.7)	2 (4.1)	2.78	1.18
Encouraging students to be independent minded in mathematics class will promote self confidence.	1 (2.0)	2 (4.1)	8 (16.3)	32 (65.3)	6 (12.2)	3.82	0.78
Students need to be creative to learn mathematics.	2 (4.1)	5 (10.2)	2 (4.1)	25 (51.0)	15 (30.6)	3.94	1.07

Table 18: Distribution of items regarding dialogue

ITEMS	SD	D	N	A	SA	MEAN	STD
If students are given too much space for discussion in mathematics class, bringing them back on line could be difficult.	4 (8.2)	6 (12.2)	1 (2.0)	32 (65.3)	6 ((12.2)	3.61	1.12
When my students critique my teaching in mathematics, they are helping me to improve on my teaching of the topic.	0 0	1 (2.0)	2 (4.1)	26 (56.1)	19 (38.8)	4.31	0.66
When students are not allowed to express themselves in mathematics class it makes them loose confidence.	0	3 (6.1)	0	29 (59.2)	17 (34.7)	4.22	0.74
Students and the teachers get to learn from each other in the mathematics class.	1 (2.0)	0 0	0 0	29 (59.2)	19 (38.8)	4.33	0.69
Provision of forum for sharing of ideas has helped me with my students in mathematics class.	0 0	1 (2.0)	5 (10.2)	33 (67.3)	8 (16.3)	4.02	0.61
As a teacher I think I can learn from my students in mathematics class.	1 (2.0)	1 (2.0)	1 (2.0)	33 (67.3)	13 (26.5)	4.14	0.74
The authority of the teachers who give room to students to express themselves in mathematics class can easily be undermined by some students.	1 (2.0)	10 (20.4)	7 (14.3)	25 (51.0)	6 (12.2)	3.51	1.02
Lack of debates in mathematics class impedes learning.	2 (4.1)	15 (30.6)	14 (28.6)	16 (32.7)	2 (4.1)	3.02	0.99
Too much freedom of expression for students in mathematics class is not good.	7 (14.3)	19 (38.8)	6 (12.2)	14 (28.6)	3 (6.1)	2.73	1.20

Dialogical atmosphere while teaching mathematics makes students share and this helps to avoid tension.	0	1	6	26	16	4.16	0.72
	0	(2.0)	(12.2)	(53.1)	(32.7)		
Some students ask questions just to distract the class.	3	18	7	20	1	2.96	1.06
	(6.1)	(36.7)	(14.3)	(40.8)	(2.0)		
Some of the students have the critical capacity to make constructive contributions in mathematics class.	2	1	3	32	11	4.00	0.87
	(4.1)	(2.0)	(6.1)	(65.3)	(22.4)		
Freedom of expression reduces students' anxiety in class.	1	1	2	33	12	4.10	0.74
	(2.0)	(2.0)	(4.1)	(67.3)	(24.5)		

Table 19: Distribution of items regarding time

ITEMS	SD	D	N	A	SA	MEAN	STD
I have too much to cover in mathematics within a limited time frame, and this has affected my interaction with my students.	7 (14.3)	15 (30.6)	3 (6.1)	18 (36.7)	6 (12.2)	3.02	1.33
There is no sufficient time to treat mathematics very well.	9 (18.4)	15 (30.6)	10 (20.4)	14 (28.6)	1 (2.0)	2.65	1.15
Lack of time is responsible for poor performance of students in mathematics.	0 0	17 (34.7)	10 (20.4)	16 (32.7)	6 (12.2)	3.22	1.07
My daily schedules are too tight to allow room for interaction with students in mathematics class.	1 (2.0)	3 (6.1)	4 (8.2)	29 (59.2)	12 (24.5)	3.98	0.88

Table 20: Casewise Diagnostics of Achievement Scores

Case Number	Std. Residual	Achievement test	Predicted Value	Residual
53	3.065	85	33.35	51.654
197	3.345	93	36.63	56.374
1299	-3.135	0	52.83	-52.830
1497	-3.200	5	58.92	-53.923
2034	-3.165	8	61.35	-53.345
2243	-3.355	18	74.54	-56.544
2266	-3.232	13	67.48	-54.475

Table 21: Residual Statistics of Achievement Scores

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	22.28	78.26	53.72	11.291	2575
Std. Predicted Value	-2.785	2.173	.000	1.000	2575
Standard Error of Predicted Value	.334	1.860	.636	.193	2575
Adjusted Predicted Value	22.16	78.21	53.72	11.293	2575
Residual	-56.544	56.374	.000	16.843	2575
Std. Residual	-3.355	3.345	.000	.999	2575
Stud. Residual	-3.372	3.348	.000	1.000	2575
Deleted Residual	-57.101	56.473	.001	16.869	2575
Stud. Deleted Residual	-3.379	3.355	.000	1.001	2575
Mahal. Distance	.009	30.345	2.999	2.742	2575
Cook's Distance	.000	.028	.000	.001	2575
Centered Leverage Value	.000	.012	.001	.001	2575

Table 22: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	159623.832	1	159623.832	457.020	.000[b]
1	Residual	898673.743	2573	349.271		
	Total	1058297.575	2574			
	Regression	184315.334	2	92157.667	271.206	.000[c]
2	Residual	873982.242	2572	339.806		
	Total	1058297.575	2574			

	Regression	196556.431	3	65518.810	195.475	.000[d]
3	Residual	861741.144	2571	335.177		
	Total	1058297.575	2574			
	Regression	199353.830	4	47262.264	139.735	.000[e]
4	Residual	858943.745	2570	338.229		
	Total	1058297.575	2574			

a. Dependent Variable: Achievement test

b. Predictors: (Constant), A1 Attitude Percent

c. Predictors: (Constant), A2 Attitude Percent, A1 Anxiety Percent

d. Predictors: (Constant), A2 Attitude Percent, A1 Anxiety Percent, A4 Motivation Percent

e. Predictors: (Constant), A2 Attitude Percent, A1 Anxiety Percent, A4 Motivation Percent, A3 Relationship Percent

Table 23: Coefficients of Achievement Scores

Model	Unstandardized Coefficients		Sig.		Correlations			Collinearity Statistics	
	B	Std. Error		Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	90.748	1.771	.000	94.220					
A2 Attitude	-.692	.032	.000	-.628	-.388	-.388	-.388	1.000	1.000
(Constant)	60.429	3.962	.000	68.199					
A2 Attitude	-.424	.045	.000	-.336	-.388	-.184	-.170	.508	1.969
A1 Anxiety	.240	.028	.000	.295	.381	.166	.153	.508	1.969
(Constant)	83.263	5.456	.000	93.961					
A2 Attitude	-.420	.044	.000	-.332	-.388	-.183	-.168	.508	1.969
A1 Anxiety	.225	.028	.000	.280	.381	.156	.143	.504	1.983

A4 Motivation	-.357	.059	.000	-.241	-.161	-.118	-.108	.981	1.019
(Constant)	69.664	7.195	.000	83.774					
A2 Attitude	-.416	.044	.000	-.329	-.388	-.182	-.167	.508	1.970
A1 Anxiety	.221	.028	.000	.276	.381	.154	.140	.503	1.988
A4 Motivation	-.338	.059	.000	-.222	-.161	-.112	-.101	.970	1.031
A3 Relationship	.189	.065	.004	.317	.110	.057	.051	.975	1.026

Table 24: Descriptive Statistics for Independent Variables

	Mean	Std. Deviation	N
Achievement test	53.72	20.277	2575
A1 Anxiety Percent	66.7000	18.12855	2575
A1 Attitude Percent	53.5304	11.38536	2575
A3 Relationship Percent	66.3063	5.58508	2575
A4 Motivation Percent	61.8681	6.16609	2575

