UNIVERSITY OF EDUCATION, WINNEBA

A COMPARATIVE STUDY OF SENIOR HIGH SCHOOL STUDENTS' WASSCE ACHIEVEMENT IN CORE AND ELECTIVE MATHEMATICS FROM 2016 TO 2018

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A thesis in the Department of Mathematics Education, Faculty of Science Education, submitted to the School of Graduate Studies in partial fulfilment of the requirements for the award of the degree of Master of Philosophy (Mathematics Education) in the University of Education, Winneba.

May, 2020

DECLARATION

Students' Declaration

I, ……..., declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature:…….…….

Date:…….…….

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis/dissertation/project as laid down by the University of Education, Winneba.

Prof. C. K. Assuah (Principal Supervisor)

Signature :…….……

Date:……..……

DEDICATION

I dedicate this work to the Almighty God for His protection and guidance always. It also goes to my wife, Theresah, Kids: Pomaa Owusu, Emmanuella Owusu, Godslove Amankwaa and Daniel Owiredu Owusu and finally to my Mum, Comfort Pomaa. May the good Lord bless you all.

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ABSTRACT

This study compared Senior High School Students' achievements in core and elective mathematics from 2016 to 2018. The study employed an explanatory sequential mixed method, and used a sample of three hundred and two (302) WASSCE results of past students who studied both Core and Elective Mathematics. Stratified, purposive, simple random and snowball sampling techniques were used for the research. Seventy-eight (78) past students and sixteen (16) teachers were also sampled for the study. The instruments used to collect data were questionnaire, semi-structured interview guide, and WASSCE results. The results indicated that students who offered both subjects performed better in Elective Mathematics than the Core Mathematics. It also showed that majority of students developed negative attitude to the study of Core Mathematics than the Elective Mathematics because they believed the former is superior to the latter. Co-curricular activities were found to deny students and teacher of precious instructional hours. The results also indicated that some Core Mathematics teachers skipped some important topics with the view that the Elective Mathematics teachers would teach them. The study recommended that students should be counselled to develop positive attitude towards the study of both subjects because they boosted their chances of gaining admission into tertiary institutions. Besides, school managements, heads of mathematics departments should intensify their monitoring activities so that mathematics teachers would not skip any topic. Furthermore, co-curricular activities should be planned in such a way that they would not interfere with the academic work.

CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter discusses the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, hypothesis, significance of the study, delimitations, limitations of the study, operational definition of terms, and organisation of the study.

1.2 Background to the Study

Education plays a critical role in the development of every individual. However, mathematics plays even more crucial role in the cognitive development of the individual, as well as the accelerated economic growth of a country worldwide. A country's ability to compete successfully in the global market, to a large extent, depends on the mathematical literacy of its citizens. According to Madu and Hogan-Bassey (2010), mathematics could be view as a set of concepts, facts, principles and operations that are fundamental to the existence of every individual. It is regarded as an embodiment of great and wonderful things experienced around the world. It deals with logic, shape, quantity, arrangement, and remains indispensable to any other discipline such as medicine, engineering, agriculture, teaching, or driving, among others. The position of mathematics in scientific, technological and economic development however, has rendered its teaching and learning very crucial in all nations and facets of life (Chinweoke, 2015).

Indeed, countries that have taken the trouble to inculcate mathematical thinking in their citizenry have chalked successes in their development. In other words, mathematical thinking has been seen not only as a foundation for children's

development but a cornerstone of their sustainable development (Dong, Clarke, Cao, Wang, & Seah, 2019). For example, the advancement in countries like Japan and China, among others, is a clear manifestation of the way they have over the decades paid special attention to the teaching and learning of science and mathematics. Anamuah-Mensah, Mereku and Ampiah (2009) is of the view that the utilisation of science, mathematics and technology has a correlation between improvement in productivity and wealth creation of a nation. The indispensable nature of mathematics might have motivated Cockcroft (1982) when he said "It would be very difficult – perhaps impossible – to live a normal life in many parts of the world in the twentieth century without making use of mathematics of some kind (p1)". In the same vein, it would be difficult or not possible for a person to live on the earth in the 21st century without the slightest utilization of mathematics. Those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures, since mathematical competence opens doors to productive futures. It is said that about 43% of employers report a problem recruiting staff with the right science, technology, engineering, and mathematics (STEM) skills (Sharpe, 2012).

Regardless of the important role mathematics plays in the lives of individuals and the society, it is one of the feared and hated subjects in the school curriculum. Boaler (2008) claims that most adults hate mathematics because of their bad experiences with the subject. In a survey conducted at selected schools in 2005-2007 to assess the relationship of pupils to individual subjects and the popularity of the subjects, mathematics was placed last in the ranking in terms of popularity and pupils' marks. It was also designated as the second most difficult subject. In terms of importance however, it was ranked third (Hrabal & Pavelková, 2010). This could possibly be attributed to the anxiety of learners. Furner and Gonzalez-DeHass (2011) believe

anxiety is not the sole reason but a "critical academic problem that educators should be informed of its nature as well as of its solutions" (p.231).

Just like many other countries, the importance attached to the teaching and learning of mathematics cannot be underestimated in Ghana. The Government recognizes mathematics as one of the pillars for national development (Ghana Ministry of Education, 2014). It is said that Ghana spends a higher proportion of its total budget and Gross Domestic Product (GDP) on education than any of the other 13 Economic Community of West African State (ECOWAS) countries (World Bank, 2017). Realizing the importance of mathematics, the educational planners have instituted policies which among other things, ensure mathematics becomes a compulsory subject at the basic and secondary levels of education. For instance, mathematics has been placed on all basic schools' timetable from Monday to Friday to ensure that children attain an understanding of the nature of it in relation to everyday activities of life (Adenegan, 2003). It has also been made part of the requirements for the qualification to secondary institutions after basic school. Thus, all final year students who sit for the Basic Education Certificate Examination (BECE), organised by the West African Examinations Council (WAEC), have to pass mathematics before they proceed to do further studies at the secondary level. Mathematics is also made a requirement for entry into a tertiary institution after secondary education in Ghana. In other words, a student who sits for the West African Senior School Certificate Examinations (WASSCE), has to obtain at least Grade C6 to pursue a tertiary education programme. In effect, mathematics is used as a sieving mechanism to determine the progression of a student from basic to secondary and secondary to tertiary respectively. This helps to ensure that students are helped in their future lives to develop skills valued in industry and university (Ofsted, 2011).

With the importance Ghana attaches to the teaching and learning of mathematics, it comes as no surprise that various attempts have been made by past and present governments, non-governmental organizations as well as individuals to incessantly continue to adopt better strategies to make the teaching and learning of mathematics attractive to improve students' overall achievements (Ampadu, 2012). For instance, the Quality Improvement in Primary Schools (QUIPS) was introduced by the United Nations International Children's Emergency Fund (UNICEF) to improve on the quality of children's reading, writing and numeracy skills in Ghana (Akyeampong, 2004). The Colleges of Education were upgraded to award diplomas and degrees, and were to ensure that teaching and learning at the basic school reflect on modern trends of education. Also, the incumbent and the past governments provided various avenues to sharpen the knowledge and skills of serving teachers. Mathematics, Science and Technology Scholarship Scheme (MASTESS), and Secondary Education Improvement Project (SEIP). Also among the interventions are the distance education programmes in the various universities of Ghana, and Mathematics Clinics organised at the local, regional and national levels have equipped teachers with the modern way of teaching and learning mathematics. In fact, the training of one thousand mathematics and science teachers throughout the 10 regions of Ghana, which emerged from the Mathematics and Science Committee set-up by the Minister of Education as a fall out of the recommendations from the Anamuah-Mensah Education Committee in 2007 is worth mentioning. Besides, the National Science and Mathematics Quiz Competition which is organized by the Ghana Education Service in collaboration with other sponsors on yearly basis at the Senior High School level are geared towards promoting the teaching and learning of mathematics. The 2019 National Science and Mathematics Quiz

competition attracted many sponsors than ever, with a majority of the quarter-final and subsequent contests televised live on the national television.

With interventions by the Government and other stakeholders, one would have expected that achievement in mathematics, particularly at the basic and secondary levels would improve. However, the case is to the contrary as exemplified by the results obtained in mathematics by students on yearly basis. For example, Ghana was ranked 45th out of 46 countries in 2003, 58th out of 59 countries in 2007 (Ministry of Education, 2008), and last out of 63 countries in 2011 on Trends in International Mathematics and Science Study (TIMSS) (Mullis, Martin, Foy, & Arora, 2012). Eventually, a number of these students who are unable to make it to the Senior High School and Tertiary Institutions respectively, join the band of unemployed and unskilled youth. This state of affairs has become a big bother to parents, education stakeholders and Ghana as a whole.