APPENDIX B: FIGURES SHOWING THE SCREE PLOTS FOR THE VARIABLES

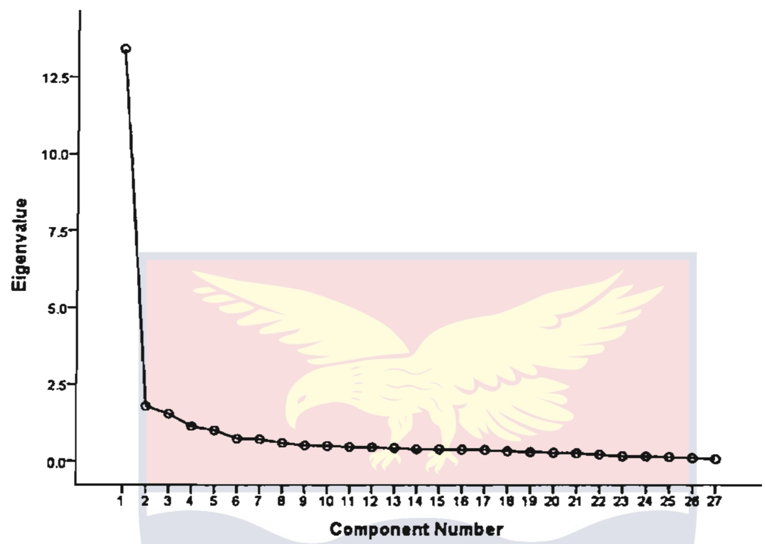


Figure 1: Scree Plot for Anxiety Variable

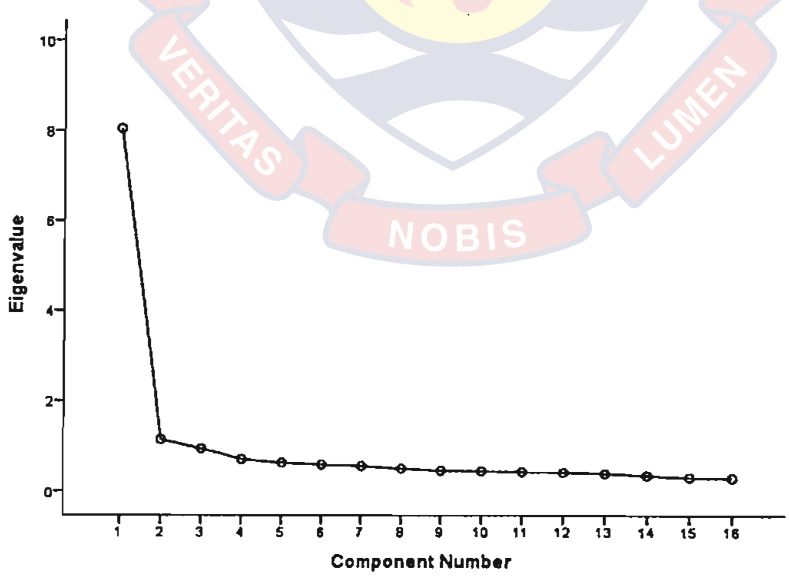


Figure 2: Scree Plot for Attitude Variable

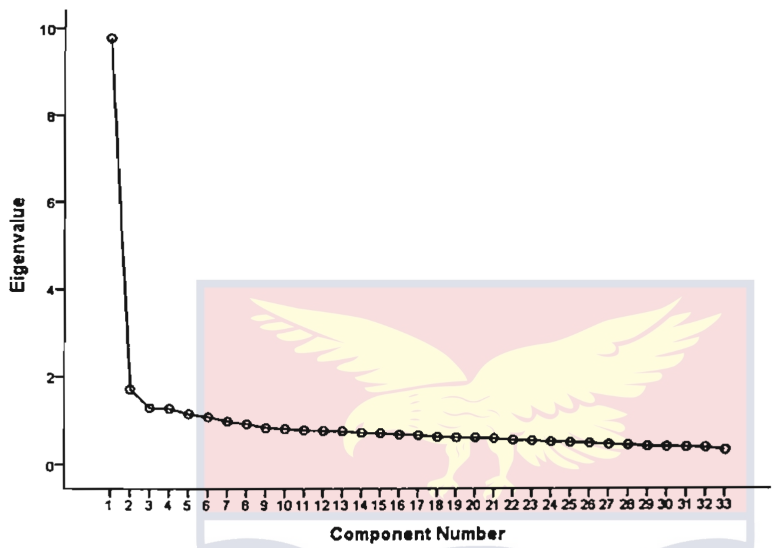


Figure 3: Scree Plot for Teacher-Student Relationship Variable

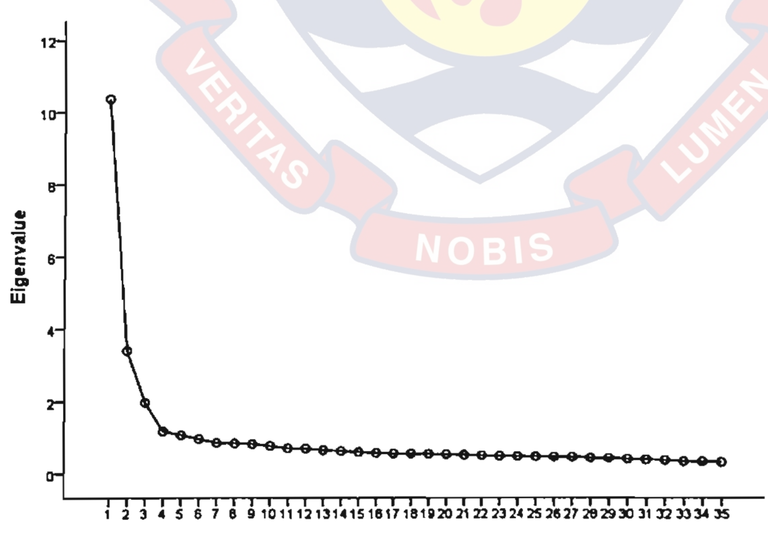
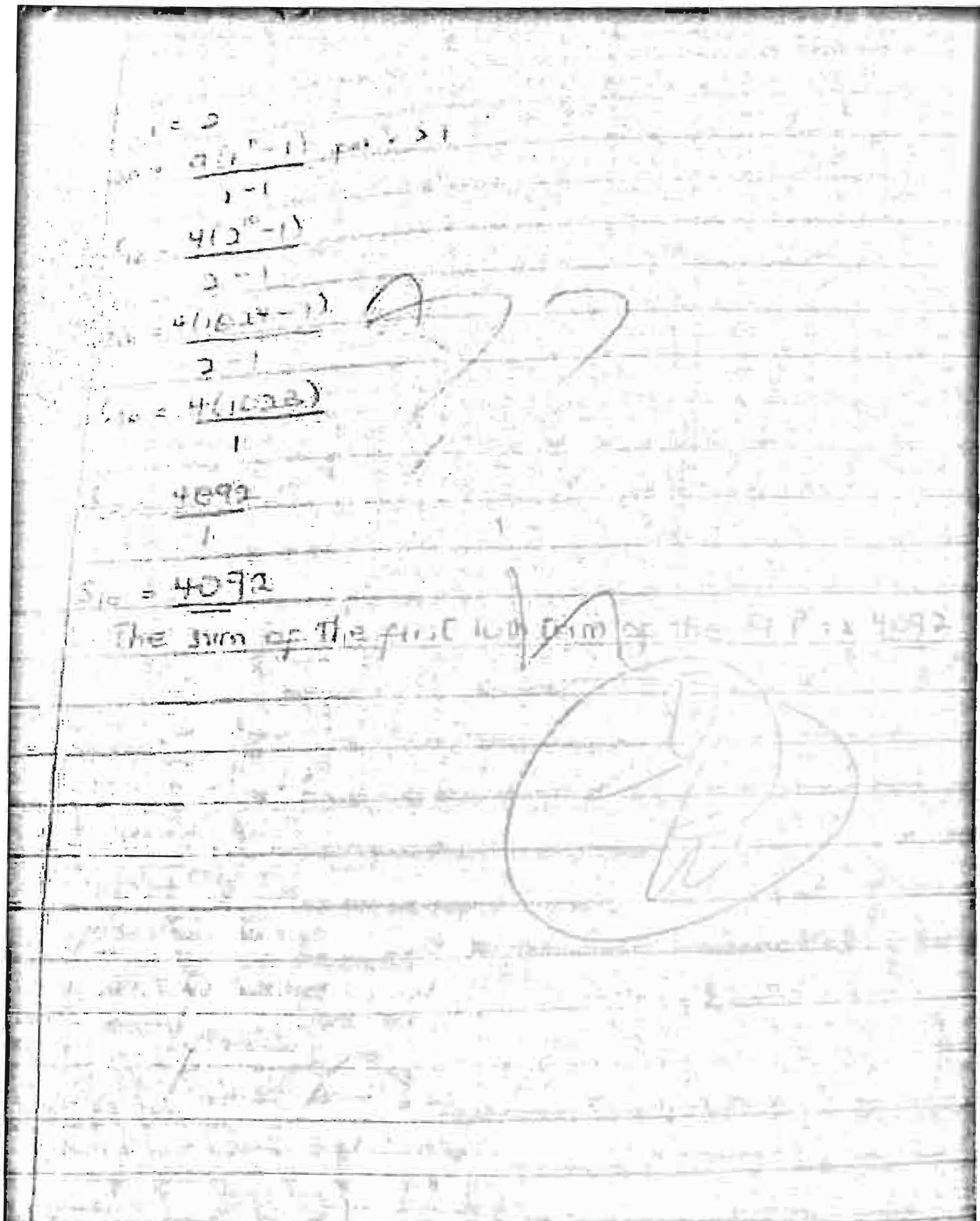