At the SHS, mathematics is divided into core and elective. As said earlier, the Core is compulsory for all students, and is made to provide a broad and balanced mathematical knowledge and skills needed for life in the rapidly changing information rich era. The elective mathematics on the other hand, forms part of elective subject such as General Arts, Business, Agricultural Science, Technical and General Science. It is designed for students who may need more mathematical skills for their future careers, and those whose interests and maturity are developed to a level that would enable them benefit from more mathematical study in different areas (Ministry of Education, 2010b). The least grade needed for tertiary education is C6 in WASSCE. Even though, a failure in elective mathematics may not count very much if the other elective grades are strong, these are programmes one cannot pursue at the tertiary level if the elective mathematics is not good. For example, a student seeking to pursue Economics,

Geography and Architecture, among others required a good grade in elective mathematics to be able to pursue some programmes. Thus, a credit in Elective Mathematics widens the scope of courses a student can pursue at the tertiary level.

Whichever type of mathematics a student studies, be it core or elective, there is the general perception that they are both difficult. However, one would expect that because the elective mathematics is an advanced one, and also built on the core, the achievement of core would be far better than the elective. Unfortunately, there is the general perception that students perform better in the elective than the core. As to whether this perception is true or otherwise, there has not been any empirical study to ascertain its veracity. Hence, the researcher decided to find out whether indeed students perform better in elective mathematics than the core using the results of past students who studied both subjects at the WASSCE.

1.3 Statement of the Problem

The West African Examination Council (WAEC) and major stakeholders of education continue to express worry about students' achievement in general, particularly in Science and Mathematics. According to Olunloye (2010), there is an unacceptable trend of high failure rates in students' WASSCE results and described it as a national disaster. Evidence by WAEC Ghana shows a downward trend in the results of Science and Mathematics over the years. According to WAEC (2018), 43.8 percent of candidates who took part in core mathematics in 2011 passed. In 2012, the figure went up a bit to 49.4 percent and then dropped to 36.6 percent in 2013. In 2014, the achievement dropped to 32.4 percent, and further went down to 24.2 percent in 2015. Though the achievement moved slightly up in 2016 to 32.83 percent and 42.73 percent in 2017, the performance could not be sustained. From WAEC, out of the number which sat for Core

mathematics in 2018, 38.33 percent obtained grades A1-C6, while 30.09 percent obtained weak passes (D7-E8), and 31.58 registering F9 (WASSCE) respectively.

The achievement of students offering Elective Mathematics from 2007 to 2014 also experienced upward and downward trends. In 2007, the percentage pass from A1 to C6 was 36.5 leaving that of D7 to F9 at 63.5. In 2008, the percentage pass dropped to 35.7 indicating a difference of 0.8. The 35.7 percent was retained in 2009. Though impressive achievements were recorded in 2011, with a percentage pass of 68.1 and 75.2 in 2012 respectively, the achievement dropped to 47.0 in 2013. This shocking achievement did not end there but further continued to the lowest ebb at 20.5 percent in 2014.

The conclusion one may draw from the above scenarios is that majority of the SHS graduates cannot gain admission into tertiary institutions, considering the fact that one needs at least grade C6 in Core mathematics to compete favourably in the admission process. It is a fact that from the SHS level upwards, admissions are based purely on academic merit using applicants' grades from either one or two sittings. Applicants to universities compete for admission in the various academic programmes taking inspiration from the available vacancies. The cut-off grade point keeps on changing from year to year as a result of the variations in the number of students who complete Senior High School and the changes in number of candidates who apply. For an applicant to gain admission, he or she ought to obtain Grade A1-C6 (WASSCE) or A-D (SSSCE) in three core subjects including Core Mathematics, in addition to credit in three elective subjects to pass the basic entry requirement for an undergraduate programme.

In fact, the proliferation of remedial schools and classes in the country is enough evidence to support the above claim. A study by Bosson-Amedenu (2018) on remedial

students' perception of difficult concepts in Senior High School Core Mathematics Curriculum in Ghana found out that topics including Ratio and Proportion, Circle Theorem, Similar Triangles, Plane Geometry, Trigonometry and Bearing, Logarithms, Mensuration, Business Mathematics, Sequence and Series and Coordinate Geometry were the most difficult. It was further noted that a majority of students failed to answer questions on these topics and always leave the answer booklets empty. Indeed, for a majority of students, mathematics is a thorn in their flesh which those who manage to pass often refer to it as scary and difficult to pass. Mathematics is a subject which students often dislike or fear at all levels of life, and according to Sam (2002), many students are scared of it and feel powerless in the presence of mathematical ideas. These students regarded mathematics as "difficult, cold, abstract, and in many cultures, largely masculine" (p.15). Sarfo and Adusei (2016) indicated that there is an increasing mathematics anxiety among students in Ghana which continue to influence achievements in both Core and Elective Mathematics. It must be emphasized that some of the elective mathematics topics are built on the core, and expectedly supposed to be more difficult than the core. However, there is the general perception that students perform better in the elective mathematics than the core. A comparative study of this nature would be of help to either confirm or disapprove this perception. It would also be in the position to bridge any perceived gap between students' achievements in both subjects. Since there has not been any empirical study to compare students' achievements in both elective and core mathematics, schools have been left without any document to serve as a guide to direct students, teachers, parents, Mathematics Departments in their decision making, and the government as well.

1.4 Purpose of the Study

The purpose of this study was in twofold: (a) to compare students' achievement in core and elective mathematics, and (b) to identify reasons that account for the differences if any, in order to serve as a guide for policy makers, parents, teachers and students in their quest to raise the standard of mathematics achievements in general.

1.5 Objectives of the Study

The following objectives guided the study:

1. To assess the trend of students WASSCE results in Core and Elective Mathematics.
2. Identify whether there are differences in students' achievements in Core and Elective Mathematics.
3. To find out the factors that account for students' achievements in both Core and Elective Mathematics.

1.6 Research Questions

The study sought to answer the following research questions:

1 What is the trend of students WASSCE results in Core and Elective Mathematics?

2 Are there differences in the achievements of students in Core and Elective Mathematics?

3 What factors account for achievement in both Core and Elective Mathematics?

1.7 Hypothesis

This study hypothesised that:

There is no significant difference between students' achievement in core mathematics and elective mathematics.

1.8 Significance of the Study

1.8.1 Significance to Student

This study will enable students draw connection between their achievement in core and elective mathematics. This would help them to know from the scratch which of the two subjects they need to invest their resources, time and attention. The study would also benefit students to disabuse their minds from the negative attitudes toward the learning of any of the subjects. The study would bring to light the challenges or factors that impede the learning of mathematics and how to overcome them.

1.8.2 *Significance to the teachers*

The study would significantly inform teachers about the trend of students' achievement in the two subjects and therefore be informed about which one to pay much attention to. The study would also reflect the achievement of teachers in the classroom and based on that come out with strategies which would help to improve on their shortcomings and attainments of students.

1.8.3 Significance to the administrators

The study would guide the school administrators with the allocation of teachers in terms of settling on the choice between allowing the same teachers to handle both core and elective mathematics as practiced by some schools or choosing different teachers for each of the subjects. The schools' management would be greatly informed about the progress of students, the actual picture of what happen in mathematics classroom during mathematics lessons in order to help them adopt the right monitoring strategies and counselling services.

1.8.4 Significance to the Stakeholders

This study in the first place would add to the volume of the existing literature. The study would be important to the Ghana Education Service because it would give a true picture of the teaching and learning and achievements of students in core and elective mathematics and therefore set its priority right. The study would also be very beneficial to parents and guardians in their quest to find solutions to the problems their wards are confronted with and how to help them. It would clarify the notion or the misconception that students who offer both subjects usually perform better in elective mathematics than core mathematics. They would be highly informed about where to pay much attention to, in terms of provision of books, extra tuition for their wards.

1.9. Delimitation

The scope of the study was delimited to students who study both Core and Elective Mathematics in Tepa Senior High School at the Ashanti Region, Ghana. Tepa Senior High School was selected because of its high achievement in terms of WAEC rankings in the region. The school was adjudged the best in the region for two consecutive times, and therefore, could serve as a suitable place for the study. The study was also delimited to the mathematics teachers in the selected school because of easy access to them. Though the study could have captured students' WASSCE results from the inception of the school, because of limited resources and time constraints the researcher decided to limit it to the WASSCE results of students who completed 2016 to 2018.

1.10 Limitations of the Study

Collecting data from past students scattered all over the length and breadth of Ghana turned out to be tedious and time demanding. In line with this study, it took some

months before sizeable data could be accessed from past students who were residing in various villages, towns and cities across the country. This required financial resources to make the study successful. The various finding of this study depended much on the information given by the respondents; hence the validity of the information relied on them. Also the whole process of accessing students' grades and their recording was really cumbersome. This required sorting those who studied core and elective from the broadsheet. Again, the face to face interview with the teachers presented some problems as some of the teachers were contacted on several occasions before they could finally make time for it. Another challenge was the cost involved in the printing and returning of questionnaires through the snail mail.