Figure 4: Scree Plot for Motivation Variable

APPENDIX C: SNAPSHOTS OF THE STUDENTS' EXERCISE BOOKS



$$10 = \left(\frac{(x+9)(x-2)}{x-1}\right)$$

$$\frac{3}{6}$$

$$10(x-1) = (x+9)(x-2)$$

$$10x - 10 = x^2 - 2x + 9x - 18$$

$$x^2 - 2x + 9x - 10x - 18 + 10 = 0$$

$$x^2 - 3x - 8 = 0$$

Using quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(-8)}}{2(1)}$$

$$x = \frac{3 \pm \sqrt{9+32}}{2} \qquad x = \frac{3 - \sqrt{9+32}}{2}$$

$$x = 4.7 \qquad x = -1.7$$

5) Find the solution set of the inequality

$\frac{1}{3}(x+4) - 1\frac{1}{2} \le 2x+3 \le 6\frac{2}{3} - \frac{1}{2}(x-1)$

$\frac{1}{3}(x+4) - \frac{3}{2} \le 2x+3 \le \frac{20}{3} - \frac{1}{2}(x-1)$

$6 \times \frac{1}{3}(x+4) - 6 \times \frac{3}{2} \le 6 \times 2x + 3 \times 6 \le 6 \times \frac{20}{3} - 6 \times \frac{1}{2}(x-1)$

$2(x+4) - 9 \le 12x + 18 \le 40 - 3(x-1)$

$2x + 8 - 9 \le 12x + 18 \le 40 - 3x + 3$

$2x + 8 - 9 \le 12x + 18 \qquad 12x + 18 \le 40 - 3x$

$2x - 12x \le 18 - 8 - 9 \qquad 12x + 3x \le 40 - 18$

$-10x \le 19 \qquad 9x \le 22$

$\frac{-10}{-10} \le 19 \qquad 9x \le 25$

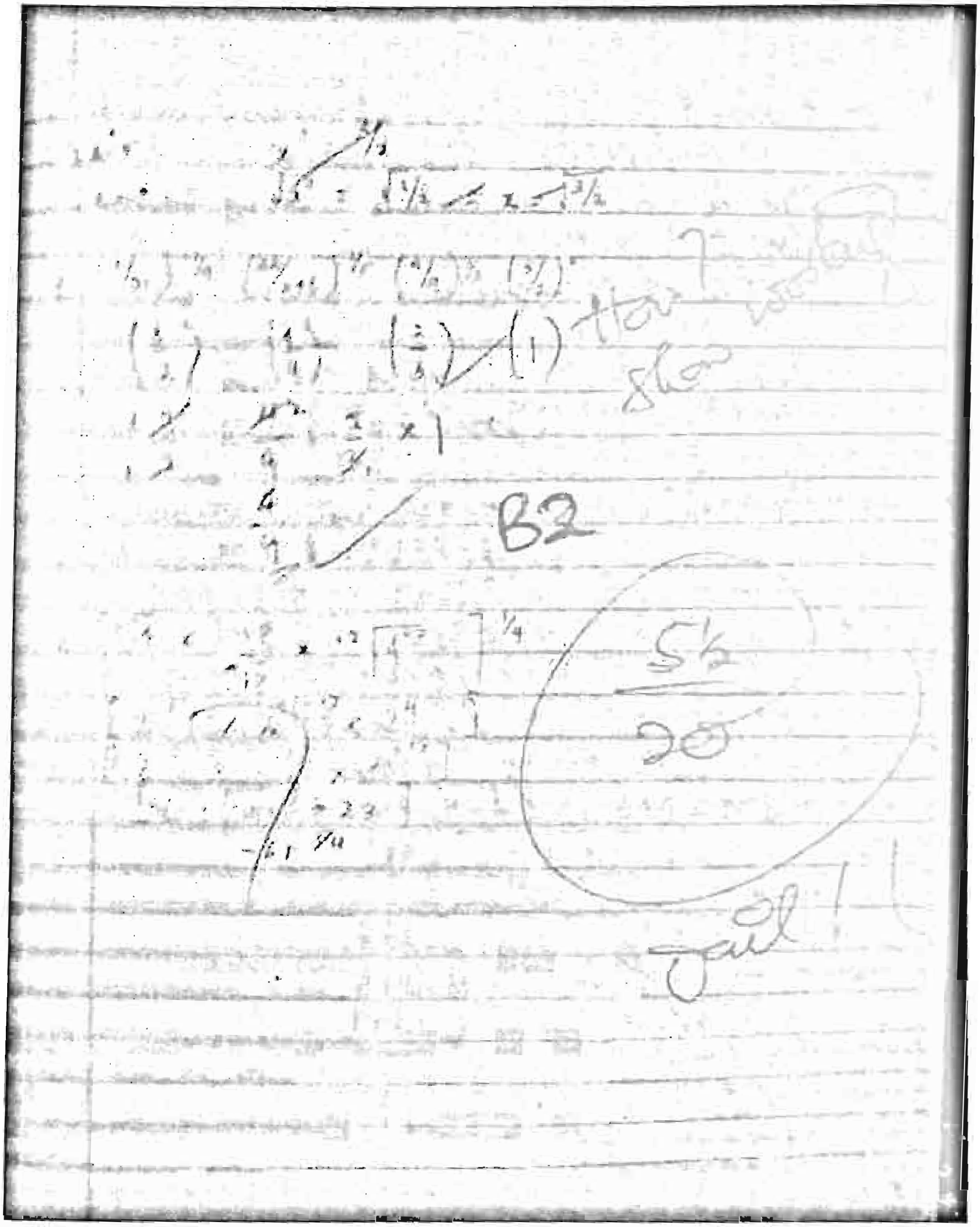
$x \le \frac{19}{-10} \qquad x \le \frac{25}{9}$

$S = \{x : x \le 19/10\}$ $S = \{x : 19/10 \le x \le 25/9\}$

0 1 2 3 ... 19/10

8

20


B2
5½
20
Fail!

The rule of the mapping by inspection is
$x \to x^2+1$

5^2+1, 6^2+1, 7^2+1, 8^2+1, 9^2+1

13.

-2	-1	0	1	2
↓	↓	↓	↓	↓
1/4	1/2	1	2	4

$\frac{3}{10}$

It is an exponential mapping
$y = ar^{x-b}$
ratio
where r = in co-domain
$\frac{1}{1/2} = 2$

$\therefore r = 2$
If $a = 1$ and $b = 0$

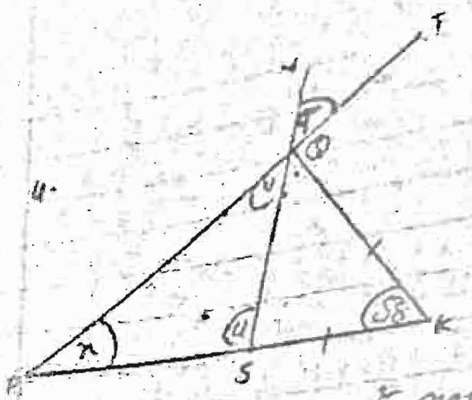
a 1st term of the co-domain = 1/4

then
$x \to 1(2)^{x-0}$
$x \to 2^x$

b 1st term of the domain = -2

$\therefore$ The rule of the mapping is $x \to 2^x$

Fail!!



=> vertically opposite angle are equal

$4° = 9°$

Angles in triangle add up to 180°

$4+4+x=180°$ (6)

$9+9+x=180°$

$18+x=180°$

$x=180-18$

$x=162°$ (6)

$\Delta PQR = x+$)

7/20

poor performance

Do correction

$a + a + 58^\circ = 180$ — makes use of the ... in ...

$2a + 58 = 180$

$2a = 180 - 58$

$\frac{2a}{2} = \frac{122}{2}$

$a = 61$

b = a (opposite angle are equal)

$b + x = a^\circ$

$9^\circ + x = 61^\circ$

$x = 61^\circ - 9^\circ$

$x = 52^\circ$ (5)

15/20

Do corrections

(2)

3) −2 −1 0 1 2

↓ ↓ ↓ ↓ ↓

$\frac{1}{4}$ $\frac{1}{2}$ 1 2 4

$y = 2^{x}$ [illegible] $x = (-2)$ $x = \frac{1}{2} \div \frac{1}{4} = 2$

$y = \frac{1}{4}(2)$

$y = \frac{1}{4}(2)$

$y = \frac{1}{4} \times 2 \times 2$

$y = 4^{-1} \times 2 \times 2$

$y = 2^{-2} \times 2 \times 2$

$y = 2^{x} \times 2$

$y = 2x$

∴ x → (2x)

Write well!

$x \to 2^{x}$

$y = \frac{1}{2}$ [illegible]

2. Solve the equation

$x^2 = y + 3$ ①

$2x - 3y = 8$ ②

Make y the subject of ①

$y = 3 - x^2$

Sub the value of y in ②

$2x - 3(3 - x^2) = 8$

$2x - 9 + 3x^2 = 8$

$3x^2 + 2x - 9 - 8 = 0$

$3x^2 + 2x - 17 = 0$

Using quadratic equation

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ where $a = 3, b = 2, c = -17$

$x = \frac{-2 \pm \sqrt{(2)^2 - 4(3)(-17)}}{2(3)}$

$x = \frac{-2 \pm \sqrt{4 + 204}}{6}$ $x = \frac{-2 \pm \sqrt{208}}{6}$

$x = \frac{-2 + \sqrt{208}}{6} = 2.1$

$x = \frac{-2 - \sqrt{208}}{6} = 2.7$

0/8

Fail!

4th Feb

Exercise 2

Simplify without using tables.

1. $3\log \frac{2}{5} - \log \frac{72}{125} + \log 9$

Soln.

$3\log \frac{2}{5} - \log \frac{72}{125} + \log 9$

$\Rightarrow \log \left(\frac{2}{5}\right)^3 - \log \frac{72}{125} + \log 3^2$

$\Rightarrow \log \frac{8}{125} - \log \frac{72}{125} + \log 9$

$\Rightarrow \log \left(\frac{8}{125} \div \frac{72}{125}\right)$

$\Rightarrow \log \left(\frac{8}{125} \times \frac{125}{72}\right)$

$\Rightarrow \log \frac{1}{9} + \log 9$

$\Rightarrow \log 1. = 0$

Write Carefully

2. $\frac{1}{3}\log_{10} 27 + \log_{10} 3 - \frac{1}{12}\log_{10} 4^6$

Soln.

$\frac{1}{3}\log_{10} 27 + \log_{10} 3 - \frac{1}{12}\log_{10} 4^6$

$\Rightarrow \log_{10} 27^{1/3} + \log_{10} 3 - \log_{10} 4^{6 \times 1/12}$

$\Rightarrow \log_{10} 3 + \log 3 - \log 2$

$\Rightarrow \log_{10} (3 \times 3)$

$\Rightarrow \log_{10} 9 \div \log 2$

$= \log \frac{9}{2}$

$\frac{9}{10}$

5) Find the solution set of the inequality

$\frac{1}{3}(x+4) - 1\frac{1}{2} \leq 2x+3 \leq 6\frac{2}{3} - \frac{1}{2}(x-1)$

$\frac{1}{3}(x+4) - \frac{3}{2} \leq 2x+3 \leq \frac{20}{3} - \frac{1}{2}(x-1)$

$6 \times \frac{1}{3}(x+4) - 6 \times \frac{3}{2} \leq 6 \times 2x + 3 \times 6 \leq 6 \times \frac{20}{3} - 6 \times \frac{1}{2}($

$2(x+4) - 9 \leq 12x + 18 \leq 40 - 3(x-1)$

$2x + 8 - 9 \leq 12x + 18 \leq 40 - 3x + 3$

$2x + 8 - 9 \leq 12x + 18$ $\quad$ $12x + 18 \leq 40 - 3x$

$2x - 12x \leq 18 - 8 + 9$ $\quad$ $12x + 3x \leq 40 - 18$

$-10x \leq 19$ $\quad$ $9x \leq 22$

$-10 \leq 19$ $\quad$ $9x \leq 25$

$\therefore x \leq \frac{19}{-10}$ $\quad$ $x \leq \frac{25}{9}$

$S = \{x : x \leq 19/10\}$ $\quad$ $S = \{19/10 \leq x \leq 25/9\}$

8/20

2 Sum of interior angles $= (n-2)180$

$\Rightarrow \quad = (7-2)180$

$\Rightarrow \quad = 180 \times 5$

$\Rightarrow \quad = 900$

remaining angle $= x + x + x + x = 4x$

$\Rightarrow 28^\circ + 75^\circ + 87^\circ + 4x = 900$

$\Rightarrow 190 + 4x = 900$

$\Rightarrow 4x = 900 - 190$

$\Rightarrow 4x = 710$

$\Rightarrow x =$ ~~177~~ 177.5°

1 Remaining angles $x + x + x + x + x = 5x$

$40^\circ + 58^\circ + 62^\circ + 5x = 360^\circ$

$\Rightarrow 160^\circ + 5x = 360^\circ$

$\Rightarrow 5x = 360^\circ - 160^\circ$

$\Rightarrow 5x = 200$

$\Rightarrow \frac{5x}{5} = \frac{200}{5}$

$\Rightarrow x = 40$

3) Abraham is three times as old as Sylvia. In eight years time Abraham will be twice as old as Sylvia. How old is Abraham now

Let Sylvia = x
let Abraham = 3x

$3x + x = 2(x+8)$
$3x + x = 2x + 16$
$4x = 2x + 16$
$4x - 2x = 16$
$2x = 16$
$x = \frac{16}{2} = 8$ and Sylvia is 8 years.