1.11 Operational Definition of Terms

It is important to clarify the following terms that were used frequently in the study:

Mathematics achievement: In this study, mathematics achievements refers to how students are able to cope with their academic tasks given to them by their teachers and also how they excel in their external examinations they write.

Senior High School: Senior High School in Ghana is the pre-tertiary education which takes students three years to complete after their basic education.

Basic Education Certificate Examination: It refers to the Basic Education Certificate Examination students who complete Junior High Schools write. This kind of examination determines whether a student could progress to the senior high level.

West African Senior High School Examination. This refers to the examination taken by students after completing three years senior high education programme.

*Free Compulsory Basic Education***.** This is an educational policy in Ghana which allows all children at school going age to attend school freely without any cost. This implies that government takes care of everything.

Ghana Education Service: This is a state institution in charge of the introduction and implementation of educational policies in Ghana

*MOE***:** Ministry of Education

*Curriculum***:** A is a series of principles introduced into the schools to correct students in ways of thinking and acting whether it is carried out in groups or individually, inside or outside the school.

SPSS: Statistical Package for the Social Sciences

STEM: Science, Technology, Engineering, and Mathematics

TIMSS: Trends in International Mathematics and Science Studies

ELM: Early Learning in Mathematics

UNICEF: United Nations International Children's Emergency Fund

QUIPS: Quality Improvement in Primary Schools (QUIPS)

ECOWAS: Economic Community of West African States

PTAs: Parents Teacher Associations (PTAs)

IWBs: Interactive White Boards

SHS: Senior High School

OECD: Organisation for Economic Co-operation and Development

1.12 Organization of the Study

The study has been organised into five (5) chapters. Chapter One deals with the background of the study, Statement of the problem, purpose of the study, objectives of the study, research questions, hypothesis, significance of the study, delimitations of the

study, limitations of the study and organisation of the study. Chapter Two covers the literature review which were reviewed on the concept of McClelland's Achievement Motivation Theory, what core mathematics are about, what elective mathematics is about, the effect of Elective Mathematics on other science subjects, WAEC as an examining body, instructional time and WASSCE achievement, relationship between students BECE and WASSCE mathematics achievement, student factor on mathematics achievement, teacher factor on mathematics achievement, school factor on students' mathematics achievements. Chapter Three focuses on the methodology which includes: research design, the study area, the population for the study, sampling and sample technique used for the study, pilot study, instrument for data collection, validity of instrument, reliability of instruments, data collection procedure and data analysis procedure. Chapter Four is on the presentation and discussion of the results. Finally, Chapter Five covers the summary of the findings, conclusions, recommendations of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This section looks at the related literature from books, internet, journals, articles and periodicals. It highlights theories that would help analyse issues that may come out of the study. This was done under the following themes: theoretical framework, what is core mathematics about, what is elective mathematics about, Effects of Elective Mathematics on other science subjects, WAEC as an examining body, instructional time and WASSCE achievement, relationship between students BECE and WASSCE mathematic achievement, student factor on mathematics achievement, teacher factor on mathematics achievement, school factor on students' mathematics achievements, school factor on students' mathematics achievements.

2.2 Theoretical Framework

The theoretical framework for this study was rooted in McClelland's Achievement Motivation Theory (McClelland, 1958), which postulates that people are motivated in varying degrees by their need for Achievement, need for Power and need for Affiliation. These needs are acquired or learned during the individual's lifetime (Draft, 2008). According to Biegge and Hunt (1980), Achievement Motivation is defined as the drive to work with diligence and vitality, constant steering toward targets, obtaining dominance in challenging and difficult tasks and creating a sense of achievement as a result. Thus, if students expect to achieve excellence in their studies, they will probably be more motivated to go the extra mile to achieve the set objectives. Motivation becomes a key ingredient in performance and productivity, given that a motivated

student is willing to exert a particular level of effort for a certain amount of time toward the achievement of a particular goal and efficiency.

Two distinct types of academic motivation can be mentioned in most academic settings. These are intrinsic and extrinsic motivation. Intrinsic motivation is the drive or desire to engage in learning for its own sake. Students engage in academic tasks because they enjoy them, feel that learning is important with respect to their self-images, and seek out learning activities for the sheer joy of learning (Middleton, 1993). When students enjoy certain subjects, they are more likely to freely engage in them via the experience of intrinsic motivation (Deci, Vallerand, Pelletier, & Ryan, 1991). Intrinsic motivation has also been linked with greater academic performance, learning, understanding, and memory (Deci et al., 1991). This suggests that when a student enjoys a particular subject, that student is not only more likely to choose it, but may actually find it less difficult, because they are better able to learn and engage with the materials present in that course. Students tend to focus on learning goals such as understanding and mastery of concepts (Ames & Archer, 1988; Duda & Nicholls, 1992; Dweck, 1986).

The extrinsically motivated students engage in academic tasks to obtain rewards like good grades and approval or avoid punishment such as bad grades and disapproval. When students see themselves as capable of doing well in a subject they tend to value it more than their counterparts who do not see themselves as capable of doing well (Eccles, Wigfield, & Reuman, 1987; Midgley, Feldlaufer, & Eccles, 1989). Slavin (2006) learned that motivation is what gets one moving, keeps one going, and determines the final destination of an individual.

Generally speaking, achievement motivation consists of a collection of beliefs which influences patterns of school achievement, such as the expectations and

standards for achievement, how learning is valued, and self-perceptions of ability (Deci & Ryan, 1985; Dweck, 2006). Achievement-related beliefs are considered to be highly influenced by the ways students understand or make meaning from their educational experiences. Some school-related experiences may include feedback from parents and teachers, motivational and affective responses to success and failure, and placement within school structures such as ability grouping. Importantly, student's achievement beliefs significantly affect their achievement-related behaviour. For example, students who consider ability to be fixed tend to avoid challenging tasks than those who view ability as flexible (Dweck, 2006). Students are bound to wake up and burn the mid night oil when they are aware of the task ahead. Achievement motivation rekindles the desire of individuals to achieve the goals set up. Rosenthal and Jacobsen (1968) found that the expectations of teachers are self-fulfilling prophecy and to some extent, could influence the level of students' achievement. Dörnyei (2001) is of the view that when a teacher is motivated to teach, it inspires his or her students to become motivated to learn. Dörnyei (2001) further indicated that teachers' values, beliefs, attitudes and behaviour, as well as the general level of commitment towards students learning and the subject matter, constitute some of the most prevailing influences on student motivation.

Knowledge of achievement motivation theory is useful to this study since one of the two subjects being compared is generally considered to be more difficult than the other. The theory is obviously important to school management, teachers and students as it shares light on how academic work or activity can be improved. The theory provides parents, teachers and students with a scale of preference from which they can make choices. With the achievement motivation theory, parents who want their wards to attain excellence in either core mathematics or elective mathematics can do so through the provision of right form of motivation. With the theory in mind, no student

could be discouraged from taking up any of the two subjects, despite the perception people may have about them. The achievement motivation can be introduced by parents through provision of textbooks, calculators and even financial support for extra tuitions. Teachers in the same vein can influence the fortunes of students in a subject area when they also adopt the right form of motivation. For example, a core mathematics teacher can apply the theory to encourage students to do better in core mathematics while elective mathematics teacher can also apply same for students to perform better in elective mathematics despite tagging it as difficult. With both intrinsic and extrinsic forms of motivation, students can work diligently to attain excellence in the subject they wish to study.

2.3 Core Mathematics

Core Mathematics is a subject designed for students who gain admission into any of the senior high schools in Ghana. It is designed to help students' develop to the extent that they can use the skills acquire to solve real life problems (Ministry of Education, 2010). Core Mathematics is one of the four core compulsory subjects that a candidate is expected to pass (A1-C6) in addition to three other elective subjects to enable one qualify to pursue tertiary education (Bossom-Amedenu, 2017). Indeed, time has changed and the survival of nations in this technologically driven society no longer resides in education which focuses on 'chew, pour, pass, and forget', but rather education that focuses on learners who are capable of using the problem solving skills to solve societal problems as and when they emerge. Mathematics curriculum has been structured to assume the core status for all Senior High School students (Ministry of Education, 2010). In the course of learning and attending to mathematics questions, students generally learn ways and means of solving problems. Problem solving is

simply what individuals engage themselves in where the solution is not expected immediately. Core mathematics as a subject has been designed to help students develop and build approach of solving mathematics problems by means of developing students' capabilities in formulating and representing problems in various ways, making use of a wide range of problem-solving strategies, and also continuously monitor students' mathematical thinking in solving problems. Exposure to problems become the channel through which students develop mathematical understandings, apply skills in different situations, and find a generalized form of learning (Ministry of Education, 2010). When students are exposed to diverse forms of mathematical problems, especially in cooperative groups, they are positioned well to create their own problems and solve them.