∴ Abraham = 3×8
= 24 years.

The meaning is not clear so don't use this method again.

4) The breadth of a rectangle is 11/2. If the length is twice the breadth, find the area of the rectangle. Leave your answer in base 5.

Breadth = x = 11/2
Length = 2x 2(11/2)

Area of rectangle = L×B
2x

11 A = L×B

Assignment 15-03-2016

1. Divide 6×10^{7} by [illegible]

$\frac{6 \times 10^{7}}{12 \times 10^{5}}$

$\frac{1}{2} \times \frac{10^{7}}{10^{5}}$

$\frac{1}{2} \times 10^{7-5}$

$\frac{1}{2} \times 10^{2}$

0.5×10^{2}

$5.0 \times 10^{-1} \times 10^{2}$

$5 \times 10^{-1+2}$

5×10^{1}

$8\frac{1}{2}/10$

V. good

[illegible]

2. Write 49000×0.0005 in standard form.

49000×0.0005

$4.9 \times 10^{4} \times 5 \times 10^{-4}$

$(5 \times 4.9) \times 10^{4+-4}$

24.5×10^{0}

24.5×10^{0}

$2.45 \times 10 \times 10^{0}$

[illegible] 10^{0} [illegible]

$2.45 \times 10 \times 1$

2.45×10

$245 \times 10^{3} \times 10^{4}$ [illegible]

Good

3. Write $8 \times 10^{4} \times 0.00000$ [illegible]

$8 \times 10^{4} \times 5.3 \times 10^{-6}$

$3n - 2\left(\frac{65}{13}\right) = -13$

$13 \times 3n - 2(13)\left(\frac{65}{13}\right) = -13 \times 13$

$39n - 2(65) = -169$

$39n - 130 = 169$

$39n = 169 + 130$

$39n = 299$

$\frac{39n}{39} = \frac{299}{39}$

$n = \frac{299}{39}$

Truth set $= \{(x, y) : (65/13,\ 299/39)\}$

(4) $\frac{1}{2}t + 2s = 8$

$t - \frac{1}{3}s = 3$

Substitution method

$t - \frac{1}{3}s = 3$

$t - 3 = \frac{1}{3}s$

$3(t - 3) = 3 \times \frac{1}{3}s$

$3(t - 3) = s$

It is not that you dont understand, it is because you are not ...

5

5:3, 6:4

Ch, dear, pls keep practising

correction

∠AOC + ∠BOC + ∠AOD = 180° (angles on a straight line)

56 + 56 + ∠DOA = 180°

∠DOA = 180° − 112°

∠DOA = 68° A1

(4) ∠RCT = ∠SAR [Property 1]

∠SAR = x

∠ROS = 2 (∠SAR)

∠ROS = 2 (x) M1

∠ROS = 2x

∴ ∠ROS = 2x A1

Number	Log
57	1.7559
254.6	2.4058
0.00592	$\bar{3}$.[illegible]

$\frac{9}{10}$

Number	Log
57	1.7559
254.6	2.4058
0.00592	$\bar{3}$.7597
	2.1123
26.43	1.5615
169	2.2279
	3.7894
	2.1123
	− 3.7894

$\bar{2}$.3227

antilog $\bar{2}$.3227 = 2.102 × 10^{-2}

$\frac{57 \times 254.6 \times 0.00592}{26.43 \times 169}$

$= 2.102 \times 10^{-2}$

$= 0.02102$

Type it on the calculator and see!!

$\log_2(2x+1) + 2 = \log_2 6x^2 = \log_2 2$ [illegible]

APPENDIX D: INSTRUMENTS FOR THE STUDY

QUESTIONNAIRES FOR STUDENTS

A1 Student questionnaire

Dear students,

This questionnaire is meant to explore your opinions about how you feel in mathematics class. Please, provide your genuine responses to each of the questions that follow. Be assured that the information you provide will be treated strictly confidential and will be used only for this research.

A. Biographic data

1. Age: __________
2. Gender: Male [ ] Female [ ]
3. Mathematics teacher gender Male [ ] Female [ ]
4. Programme:______________________ **Student's Number...............**

B. In your own view, how should a teacher relate with his/her students____
____

Instruction: The following are statements that indicate your opinion on how you feel in a mathematics class. Kindly indicate your level of agreement/disagreement with each of them by ticking the appropriate cell.

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am afraid of mathematics. (1)					
I am comfortable with mathematics. (2)					
I relax in Mathematics class. (3)					
Mathematics makes me feel uncomfortable. (4)					
I mostly feel peaceful when solving mathematics problems. (5)					
Mathematics makes me feel restless. (6)					
Mathematics makes me feel impatient. (7)					
I feel relaxed while taking mathematics tests. (8)					
I am often at ease in mathematics class. (9)					
Mathematics makes me feel nervous. (10)					
I get confused when working mathematics. (11)					
I feel no stress when answering mathematics questions. (12)					
I am unable to think clearly when working mathematics. (13)					
Mathematics makes me feel confused. (14)					
A mathematics tests do not scare me. (15)					
I usually make mistakes while solving Mathematics questions. (16)					
I feel very calm when working mathematics. (17)					
I feel relax when taking mathematics tests. (18)					

A2 Student questionnaire

Dear students,

Instruction: The following are statements that indicate your opinion on how you relate to mathematics. Kindly indicate your level of agreement/disagreement on each of them by ticking the appropriate cells.

Student's number.........................**Student's Programme**..................

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Even though I work hard on mathematics, it seems difficult for me. (1)					
Generally I feel secure about undertaking Mathematics related programme in future. (2)					
Mathematics related subjects have been my worst subjects. (3)					
I do not have the ability to do well in Mathematics. (4)					
I have a lot of confidence when it comes to mathematics. (5)					
I can learn advanced mathematics. (6)					
My friends do better than me in mathematics. (7)					
I am sure I can do advance work in mathematics. (8)					
Most subjects I can handle well, but I have problems with mathematics. (9)					
I can handle more difficult mathematics problems. (10)					
I do badly in tests of mathematics as compared to that of my friends. (11)					
Thinking out Mathematics problems does not appeal to me. (12)					
I feel good solving Mathematics questions. (13)					
Mathematics is the most difficult subject for me. (14)					
I feel I can do well in Mathematics.(15)					
I like Mathematics. (16)					
I do not see myself becoming successful in the learning of mathematics. (17)					
When I am faced with mathematics related problem that I cannot solve immediately I stick with it until I solve it. (18)					
I am not good in the study of mathematics (19)					
Even when a mathematics question is difficult, I keep working until I find an answer. (20)					
When I am left with a question that					

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
requires the use of Mathematics to answer, I will keep on trying until I answer it. (21)					
I am capable of solving difficult mathematics questions. (22)					
In mathematics class, I see others to be better than me. (23)					
I feel comfortable with Mathematics. (24)					
A mathematics test is always welcome by me. (25)					
I usually feel relax when solving mathematics questions. (26)					
I see myself to be good in mathematics. (27)					
Ido not enjoy learning mathematics. (28).					

A3 Student questionnaire

Instruction: The following are statements that indicate your opinion on how your mathematics teacher relates to you in class. Kindly indicate your level of agreement/disagreement with each of them by ticking the appropriate cells.

Student's Number.........................Student's Programme................