Reasoning skills Development: It is anticipated that students will develop the habit of learning to reason and come out with proofs as necessary and powerful aspects of understanding and using mathematics. The various procedures involved in making and investigating inferences, developing and drawing conclusions to arguments, and relating various types of reasoning and methods of proof. Reasoning skills are really important for many areas of study such as science, social studies, social skills, literature, and most other areas of study. Students who are mathematically inclined translate the reasoning skills in many spheres of life (Ministry of Education, 2010).

Skills in Communication: Communicative skills go hand in hand with the learning of mathematics. The development of communicative skills is considered as an integral part of mathematics activities. Students who have control over mathematical concepts are expected to comprehend and use the language of mathematics in areas including listening, speaking, reading, and writing. Mathematics communication involves the use of special vocabulary and new symbol systems, and serves as a tool

for organization and thinking. Students and teachers more often, are "talking about mathematics" in their day to day conversation. Different forms of mathematical assessment usually expect students to explain their thoughts or opinions and to put the way they solve problems in writing (Ministry of Education, 2010).

Although, some mathematicians and mathematics teachers have in-depth understanding of mathematics concepts, yet they struggle with communication skills. They have difficulty with conveying concepts on a level other will understand, or efficiently use communication devices such as analogies and illustrations. Skills in Communication must be demonstrated with a full range of curriculum applications.

Connection making: Relating mathematics to other situations in the long round fosters deeper mathematics understanding and assists its learning. Students are expected to develop the habit of making connections among different mathematics topics, across other content and skill areas, and into the "real" world. When teachers are introducing new concepts, it is necessary that they help students in making connections with the concepts students previously learned and understood. Making connections with the already attained knowledge lead to more efficient and generalizable learning. Students after attaining concepts should be in the better positions to use the conceptual image across all mathematics topics. Forming conceptual image and representation assist with organization, recording, communication, modelling, predicting, and interpreting mathematical ideas and situations. Some of the representations used in mathematics include graphs, diagrams, charts, three-dimensional models, computer-generated models, and symbol systems. The inclusion of some topics like Algebra, Geometry, among others, in mathematics support courses such as A-level Psychology, Sciences and Geography as well as technical and vocational qualifications.

2.4 Elective Mathematics

Elective Mathematics is one of the subjects offered in the West African Senior School Certificate Examination (WASSCE) in English speaking West African countries. In some jurisdictions it is called Further Mathematics. Elective Mathematics exposes students to more concepts of Core Mathematics and serves as a requirement or foundation to embark on professional studies in engineering, scientific research, and a number of studies in tertiary and other institutions of higher learning (Ministry of Education, 2010; Darlington, 2015). It endows students with the ability to read, analyse and perform calculations based on the three fundamental skills that are vital for living and working in life (Ministry of Education, 2010). Thus, it deals with reasoning by correlations, making judgments through discrimination of values, analysis of data, and communication of one's thoughts through symbolic expression and graphs (Ministry of Education, 2010).

General Aims of Elective Mathematics: The elective mathematics syllabus has been structured to help students appreciate and consider mathematics as a tool for analysis, high development of critical and effective thinking, identify the formation of order, patterns and relations. Elective mathematics assists the communication of students thought by making use of symbolic expressions and graphs. The study of elective mathematics enables students to improve on their mathematical capabilities which are beneficial in commerce, trade and public service, make effective use of ICT in problem solving and investigation of real life situations.

Scope of Elective Mathematics Content*:* Students who study elective mathematics are made to learn the following content areas: Coordinate Geometry, Algebra, Statistics and Probability, Calculus, Vectors and Mechanics, Matrices and Transformation. In Ghana, the Science, Technology and Mathematics Education

(STME) clinic has become an annual formality. It is organized to unearth the reasons for students' low participation in STME and to further solve problems of girls associated with the learning of the subjects. Despite these consistent efforts and the relevance of mathematics, girls' willingness to the study of elective mathematics at the Secondary School level has been very challenging. A research conducted by Baah-Korang, Gyan, and McCarthy (2013) to find out the difference between male and female students' involvement in the study of elective mathematics at SHS level skewed toward the male. Some female respondents who were interviewed during the research to ascertain why they got attracted to elective mathematics gave reasons such as the support and persistent encouragement they received from parents; feared elective mathematics was difficult and therefore needed not to waste their time and energy studying it. The research further established that financial status was a factor that could highly influence female students' decision to engage in the study of elective mathematics at the SHS (Baah-Korang et al., 2013).

2.5 Effects of Elective Mathematics on other subjects

The relationship between mathematics ability and subsequent performance in other science subjects has been investigated in the Organisation for Economic Co-operation and Development (OECD) countries (Ballard & Johnson 2004; Hoag & Benedict, 2010; Lagerlöf & Seltzer, 2008; Olatoye, 2007; Oluwatusin & Dele-Rotimi, 2017). A study in Nigeria to examine the effect of further mathematics curriculum on students' performance in science-based subjects (Mathematics, Biology, Chemistry and Physics) affirmed that students who studied further mathematics in addition to other science subjects significantly performed better than their counterparts who did not study further mathematics in the senior secondary certificate examination (Oluwatusin and Dele-

Rotimi, 2017). According to the study, ex-post-facto research design was adopted and this involved the collection of information from records of selected secondary school using stratified random sampling technique. An inventory was used for data collection and analysed using descriptive statistics (mean and standard deviation) and inferential statistics (t-test and correlation) at 0.05 level of significance. There was a significant difference between students who studied further mathematics as against their counterparts who did not study further mathematics overall achievement in Biology, Chemistry and Physics. In other words, there was positive and significant relationship between each of the subjects (Biology, Chemistry and Physics) and other science subjects. The authors recommended that Mathematics teachers should be encouraged to teach further mathematics in the school in order to develop students' scientific skills right from secondary schools. It was also recommended that Further Mathematics, if possible, should be made compulsory for both science and commercial students in secondary schools as majority of them will still take up a related course in further mathematics when they get to tertiary institution.

Hoag and Benedict (2010) believe that gaining maturity and understanding in mathematics helps students to become better overall learners in life. It therefore comes as no surprise that many institutions require a sufficient knowledge in elective mathematics to pursue some of their programmes. A study by Yusif (2015) to investigate the effect of elective mathematics on economics (major) at the KNUST found a correlation between the two. The study used two cohorts of students who entered KNUST in 2009/2010 and 2010/2011 academic years. Ordered probit was fitted to individual data collected from 334 respondents (142 females and 192 males) who graduated in June, 2013 and June 2014 respectively. It was found that the performance in mathematics related courses in the first year and cumulative weighted average at the

end of year one had a significant and direct influence on the performance of students in subsequent years. The findings confirmed that mathematical ability both at the SHS level and in the university is positively correlated with overall performance in university economics. In other words, it would be difficult to study economics at the tertiary or higher institutions without a good grounding in mathematics.

2.6 WAEC as an Examining Body

Fagbamiye (1998) defined examination as a tool used for determining and adjudging the standard of education in any country. Uduh (2009) on the other hand described examination as the process of investigating how much of the objectives of specific tasks a learner has well-read and understood. Examinations could be the one which is conducted internally or the one externally conducted. Internal examination refers to the type of examination organized by schools by means of teacher-designed tests. Such examinations could be organized on weekly, termly or end of the school's academic calendar. External examination refers to those which are developed and organized by external bodies. The only external examination body in Ghana is the West African Examinations Council (WAEC).

According to Antoh (2018), the West African Examination Council (WAEC) was established after G.B. Jeffery report of March 1950 following the continuous request and agitation for a local body to carry out what the University of Cambridge Local Examinations Syndicate and the University of London School Examinations Matriculations Council previously had done in the colonies. It was then realised that the body had been confronted with different cases such as over-emphasis of examinations and certification in Ghana, poverty, fear, and the examination

malpractices. As a result of the various challenges, the formation of WAEC was eminent.

2.7 Instructional Time and Students Mathematics Achievement

One of the important assets of every system, institution is time and remains indispensable and vital educational resource in Ghana. Managing instructional time for mathematics teaching remains essential ingredient in keeping up with the entire academic duration. It has been debated that the three years' duration for entire senior high education is insufficient and therefore requires a one-year extension. The advocators for such extension are of the view that it will help the majority of students to progress as expected if the students get ample time to correct deficiencies from the basic level as well as cover the SHS curriculum. Mathematics achievement could be enhanced by increasing the short mathematics instruction periods (Bawuah, Sare, & Yelviel-Dong, 2014).

According to Agabi (2010), "time is a resource that is highly limited in supply and critical to education, but often taken for granted by the providers of educational resources (p.99)." The sad thing as noted by him is that least attention is usually apportioned to it which is not peculiar to schools including private and public institutions. The greatest among all those who are culpable are the major stakeholders in education. Time has and will continue to be the pivot around which all school activities evolve. The number of hours allocated for the teaching and learning of a subject in a school has been found to influence greatly on the total achievement of students.

Amanyi, Owuba, and Adjabui (2013) realized that there is the need to increase time allocated for teaching and learning of Elective mathematics since the actual

duration for teaching the subject was not enough. They further noticed that teachers as a matter of fact have different rates and approaches of relaying information in a given duration. Since the treatment duration was found not to be enough, majority of teachers who teach in the various senior high schools in Ghana were compelled to cover up to certain areas in the subject before WASSCE. Duration of SHS is a determinant of students' achievement in WASSCE as confirmed by Akaboha and Kwofie (2016). Another factor also highlighted was the number of years spent by a student in school which to a large extent influences his or her academics. It became known that when the duration is lengthy, students get enough time to prepare for their exams but when the duration is too short, inadequate preparation becomes inevitable and influence the final achievement. Teachers on the other hand become inefficient as they hardly get ample time to complete the syllabus in the phase of the duration being too short. Teaching and learning therefore, turn out to be hasty and shoddy.

Furthermore, a comparative study that focused on finding the trend of students' achievement in mathematics indicated that there was a continuous increase in population of students that sat for WASSCE in general mathematics as time progressed (Nduka & Zalmon, 2017). Time is considered as a factor in the achievement level of students in an external examination. Despite the various views many researchers (Agabi, 2010; Kelly, 2002; Wang, Kao, Huan, & Wu, 2011) share on time and its role, Acquaye (2010) believes that the low achievement of students in the senior high schools theoretically starts from the primary school through to junior high school to senior high school. He claims that the problem arises from a complex of internal and external factors which could be solved within the right environment (curriculum, teacher and infrastructure) as exhibited in some schools in this country and has no connection with the nature of WAEC questions.

Musa and Dauda (2014) who also did a trend analyses of students' mathematics achievement in WASSCE realized that the achievements of students in mathematics do not follow a particular pattern. Musa and Dauda (2014) also recognized a consistent abysmal achievement of students in mathematics over the years with the results indicating that half of students had failed in mathematics. This could have a telling effect on the Nigeria vision 2020 and concluded could remain as mirage until measures had been put in place to improve mathematics achievements. Mireku, Okpoti, Addo, Mereku, and Oteng (2014) discovered that the number of boys who sat for elective mathematics in WASSCE was more than twice the number of girls in 2012. Despite the fact that more boys took part in the examination than girls, their study revealed that more girls failed in the elective mathematics than boys in the year. The outcome of the study also showed that once more boys wrote mathematics than girls wrote the examination obviously suggests that there are more boys in school than girls. Amazingly, the number of girls who failed in Core Mathematics exceeded that of the boys who obtained fail in the subject. A study carried out by Bosson-Amedenu (2018) used four classes made up of two core mathematics WASSCE private candidates' and two regular core mathematics WASSCE candidates'. In each class, experimental and a control group were formed. Out of the six classes of the final year students four classes were selected as they were given the same test (pre-test which was their mock examination). Core Mathematics WASSCE was selected as the post-test for both private and regular candidates. Among the findings was that private candidates taught with the WAEC syllabus did far better than their counterparts who were taught with the traditional GES syllabus. It was also revealed that the continuing candidates who were taught with the WAEC syllabus also did far better than their counterparts who were

taught with the GES syllabus. Again, 91% of the mathematics teachers were found not to be aware of the existence of the WAEC syllabus.

2.8 Effects of BECE results on WASSCE Mathematics Achievement

Some studies (Akaboha & Kwofie, 2016; Ntim, 2010) have shown that the grades of students in BECE is a determinant of their achievement in their senior high education and by extension exhibit high achievement in WASSCE. Students take great inspiration from the subjects they performed excellently in and try to maintain such high standard of achievement. One of such studies is the one conducted by Akaboha and Kwofie (2016). They discovered that the grade students obtained in BECE mathematics was a determinant or predicting factor of how students actually perform in the WASSCE. They presented as a matter of fact that students who entered senior high school with high grades in mathematics eventually excelled in the subject as compared to their counterparts who entered with low grades. The grades of students in BECE is a motivating factor for them to excel in the WASSCE. Students are motivated enough to replicate such BECE achievement in their subsequent examinations (WASSCE). Students who learned basis of the mathematics well at initial stages in life only build on those basics to become high achievers.

2.9 Student Factor on Mathematics Achievement

To put this study in context, this section of the review looks at student factors that affect mathematics achievement especially at the SHS level. Among these are attitude, anxiety, motivation, and sex differences (Abotowuro, 2015; Asante, 2010; Oluwole, 2016; Salifu, Nyamekye & Issahaku, 2017; Yara, 2009) as discussed.

2.9.1 Effects of Students Attitude on Mathematics Achievement

Individual attitudes toward the learning of mathematics play an important role in the determination of mathematical achievement. Attitude is a long term change that occurs to individuals through experiences one gains in life (Mohd, Mahmood, & Ismail, 2011). Learning forms part of the changes that occur in life. In the same way are attitudes formed from previous encounters and reflections as people continue to learn. Efforts have been made by social psychologists to explain how people form attitudes using three major learning theories. The theories according to Ntim (2010) are classical conditioning, operant conditioning and observational learning.

Classical Conditioning as advocated by Pavlov (1927), refers to a process in which an individual (learner) becomes familiar with a particular phenomenon due to his or her excessive exposure to that occurrence for a long time. This theory lays emphasis on the fact that continuous exposure to the attitude object changes the original attitude of the person. According to Linero and Hinojosa (2012), people are more likely to develop positive attitude towards an 'attitude object' they are frequently exposed to than one they are not exposed to. The second way an attitude of an individual changes is through the theory of operant conditioning which was propounded by Skinner (1974). It is a learning theory which states that learners' attitude and behaviour are conditioned by stimulus – thus reinforcement and punishment. The theory explains that any attitude which is followed by a positive response is more liable to be repeated – and Skinner describes this as a reinforcement. On the other hand, any behaviour or attitude which is always followed by a negative response is not liable to be repeated again. This act according to Skinner is known as a punishment (Ntim, 2010).

Observational Learning is a form of learning theory advocated by Bandura (1997). The theory postulates that behavioural or attitudinal change results from what

individuals watch or observe other people around them do, especially people individuals have keen interest in whatever they do, appreciate, or revere. According to the observational learning theory, students or learners' behaviours and attitudes are formed because of what they see around them. Since teachers, school authorities and parents are invariably considered as role models for their students and children, it happens that the attitudes and behaviours of teachers and parents are imitated by the learners (Yara, 2009). For instance, if a teacher who teaches a student always shows some form of mastery over what he or she teaches, the students s/he teaches also tend to learn without showing any sign of fear. But if a teacher who lacks confidence teaches a student, it results in the student, lacking of confidence in his or her learning.

Attitude formation is not peculiar to the high levels of education only but also experienced at the initial stages of education too. Salifu, Nyamekye and Issahaku (2017) learned that teachers' beliefs, attitudes, knowledge, professionalism, demeanour and personality were the major contributory factors to female students' negative attitudes towards mathematics at the Junior High School level in Ghana. The study revealed that the environment of the school (both in and outside the classroom), influence of friends, the home and the family of the female student, as well as socio-cultural beliefs such as gender stereotyping and gender roles have great influence on the attitude formation of students towards mathematics.

Some studies (Eshun, 2000; Yara, 2009) at the senior high level have brought to light the essence of paying attention to students' attitude towards mathematics. Lawsha and Waheed (2011) acknowledge that the development of positive attitude towards mathematics places an individual on the high levels of achievement. They noticed that gender difference had a trivial effect on students' attitude formation toward mathematics. Addae and Agyei (2018) with a study which reflects on high school

students' attitudes towards the learning of mathematics and how the students perceived teachers' teaching practice, found that students had a strong interest in doing mathematics and perceived the study of the subject to be extremely useful to their programmes of study. The application of the mathematical concepts in the other areas of students' programme of study generated and augmented their confidence in doing mathematics. Abotowuro (2015) in his quest to investigate about the perceived difficulties of senior high school students in elective mathematic, found that there is no association between gender and students' perceived difficulties in mathematics. He further noticed that students' perception towards Elective Mathematics was not caused by the type of students' programme of study. It does not matter whether a student is an Arts student, Business student or General science student, how a General science student perceived elective mathematics did not differ from how a Business or General Arts student perceive it. In terms of ethnicity, he found that a students' ethnic background was determinant for his or her perception about Elective Mathematics. Finally, he found also a strong association between educational background of a students' parents and their perceived difficulties in Elective mathematics.