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My mathematics teacher is not friendly in class. (1)					
My Mathematics teacher encourages me to think critically in mathematics class. (2)					
My mathematics teacher challenges me to be creative in mathematics class. (3)					
My mathematics teacher is approachable. (4)					
My mathematics teacher encourages me to ask him/her questions during mathematics class. (5)					
My mathematics teacher is very happy when a student uses a method he/she did not teach to solve mathematics questions. (6)					
My mathematics teacher does not pay attention to students who ask questions that have nothing to do with the topic the teacher is discussing.(7)					
My mathematics teacher comes late to class most of the time. (8)					
My mathematics teacher gets angry when I fail to answer questions correctly in class. (9)					
My mathematics teacher gives a harsh response when I give a wrong answer in mathematics class. (10)					
My mathematics teacher could disgrace anyone before other students in mathematics class. (11)					
I have the opportunity to talk to my mathematics teacher about my concerns in mathematics. (12)					
I am free to express my opinion in mathematics class even if it is different from my teacher's opinion. (13)					
My mathematics teacher encourages students to discover new methods of solving mathematics questions. (14)					
My mathematics teacher easily accommodates alternative methods of solving questions apart from his/her approach. (15)					

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My mathematics teacher rushes through lessons in class. (16)					
During class, my mathematics teacher does not allow students to freely make contributions. (17)					
I am afraid to approach my mathematics teacher for help in mathematics class. (18)					
My mathematics teacher ignores students when he/she thinks your contribution in mathematics is not relevant. (19)					
Discussion in mathematics class helps me to recall things during examination. (20)					
My mathematics teacher encourages me to ask difficult questions in mathematics class. (21)					
My mathematics teacher says he/she is learning from us in mathematics class. (22)					
The relationship between my Mathematics teacher and students is like master and servant. (23)					
Some of my mates are afraid to ask questions in mathematics class. (24)					
My mathematics teacher is only nice to those he/she thinks are good at mathematics. (25)					
My mathematics teacher allows exchange of ideas in class. (26)					
My mathematics teacher believes students have something good to offer in mathematics class. (27)					
My mathematics teacher has good social relationship with students in mathematics class. (28)					
My mathematics teacher sometimes jokes in mathematics class to release tension. (29)					
I feel intimidated in my mathematics class.(30)					
My mathematics teacher promotes a relaxed atmosphere for our learning of mathematics. (31)					
My mathematics teacher gives enough attention to every student. (32)					

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am good at mathematics because my mathematics teacher believes in me. (33)					

A4 Student questionnaire

Dear students,
This questionnaire is meant to explore your reasons why you are studying mathematics. Please, provide your genuine responses to each of the questions that follow. Be assured that the information you provide will be treated strictly confidential and will be used only for this research.

Instruction: The following are statements that indicate suggested reasons why you spend time studying mathematics. Kindly indicate your level of agreement/disagreement with each of them by ticking the appropriate cells.

Programme.......................... **Student's Number**..............................

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I feel that it is a waste of time studying mathematics. (1)					
I am studying mathematics because I want to show to others (e.g., teachers, family, and friends) that I can do mathematics. (2)					
I am studying mathematics because I want to show myself that I can do well in mathematics. (3)					
I don't see how mathematics is of value to me. (4)					
I am studying mathematics because I believe that mathematics will improve my work competence in future. (5)					
I am studying mathematics because it is a compulsory subject in senior high school. (6)					
I am studying mathematics in order to obtain a more prestigious job later on in life.(7)					
I am studying mathematics to show myself that I am an intelligent person. (8)					
I am studying mathematics in order to have an opportunity to study a programme of my choice later on. (9)					
I am studying mathematics for the pleasure that I experience when I am able to solve questions. (10)					
I am studying mathematics because what I learn in mathematics now will be useful for the course of my choice in university. (11)					
I am studying mathematics because I want to feel the personal satisfaction of understanding mathematics. (12)					
I am studying mathematics because studying mathematics will be useful for me in the future. (13)					
I am studying mathematics so as to broaden					

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
my knowledge. (14)					
I am studying mathematics because I want to have "the good life" later on. (15)					
I am studying mathematics because I think that mathematics will help me better prepare for my future career. (16)					
I can't see why I should study mathematics. (17)					
I am studying mathematics because of the fact that when I do well in mathematics, I feel important. (18)					
I am studying mathematics for the pleasure that I experience when I learn how things in life work because of mathematics. (19)					
I work very hard in mathematics because I want to be respected as an intelligent student (20)					
I am doing my best in mathematics so that I can have the best grade at WASSCE (21)					
I am studying mathematics because I plan to major in a mathematics related programme at the university. (22)					
I am studying mathematics because I am sure I can use mathematics in the future. (23)					
Mathematics will **not** be important for the rest of my life. (24)					
I feel helpless studying mathematics. (25)					
I don't enjoy doing mathematics. (26)					
I would rather have someone give me an answer to mathematics questions than to solve it by myself. (27)					
Mathematics is not useful to me. (28)					
Using mathematics effectively will help me in my future studies. (29)					
I will need a firm mastery of mathematics in my future work. (30)					
Trying to solve mathematics related problems does not appeal to me. (31)					
It does not make any difference whether I learn mathematics. (32)					
The subjects which require mathematics are waste of time. (33)					
For me, solving mathematics problems is a waste of time. (34)					
Solving mathematics problems is boring (35)					

Teacher questionnaire on teacher-student relationship

Dear colleague,

This questionnaire is meant to explore your experiences about how you relate to your Mathematics students in class. Please, provide your genuine responses to each of the items that follows. Be assured that the information you provide will be treated strictly confidential and will be used only for this research.

C. Biographic data

5. Age:20-25 yrs[ ] 26-30yrs[ ] 31-35yrs[ ] 36-40yrs[ ] 41-45yrs[ ] 46-50yrs[ ]
6. Gender: Male [ ] Female [ ]
7. Number of years you have been teaching in SHS______________________
8. Qualification: B. Sc. [ ] B. Ed. [ ] M. Sc. [ ]M. Ed. [ ] PGDE [ ] HND [ ]
   Others, please indicate____

D. What do you think constitute professional relationship between you and your students____

____

Instruction: The following are statements that indicate your opinion on how your students relate to you and others in your class. Kindly indicate your level of agreement/disagreement on each of them by ticking the appropriate cells.

E. Overall experience in your Mathematics class

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
If students are given too much space for discussion in mathematics class, bringing them back on line could be difficult. (1)					
I pay attention to every question student poses in my mathematics class. (2)					
I have too much to cover in mathematics within a limited time frame, and this has affected my interaction with my students. (3)					
When my students critique my teaching in mathematics, they are helping me to improve on my teaching of the topic. (4)					
Some students are too shy to answer questions in my mathematics class. (5)					
Students don't have to understand everything about mathematics during my teaching. (6)					
Some students are too afraid to make contribution in my mathematics class. (7)					
It is sometimes difficult to treat all students fairly in my mathematics class. (8)					

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
It is not helpful to waste time on a recalcitrant student when teaching mathematics. (9)					
I give students difficult questions to inspire them to think in mathematics class. (10)					
When students are not allowed to express themselves in mathematics class it makes them loose confidence. (11)					
Students who ask questions in mathematics class are those whom are able to articulate their ideas. (12)					
Students and the teachers get to learn from each other in the mathematics class. (13)					
Students are too afraid to learn mathematics because they are lazy. (14)					
Provision of forum for sharing of ideas has helped me with my students in mathematics class. (15)					
As a teacher I think I can learn from my students in mathematics class. (16)					
The authority of the teachers who give room to students to express themselves in mathematics class can easily be undermined by some students. (17)					
Lack of debates in mathematics class impedes learning. (18)					
My students do not ask enough questions in mathematics class. (19)					
Every student should be able to learn mathematics. (20)					
Too much freedom of expression for students in mathematics class is not good. (21)					
Friendship with the students when teaching mathematics helps them to learn. (22)					
Dialogical atmosphere while teaching mathematics makes people share and this helps to avoid tension. (23)					
Students' dislike of mathematics is the cause of mathematics anxiety. (24)					
The understanding of mathematics may come later after the classroom encounter. (25)					
Students should obey their teachers no matter the situation in order to understand mathematics. (26)					
Students do not ask questions in mathematics class for fear of being shut down by peers. (27)					
There is no sufficient time to treat mathematics very well. (28)					
Friendship and learning go hand in hand in mathematics class. (29)					
Lack of time is responsible for poor					