2.9.2 Effects of Anxiety on students' Achievements

Another factor which has been found to impact negatively on students' mathematical achievement is their inability to overcome anxiety. Finding difficulty to understand mathematical concepts affect the way students think, imagine and analyse situations, which call for quick response. Anxiety results from frequent exposure of students to experiences that are considered negative in nature, and students' consistent exposure to challenging mathematical material (Beilock, Gunderson, Ramirez, Levine, & Geist, 2010). Sarfo and Adusei (2016) expressed their dissatisfaction towards how students'

mathematics anxiety is approached or dealt with as a result of strong effects on achievements. According to Sarfo and Adusei (2016), students with high anxiety for mathematics underperform as compared to those with some level of control. Thus, the more one is caught in the web of anxiety, the more the repercussions on attitudinal change. According Affum-Osei, Asante, and Forkuo (2014), majority of senior high school students become affected by moderate stress levels. Affum-Osei, Asante, and Forkuo (2014) discovered in their study that majority of female students more often than not become moderately stressed as compared to their male counterparts. The study however indicated that the transition of students from childhood to adolescence significantly contribute to incessant stress experienced. However, notwithstanding the intensity of the stress, it was found to have no significant influence on the academics of students.

A number of studies (Kawaguchi, 2011; Mühlenweg, 2010; Ponzo & Scoppa, 2014; Sprietsma, 2010) have shown that age difference is not responsible for the conceptual image a student attains. Abotowuro (2015) in a study to access the factors influencing the perceived difficulties of Senior High School students in elective mathematics affirmed that students' age attained is not a ground for fear of mathematics. It was observed that a crop of students who were few years old behind the ages of their colleagues, did not entertain any form of fear toward mathematics when they were offered mathematics as a course of study.

2.9.3 Effects of motivation on achievement

In every educational institution, the kind of treatment offered to a student cannot be underestimated since they are the force around which every activity in the school evolve. Their actions, attitudes and how they prepare for their final exams appear to

remain a major concern to all stakeholders in education. Since their future prospects usually depend on the outcome of the WASSCE, many studies (Eccles, Wigfield, & Reuman, 1987; Midgley, Feldlaufer, & Eccles, 1989) have been carried out to show what actually have been a factor emanating from the students' side that affect their achievement. To keep students on their toes, pragmatic efforts should be made to ignite learning spirit in them. One of these efforts is to use motivation so as to sustain the interest of students in a continuous manner (Slavin, 2006).

Motivation for so many years has been found as an effective way of changing the course of students' mathematics achievements. The extent to which students are motivated becomes a tool or a catalyst for their achievements in mathematics. It is therefore important for teachers to give recognition to every form of students' responses in the course of lesson. Giving recognition to the responses of students and setting the emotional tone do not only serve as an intrinsic form of motivation but also have positive impact on students' mathematics achievement (Battey & Leyva, 2013). Similar findings have also been reported in research other studies conducted by many researchers. One of such studies is the one by Ali (2015) which investigated the relationship between motivational enhancement therapy and mathematics academic achievement using a sample of college students in Zambia. He found a significant and positive relation among motivational enhancement therapy and mathematics academic achievement. He indicated that students who happened to have high motivational enhancement therapy at the end of the day did better than their mates who were exposed to low motivational enhancement therapy on academic achievement as it was determined by the use of averages of the term examination grades.

It is not only mathematics that demands a high form of motivation. Riffat, Noureen, and Anjum (2016) who also based their study on achievements of students

and its relationship with motivation and self-concept discovered a high and significant correlation between students' proficiency in English and mathematics and motivation. It was noticed that majority of students whose proficiency in English were high were highly motivated to excel in mathematics. Motivation in conclusion is thought of as a tool that equips students or guarantees individual's ability to understand certain mathematical concepts.

Oluwole (2016) also studied about how effectively motivation improve mathematics learning gains among school-going adolescents in Oyo State, Nigeria. In the study, Oluwole (2016) used standardized scales as instruments and the data received was analyzed using Analysis of Covariance (ANCOVA) statistical analysis. The outcome of the study indicated that the introduction of motivational therapy was highly related with students' mathematics learning gain. Per the results of the study, he emphasized that the students should be given special training on how they can effectively employ motivational enhancement therapy. The need for an intensification of the efforts of experts in educational testing/evaluation and Counselling/Educational psychologists in organization of seminars/conferences were identified as very imperative. The study carried out by Salifu, Nyamekye, and Issahaku (2017) indicated that male students outperformed on the average than their female counterparts in all aspects of mathematics achievement indicators which consisted of understanding, knowledge and perception. Denteh, Mensah and Issaka (2017) also found a similar result which confirmed the study by Salifu, Nyamekye and Issahaku (2017) but their study went further to consider the effects of motivation in terms gender on students' achievement in mathematics in Asesewa Senior Secondary School in Manya Krobo District. In terms of gender, the introduction of any form of motivation changed the

attitudes and learning strategies of female students than their male counterparts which eventually caused the female students to excel and outperform their male counterparts.

2.9.4 Sex differences in math students' mathematics achievements

Asante (2010) noted that there existed a substantial difference between mathematics achievement between male and females at the secondary level of education. The clear cut differences in the achievement was attributed to some of the socio-cultural factors peculiar to Ghanaians. Asante (2010) learned that the perceptions held in the Ghanaian societies invariably makes it possible for the fortunes of newly born baby to be predicted. From that analogy, it was concluded that students' achievement in any subject is highly determined by the way they perceive it. Benbow and Stanley (1980) cited by Foy (2013) also observed that female students performed better in the aspect of mathematics which involved computation, while their male counterparts did well when it came to mathematics involving reasoning skills.

2.10 Teacher Factor on Mathematics Achievement

A good mathematics achievement is required for students to face the future challenges of the society. However, the problem of low mathematics achievement still persists and one of the factors have been found to contribute to this problem include teacher factors. Previous researchers have linked teacher factors with various elements such as teacher quality, Teacher Pedagogical Content Knowledge (TPCK), teacher effectiveness, teaching practices, teacher characteristics, teacher satisfaction and professional development.

2.10.1 Mathematics Teachers' Role in Mathematical Skill Development

Teachers play important roles in the development of students' mathematical abilities and skills in all levels of education. Teachers constitute the interconnection of any defensible transformation of the system. Stephenson (2018) asserted that the in-depth knowledge of a teacher in a subject area is a necessary condition for his ability to know how to teach a precise content in the manner that it would be well understood by students. For better and quick transformation of the system, it is important to build teacher capacity which is very crucial for successful teaching and learning and should therefore be the turning point for restructuring the education system (Egbo, 2011). In a study by Wilmot (2015) to investigate the knowledge base of senior high school teachers in Ghana for teaching algebra compare to that US counterparts, it was found that the US teachers comparatively performed significantly better than their Ghanaian counterpart. Assigning reasons to the differences in achievement, Wilmot (2015) posited that while the US teachers taught everything concerning algebra, the Ghanaian teachers taught a mathematics curriculum which contained algebra combined with other areas of mathematics such as calculus, geometry, probability, statistics, and vectors, among others. The study further brought to the fore some short falls of Ghanaian teachers in terms of how graphs of some algebraic functions were handled which might be more fully developed among the US teachers. Finally, Wilmot (2015) recommended the need for Ghanaian teachers to get exposed to different questioning skills so that they could expose their students to higher order questions such as those that cover application problems.

2.10.2 Teacher Quality on achievement

Teacher quality is considered crucial in all levels of education. It is generally perceived that a student whose teacher is highly qualified in certain areas always excel. Yemi and Adehina (2013) realized that it took a qualified teacher to effectively teach to the full understanding of students. Despite the growing concerns people have expressed about the behaviour of teachers. Mathematics teachers in particular for some time now have been considered as the main factor in the achievement of students in the subject due to the fact that it takes a competent teacher to have mastery over a mathematical concept. Lubaale (2015) accepts a great deal of challenges in the course of upbringing of teachers to facilitate the development of education. Lubaale (2015) mentioned lack of academic staff, financial problems, goal displacement, imbalance between students offering science, unsupported curriculum as some of the factors that were against making teacher education reach a higher standard. Despite challenges faced by teachers, they remained ridiculed by parents, politicians when students finally do not excel in their external exams.

Avong (2013) observed that the blame cannot only be hurled at teachers as teachers could be categorized into different groups. Some teachers are considered competent whilst others are categorized as incompetent. Avong (2013) was of the view that the scarcity of competent mathematics teachers has made the incompetent ones dictating the pace of the subject at the senior high level and that might mostly account for the unfortunate achievement by students. The confidence level of students along the line incessantly dwindles after having lost contact with a teacher who has mastery over the subject. In schools where shortage of teachers is experienced, students are provided with the opportunity to resort to noisemaking, loitering about and the playing of truancy. Also, as a result of the difficulty majority of students find in understanding

some mathematical concept, most concepts become scars in the flesh of those unfortunate students and go a long way to influence the way they learn subsequent concepts they come across. Yemi and Adeshina (2013) also established that among all factors which relate to students' abysmal mathematics achievements, shortage of qualified mathematics teachers in a school is the one which need much attention and should be the priority of anyone who has education at heart. As viewed by Idowu (2015), teachers happen to be the main custodians of students, and therefore the way and manner they perform their roles can have dire consequences on way the students learn.

Battey and Leyva (2013) also in a study tried to ascertain the unfortunate achievements among Senior Secondary students at West Africa Secondary School Certificates Examination level in Bo City, Sierra Leone realized that teachers' qualification or area of specialization affected the academic achievement of the students. Battey and Leyva (2013) noticed that a well-qualified teacher knows how to blend the topics and also have the skill to vary his or her methods for the enhancement of students understanding of the topics he/she teaches.

Notwithstanding the previous arguments that students' mathematics achievements is directly related to teacher' qualification, Gegbe and Koroma (2014) alleged that some teachers consider students' poor academic achievement to be negatively related to the teachers' academic qualification. They were emphatic that the continuous spread of falsehood about teachers that unqualified teacher is not in the position to teach students well should end. They claimed that the qualification of a mathematics teacher does not guarantee his understanding of a mathematical concept. They therefore came to the realization that experience gained by a teacher for teaching a particular concept happens to be the surest way of promoting students understanding.

Haliru and Bashir (2018) found that several variables join together to ensure students' progress in mathematics. They noticed that teachers' variables such as their pedagogical knowledge, subject matter knowledge, teacher-student relationship, teachers' qualification and experience combine together to influence students' interest and achievement in Mathematic. They also discovered that when the implications of the various teacher variables are considered individually, only the subject matter of a teacher is associated with achievements. But when it comes to an interest sustenance of students in mathematics, all the teacher variables play important roles. Ajayi and Ekundayo (2010) indicated that irregular payment of teachers' salaries affects their efficiency and its ultimate effects is low students' achievements.

2.10.3 Teaching and Learning Materials on Achievements

It is important to understand that instructional materials and the teaching approach adopted for teaching various topics in a subject are very important in the general delivery in the school curriculum. The ability of teachers to link their topics and subsequently adopting the right methodology and learning materials are very imperative to classroom business. The method employed and kind of teaching materials used during teaching affects students' achievement (Gegbe & Koroma, 2014). The introduction of right methodology in the lesson delivery without any dispute helps immensely by paving way for the intended concept to be attained within stipulated period. Learning materials on the other hand have also been recognized to be very supportive as they make lessons practical and also link classroom activities to the real world.

Umameh (2010) acknowledged that teachers are great assets to students because they play important roles in managing the academics of students. He revealed that

teacher's inadequate preparation before lessons, poor background in mathematics and their lack of interest in the subject come together to support the poor achievement of students. It was asserted that teachers who have those challenges tend to have difficulty with the proper use of instructional materials and hence its associated implication on students' achievement.

Berna and Erdurana (2010) pointed out that continuous usage or exposure of students to interactive whiteboard in mathematics lessons enhances the understanding, inspire and sustain their interest. Moreover, their study data point out that teachers valued the benefits of using an Interactive White Boards (IWBs) in classrooms and brought to light the need of majority of teachers to be conversant with its usage. It was maintained by Berna and Erdurana (2010) that since the approach is not familiar in the system, the need for training workshops for teachers must be done continuously for them to acquire the skill of using IWBs.

In this technological era, the need has arisen for different approaches to teaching to be tested on regular basis. Mathematics teachers' level of awareness of the emerging technological approaches has been found to be low. Onaifoh and Ekwueme (2015) in their study realized that higher percentage of mathematics teachers in the system are not aware of the existence of e-learning approach to teaching and to make mention of its usage in the classroom. They presented that teachers were only aware of Audio and Video tape in the teaching and learning process. E-learning offers new ways of enhancing students' achievement and models such as the introduction of video and teleconferencing in teaching. The teaching safeguards best practices and ensures constructive modifications in the classroom instruction which eventually raises the confidence level in the teaching and learning situation as well as exposing the learners to numerous learning styles (Dhariwal, 2010). A study conducted by Adeleke and

Oloyede (2010), showed that students mathematic achievement could be improved by both procedural and conceptual learning strategies and that students' study habits in mathematics yielded significant difference in students' study habits with conceptual strategy having higher score.

According to Ottmar, Rimm-Kaufman, Larsen, and Berry (2015), teachers who are trained in Responsive Classroom and ensured that its usage is frequent, at the end of the day showed higher use of standards-based mathematics teaching practices. It was revealed that more use of standards-based mathematics teaching practices was associated with greater enhancements in math achievement. The results of their study also demonstrated the essence of equipping teachers with social and emotional capacity through the creation of supportive classroom that permits teachers to afford stronger mathematics teaching practices that lead to improved student learning. Researchers (Fumador & Agyei, 2018), have shown that diagnostic conflict teaching and orthodox teaching methods greatly impact on the remediation of algebraic errors and misconceptions among second year high school students. Although they discovered that the two approaches impacted positively on students' academic work, the diagnostic conflict teaching approach was more effective in overcoming students' algebraic errors and misconceptions as compared to the orthodox approach.

Mathematics achievement could be enhanced by increasing the short mathematics instruction periods, resourcing teachers with instructional and curriculum materials, exposing teachers to new approaches to teaching, regularly giving teachers in-service training, enhancing teachers' skills in the way they assess students, improving teacher quality and finally motivating teachers (Bawuah, Sare, & Yelviel-Dong, 2014). It is believed that the use of behavioural objectives promote effective strategy for teaching and learning mathematics (Yusuf, 2010). This strategy has been

found to improve students' mastery of content at the understanding level than at the knowledge level of cognition (Ifamuyiw, 2010). Varying learning strategies immensely contribute to the achievements of students' mathematics. The use of innovative way of teaching is recommended as a better approach to enhancing understanding. There is also the urgent need to improve pedagogical content knowledge of teachers. Yusuf (2010) emphasised that through in-service training, teachers' skills in addressing students' mathematical misconceptions and errors could be made effective and well enhanced.

2.11 School Factor on Students Mathematics Achievements

Several research findings (Abreh, Owusu & Amadahe, 2018; Adebola & Atanda, 2011; Onderi, Okwara, Raburu, Barongo, Mokaya, Mokogi & Omae, 2015) have pointed to school factors as part of elements that influence students' mathematics achievement in secondary schools worldwide. In a study to assess the relationship between school factors and academic achievement among Secondary School Students in Kenya, Onderi, et al. (2015) found a correlation between school factors and mathematics achievement. It was established that;

a. School factors affect performance in mathematics like school policy on class promotions. In other words, when a school has put some marks to be scored by a student before going to next class performance is likely to be high and vice versa.
b. availability of adequate teaching learning facilities will contribute highly to the academic achievement in mathematics.
c. highly qualified and motivated teachers will contribute a lot to the good performance in mathematics.

d. previous school performance also contributes much to the current performance since it gives students morale to do even better.

Adebola and Atanda (2011) in another study to investigate the effect of school quality on students' academic achievement found a positive correlation between the nature of the school in terms of quality and students' achievements in mathematics. The study claimed that when the required resources are located in a school, students' academic work improves steadily. In support of the earlier research, Yemi and Adeshina (2013), also identified students' abysmal achievement in mathematics to poor facilities, equipment and available instructional materials which are major ingredients of effective teaching and learning.

There is also evidence to show a strong connection between material and human resources and achievement of students. A study conducted by Valerie and Zuz (2011) to examine the achievements of grade six students in reading and mathematics observed that school physical features including size and school shifts had an inverse relationship with achievement of grade 6 students' achievement in reading and mathematics. The shift schooling although was found not to have any connection with achievement. They indicated that shift was found to be an impediment to co-curricular activities, disciplinary issues and above all led to a reduced morale among teaching staff. Chiu (2010), in his multi-level analyses of family and school on mathematics achievement using 107,975 15 year olds' mathematics tests and questionnaires in 41 countries, presented that school characteristics were associated with student achievement. Chiu (2010) emphasized that the fair distribution of country and school resources were linked to higher mathematics scores. For schools where government and the Parents Teacher Associations (PTAs) provide the requisite educational materials, students' achievements tend to be higher than in schools where educational materials were found

to be low. Similar results were shown across the various countries used in the study where wealthier countries, intangible processes had stronger links with mathematics achievement, indicating that greater availability of public physical resources promote enhanced achievements.