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
performance of students in mathematics. (30)					
If a student is appreciated for his/her contributions, he/she will be encouraged to do more. (31)					
Mathematics should not be compulsory for every student. (32)					
Friendship makes the class room atmosphere cordial and everyone feels at home in mathematics class. (33)					
My daily schedules are too tight to allow room for interaction with students in mathematics class. (34)					
Some students see me after the class for clarification of some points in mathematics. (35)					
Encouraging students to be independent minded in mathematics class will promote self confidence. (36)					
Students must abide by rules and regulations. (37)					
My students are doing well in mathematics because they just follow my instructions..(38)					
Students need to be creative to learn mathematics. (39)					
Students do not see the usefulness of mathematics to them. (40)					
Building relationship in mathematics class will prevent teachers from finishing their syllabus. (41)					
Students are too anxious when solving mathematics problems because they lack the ability to be successful in the subject. (42)					
Friendship and learning are linked because when the students consider you as a friend, they learn better, especially in mathematics class. (43)					
Students who are too often confused in mathematics class are not intelligent enough to study the subject. (44)					
Students make too many mistakes when solving mathematics problems due to lack of practice. (45)					
Some students are too boring to be taught mathematics. (46)					
Mathematics would be useful for only a few of the students. (47)					
Students who do not ask questions in mathematics class have low self-esteem. (48)					
My students have so much confidence and trust in me that many of them simply take					

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
what I give them in mathematics class. (49)					
Some students ask questions just to distract the class. (50)					
Allowing students to be free enhances the class room atmosphere for learning mathematics. (51)					
Teachers sometimes perceive students who challenge their ideas in mathematics class as disrespectful. (52)					
I see the students as my friends in mathematics class. (53)					
Mathematics is not useful for every student. (54)					
Some students do not want to learn mathematics. (55)					
Not every student can learn mathematics because it is a difficult subject (56)					
Some of the students have the critical capacity to make constructive contributions in mathematics class. (57)					
Mathematics is too difficult to be understood by all the students. (58)					
Freedom of expression reduces students' anxiety in class. (59)					

Interview guide for students

1. In your own view, how should a teacher relate with his/her students?
2. What do you understand by learning?
3. How does your ability to express your views in class help in your learning?
4. Why will you not express yourself in mathematics class?
5. What do you think can be the disadvantages of you not expressing your opinion freely in class?
6. How can teachers and students learn something from one another?
7. How do your interactions with your teachers promote learning?
8. How does classroom learning help you develop your critical and creative thinking capacities?
9. How do you feel in mathematics class?
10. How do you feel when writing a test in mathematics?
11. What do you understand by anxiety in relation to the learning of mathematics?
12. What can cause anxiety for you in mathematics class?
13. How can mathematics anxiety be minimized or eliminated for you?
14. What do you do when answering a mathematics question that proves difficult to you in class or assignment?

15. What do you do when answering a mathematics question that proves difficult to you in examination?
16. How useful is mathematics to you now?
17. How useful will mathematics be for you in the future?
18. How confident are you to succeed in learning mathematics?
19. How much time do you spend learning mathematics on your own?
20. Which is your best subject and why? (Students to arrange the subjects of their programmes in order of preference).
21. What do you understand by attitude in relation to the learning of mathematics?
22. What do you understand by motivation in relation to the learning of mathematics?
23. Why are you studying mathematics?
24. What can motivate you to study mathematics better?
25. What can prevent you from studying mathematics?
26. When do your teachers listen to your views in class?
27. If you are privilege to change anything in the learning of mathematics, what will that be?

<u>**Interview guide for Teachers**</u>

1. What do you understand by learning?
2. What do you think constitute teacher-student professional interaction?
3. What qualities do students who challenge and give new perspectives to your ideas have?
4. What are the symptoms of anxiety in your students?
5. In what way will allowing students to express their ideas freely help in the learning process?
6. Under what circumstances would you not allow students to freely express their opinions in your class?
7. What do you think can be the disadvantages of teachers allowing students to freely express their opinions in class?
8. How well does the classrooms atmosphere promote learning?
9. How do your interactions with your students promote learning?
10. How are your students motivated?
11. What causes anxiety in students generally?
12. How can mathematics anxiety be reduced or eliminated in students?

13. Briefly tell me about the attitudes of your students
14. How can students' self-concept towards the learning of mathematics be improved?
15. What percentage of the students in your class is eager to learn mathematics?
16. What percentage of your students is likely to study mathematics or its related programmes after senior high school?

APPENDIX E: ACHIEVEMENT TEST

Name of the school:..

Name of the student:..

Class: ....

Number:..

Instruction: Circle the letter of the correct or best answer to each item clearly.

1. What are the roots of the equation $2x^2 - 4x - 6 = 0$

   A. $3, -1$
   B. $-3, -1$
   C. $-3, 1$
   D. $3, 1$

2. If $\sin x = \cos 50°$, then x is …

   A. 40°
   B. 45°
   C. 50°
   D. 90°

3. Find the value of n if $\frac{\log_{10} n}{\log_{10} 64} = \frac{1}{2}$.

   A. 4
   B. 8
   C. 16
   D. 24

4. If $k\sqrt{28} + \sqrt{63} - \sqrt{7} = 0$, find k

   A. -2
   B. -1
   C. 1
   D. 2

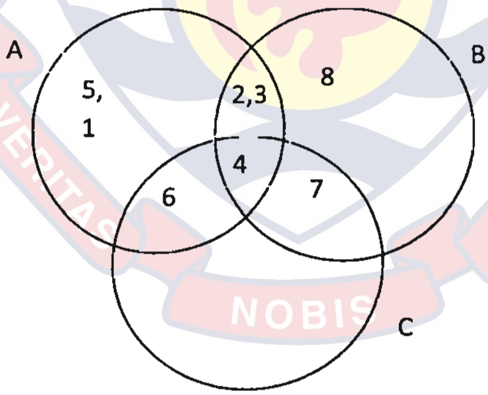
5. Given that $81 \times 2^{2n-2} = k$, find $\sqrt{k}$.
   A. 4.5×2^{n}
   B. 4.5×2^{2n}
   C. $9 \times 2^{n-1}$
   D. 9×2^{2n}

6. Evaluate $1011_{two} \times 1101_{two}$
   A. 11000_{two}
   B. 1000111_{two}
   C. 1001111_{two}
   D. 10001111_{two}

7. If y varies inversely as x^2, how does x vary with y?
   A. x varies inversely as y^2
   B. x varies inversely as $\sqrt{y}$
   C. x varies directly as y^2
   D. x varies directly as $\sqrt{y}$

8. The n^{th} term of a sequence is given by $\frac{3}{4} \times 2^n$. Write the first three terms of the sequence.
   A. $\frac{2}{3}, 0, 6$
   B. $\frac{3}{2}, 3, 6$
   C. $\frac{2}{3}, 3, \frac{8}{3}$
   D. $\frac{2}{3}, \frac{3}{4}, 6$

9. What is A ∩ B in the diagram below?



   A. {2, 3}
   B. {2, 3, 4}
   C. {1, 2, 3}
   D. {2, 3, 8}

10. Factorize the expression x(a − c) + y(c − a).
   A. (a − c)(y − x)
   B. (a − c)(x − y)
   C. (a + c)(x − y)
   D. (a + c)(x + y)

11. If $\frac{p-2q}{2p+q} = \frac{2}{5}$, *find* $p:q$

A. $-9:8$
B. $-3:1$
C. $3:1$
D. $12:1$

12. Given that $x + y = 7$ and $3x - y = 5$, evaluate $\frac{y}{2} - 3$

A. -1
B. 1
C. 3
D. 4

13. Solve the inequality $2(x+3) - 3(x-1) \leq 12$

A. $x \leq 3$
B. $x \leq -3$
C. $x \geq -3$
D. $x \geq 3$

14. If it is 12 O'clock now, what time will it be in 500hours

A. 2 O'clock
B. 5 O'clock
C. 6 O'clock
D. 8 O'clock

15. A goat is tied to a post at the centre of a square field of side 20m by a rope 10m long. Find the fraction of the field the goat is able to graze on rope (Take $\pi = \frac{22}{7}$).

A. $\frac{11}{14}$
B. $1\frac{4}{3}$
C. $85\frac{5}{7}$
D. $314\frac{2}{7}$

16. The bearing of Q from P is $122°$, what is the bearing of P from Q?

A. 212°
B. 248°
C. 292°
D. 302°

17. Each side of a regular convex polygon subtends an angle of 30° at its centre. Calculate each interior angle.
    A. 75°
    B. 150°
    C. 160°
    D. 168°

18. If p = $\binom{4}{3}$ and q = $\binom{-2}{7}$, Find 4p − 2q
    A. $\binom{12}{-2}$
    B. $\binom{12}{2}$
    C. $\binom{20}{26}$
    D. $\binom{20}{-2}$

19. The data below shows the frequency distribution of marks scored by a group of students in a class test. Find the mean mark.

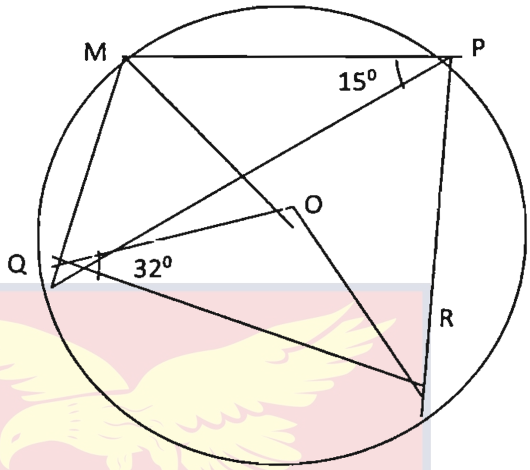
Marks	2	3	4	5	6
Frequency	2	4	5	3	1

    A. 1.3
    B. 1.5
    C. 2.7
    D. 3.8

20. The cost of8pens and 12pencils is 90Gp and the cost of 6pens and 11pencils is 70.5Gp. find the cost of a pen and a pencil.
    A. A pen is 0.09Gp and a pencil is 0.015Gp
    B. A pen is 1.9Gp and a pencil is 6.3Gp
    C. A pen is 5.1Gp and a pencil is 3.6Gp
    D. A pen is 9.0Gp and a pencil is 1.5Gp

21. A ladder 30m long rests against a vertical wall. The distance between the foot of the ladder and the wall is 8m. How far up the wall is the ladder?
    A. $2\sqrt{241}$
    B. $2\sqrt{209}$
    C. $2\sqrt{19}$
    D. $2\sqrt{11}$

22. In the diagram,Ois the centre of the circle, $< OQR = 32°$ and $< MPQ = 15°$. Calculate $< QPR$



A. 75°
B. 73°
C. 58°
D. 47°

23. From a box containing 2 red, 6 white and 5 black balls, a ball is randomly selected. What is the probability that the selected ball is black?

A. $\frac{2}{13}$
B. $\frac{5}{13}$
C. $\frac{5}{11}$
D. $\frac{5}{6}$

24. The angle of elevation of the top of a flagpole is 42° from a point P which is 100metres from the foot B of the flagpole. Q is a point on the same horizontal line BP such that $BQ = 45$metres. Calculate, correct to one decimal place, the angle of elevation of the top of the flagpole from Q.

A. 48.4°
B. 60.4°
C. 63.4°
D. 83.4°

25. Construct a quadratic equation whose roots are $-\frac{1}{2}$and2.

A. $3x^2 - 3x + 2 = 0$
B. $3x^2 + 3x - 2 = 0$
C. $2x^2 + 3x - 2 = 0$
D. $2x^2 - 3x - 2 = 0$

26. If $\sin x = \frac{12}{13}$, where $0° < x < 90°$, find the value of $1 - \cos^2 x$

A. $\frac{25}{169}$

B. $\frac{64}{169}$

C. $\frac{105}{169}$

D. $\frac{144}{169}$

27. Given that $\log_4 x = -3$, find x.

A. $\frac{1}{81}$

B. $\frac{1}{64}$

C. 64

D. 81

28. Simplify $3\sqrt{12} + 10\sqrt{3} - \frac{6}{\sqrt{3}}$

A. $7\sqrt{3}$

B. $10\sqrt{3}$

C. $14\sqrt{3}$

D. $18\sqrt{3}$

29. Given that $27^{1+x} = 9$, find x.

A. -3

B. $\frac{-1}{3}$

C. $\frac{5}{3}$

D. 2

30. If $y = 23_{five} + 101_{three}$, find y, leaving your answer in base two.

A. 1110

B. 10111

C. 11101

D. 111100

31. If x varies inversely as y and $x = \frac{2}{3}$ when $y = 9$, find the value of y when $x = \frac{3}{4}$

A. 8

B. 4

C. -4

D. -8

32. The n^{th} term of a sequence is given by $(-1)^{n-2}2^{n-1}$. Find the sum of the 2^{nd} and 3^{rd} terms.

A. -2
B. 1
C. 2
D. 6

33. $S = \{1, 2, 3, 4, 5, 6\}, T = \{2, 4, 5, 7\}$and $R = \{1, 4, 5\}$. Find $(S \cap T) \cup R$
A. $\{1, 4, 5\}$
B. $\{2, 4, 5\}$
C. $\{1, 2, 4, 5\}$
D. $\{2, 3, 4, 5\}$

34. Given that $(2x + 7)$ is a factor of $2x^2 + 3x - 14$, find the other factor.
A. $x + 2$
B. $x + 1$
C. $x - 2$
D. $2 - x$

35. *If* $y = \sqrt{ax + b}$, express x in terms of $y, a,$ *and* b.
A. $x = \frac{y^2-b}{a}$
B. $x = \frac{y+b}{a}$
C. $x = \frac{y-b}{a}$
D. $x = \frac{y^2+b}{a}$

36. Find the truth set of the inequalities $-3 \leq \frac{2}{3}(x - 1) \leq \frac{1}{2}x$
A. $\{x: -3.5 \leq x \leq 4\}$
B. $\{x: -4 \leq x \leq 4\}$
C. $\{x: -3.5 < x < 4\}$
D. $\{x: -14 < x < 4\}$

37. In a particular year, March 6th, was a Wednesday. On which day of the week is April 15th?
A. Saturday
B. Sunday
C. Monday
D. Tuesday

38. An isosceles triangle is of base $10cm$. If the equal sides are $13cm$ each, find the height of the triangle.
A. 8cm
B. $\sqrt{69}cm$
C. $12cm$

D. $\sqrt{269}cm$

39. Town P is on a bearing 315° from town Q while town R is south of town P and west of townQ. If town R is 60km away fromQ, how far is R from P?

A. 30km
B. 42km
C. 45km
D. 60km

40. If the interior angles of a hexagon are $107°, 2x°. 150°, 95°, (2x - 15)°$and 123°,find x.

A. $57\frac{1}{2}°$
B. 65°
C. 106°
D. 120°

Thanking you for your participation.