Serene atmosphere as perceived by other researchers (Gegbe & Koroma, 2014; Umameh, 2010) is a sine-qua-non for better engagement, achievement, among others, and has been spotted to warrant diverse forms of achievement in mathematics. A study by Gegbe and Koroma (2014) shows that environment within which students learn has a dire influence on their academic achievement as perceived by both teachers and students. Students, failure to develop the desired interest in what they learn, their low commitment level to what they practice in the class and the failure of students to utilize the little study materials at their disposal remain as the factors leading to their poor achievement in WASSCE mathematics (Umameh, 2010). To sustain the interests of students in mathematics and make learning more enjoyable, the use of interactive white board has been found to be very effective for teachers.

According to Rumberger and Palardy (2004), classroom inputs and processes contribute to student achievement. In EER, class composition was found to positively relate to MA of students between classes (Van Damme, De Fraine, Van Landeghem, Op-denakker, & Onghena, 2002). Research has shown that high-ability students perform best when associating with other high-ability peers, while lower-ability students benefit from interaction with students in the middle of the ability distribution (Burke & Sass, 2011). Classroom learning environment and classroom assessment were among the eight teachers' variables included in the dynamic model for measuring quality of teaching (Kyriakides & Creemers, 2008). Rajoo (2013) has shown that the quality of classroom learning environment is a significant determinant of students' MA.

Formative assessment is one of the most important factors associated with effectiveness at all levels (Kyriakides & Creemers, 2008). Stears and Gopal (2010) have proposed interpretative and interactive approaches to assessment.

2.12 Parental Factor on Students Mathematics Achievements

Numerous studies (Chiu, 2010; Hunt & Hu, 2011; Martin & Veiga, 2010; Johnson, 2014) have documented the importance and central role of parental participation in the schooling of their wards. In other words, there is a positive relationship between education level of the parents and the student performance in mathematics (Fan & Chen, 2001). All aspects of involvement of parents in mathematical learning is liable to be affected by the way parents appreciate mathematics as an important subject and how well they expect their wards to succeed (Hunt & Hu, 2011). Variables closely related to level of parental education such as income, occupation, and socioeconomic status consistently have been shown to have a direct positive association with student mathematics achievement (Ma, 2001; Ma & Kishor 1997; Schreiber, 2002). According to Nyarko (2011), parental school involvement refers to the complete engagement of parents support in the activities of their wards in school with the aim of promoting their children's academic success. It was found that the role of a mother in the achievement of her children is exceptionally indispensable (Nyarko, 2011), as it has a positive and significant correlation with the academic achievement of the students. Nyarko (2011) found that though fathers also play essential role in their wards' education, there is no significant connection between father's school involvement and academic achievement of the students. Mothers were found to be more involved than fathers on the three levels of parental involvement in children's schooling (Nyarko, 2011). These levels were: behaviour, cognitive-intellectual, and personal. Mothers in general were of the view

that students were their future and nothing else and therefore expended all their resources especially-money, material, time, etc. to ensure that their children's academics improved in school. The study (Nyarko, 2011) again indicated that majority of mothers in Ghana at times even sell their personal belongings or borrow from the banks or friends in order to facilitate the educational success of their wards.

According to Martin and Veiga (2010), inequalities in parents' education play an important role in students' mathematics achievement tests score disparities. Comparing the socio economic status of many countries and their relationship with mathematics achievement, Martin and Veiga (2010) revealed that students turned to perform well in mathematics in countries where parents' educational and economic status were high as compared to others where their economic status was low. Again Chiu (2010) in a study to look at the effects of inequality, family and school on mathematics achievement concluded that family characteristics were linked to mathematics scores. Accordingly, students in developed countries had higher mathematics scores, but with diminishing marginal returns. In other words, students from countries with equal distributions of income, scored higher in mathematics compared to those from low and uneven distribution of income.

Johnson (2014) discovered barriers to parent's involvement in their wards mathematics education. According to Johnson (2014), the inability of parents to understand higher-level of mathematics courses served as a great barrier to the parents' engagements. In some instances, parents' misunderstanding of the higher-level mathematics has the tendency of causing disagreements. Sometimes, students would wish their parents to teach them a certain mathematics concept the way their teacher taught them. Once, the parents were not knowledgeable about the particular concept, it would create conflict between the parents and students. Another barrier she identified

was parents' inability to get enough time for their wards. She indicated that students whose parents had enough time to help them with the learning of mathematical concepts become excellent as compared to their colleagues whose parents had no time.

2.13 Summary of the Literature Reviewed

The literature reviewed shows that attitudes students form toward the learning of mathematics as a subject has a dire consequence on achievement. Attitudes emanate from past learning experiences which in effect go a long way to influence achievement either positively or negatively. The literature reviewed also showed that Elective Mathematics significantly affected the overall students' achievements in Core Mathematics and the science subjects. It also indicated that students' level of anxiety affect their achievements in mathematics and that students with high anxiety for mathematics underperform as compared to those who have some level of control over their anxiety. Literature reviewed that there is a significant and positive relation among motivational enhancement therapy and mathematics academic achievement and that students who happened to have high motivational enhancement therapy at the end of the day did better than their mates who were exposed to low motivational enhancement therapy. It also established that teacher quality and the kind of teaching and learning materials used are significant determinant of students' achievement in mathematics. Literature further established a positive correlation between the nature of school in terms of quality and students' achievements in mathematics. Finally, the literature established a link between family characteristics and students' mathematics scores and that countries with more equal distributions of income, students scored higher in mathematics as compared to those with low and unequal distribution of income

CHAPTER 3

METHODOLOGY

3.1 Overview

This chapter describes the method and procedures used for the study. These are discussed under the following headings: the research design, description of the study area, population, sampling technique and sample size, instruments for data collection, pilot study, validity of instruments, reliability of instruments, data collection procedure, data analysis procedure and ethical considerations.

3.2 The Research Design

This study adopted the mixed methods approach using the explanatory sequential method. According to Creswell (2013), mixed methods is an approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks. The explanatory sequential mixed methods involves the collection of quantitative data first, and then explaining the quantitative results with in-depth qualitative data (Creswell, 2013). By mixing both quantitative and qualitative data, a study can gain its breadth and depth of understanding, and corroboration and offset the weaknesses inherent in using each approach by itself. According to Creswell (2013) one of the most advantageous characteristics of conducting mixed methods research is the possibility of triangulation. Triangulation allows one to identify aspects of a phenomenon more accurately by approaching it from different vantage points using different methods and techniques. The study adopted this research design because the quantitative data were first collected and analysed, followed by the qualitative data. Thus, the WASSCE results of students who completed Tepa Senior High School from

2016 to 2018, were initially collected and analysed quantitatively to find achievement in both core and elective mathematics, followed by the reasons why such results occurred.

3.3 Description of Study Area

Tepa is located in the Ahafo-Ano North Municipality in the North Western part of Ashanti Region. It is the capital of the Municipality and lies between Latitude, 60 47'N and 70 02'N and Longitude, 2026'W and 20 04'W. According to the 2010 Population and Housing Census, Tepa has a population of 17,950, with farming as their major occupation. The Municipality is endowed with Basic and Secondary schools out of which Tepa SHS is the beacon in the area. Tepa Senior High School came to the lime light in 2012, when the school was ranked first in WASSCE, Ashanti Region, and 3rd best school in the country. In 2013, the school again placed first in the region and performed creditably nationwide. The consistent academic achievement of the school has led to a sharp increase in the school's population, infrastructure, and other sporting activities. The school in 2019 performed creditably in the National Science and Mathematics Quiz Competition by receiving the Most Impressive School Award. Currently, it is the second highest populated school in the region and continue to be one of the best performing schools in Ghana. Hence the justification for choosing the school as the study area. The map below shows exactly where Tepa is located in the Ahafo - Ano North Municipality.

Figure 1. Map of Ahafo-Ano North showing the location of Tepa

3.4 Population

The population for the study consisted of all students of Tepa Senior High School who completed 2016 to 2018 and studied both core and elective mathematics up to the WASSCE level, and teachers who taught mathematics during the period. According to McMillan and Schumacher (2014), population is a group of individuals or events from which a sample is drawn and results can be generalized to other people. Fraenkel, Wallen, and Hyun (2012) also define it as the group of interest to the researcher, the group to whom the researcher would like to generalise the results of the study. In other words, the group the investigator wishes to make inferences is contacted for the research.

For this study, however, the population was 1,420, comprising 1,400 past students and 20 Mathematics teachers. Out of the total students' number, 460 completed in 2016, 400 completed in 2017, and 540 completing in 2018. This is presented in Table 3.1. Out of the population, 950 studied General Science, 352 studied General Arts, while 98 studied Business. The details are shown in Table 3.2. In terms of gender, 1114 were males while 286 were females as represented in Table 3.3.

Table 3.1: Students who completed SHS from 2016 to 2018 and Mathematics Teachers of Tepa SHS.

Year Group	Number of student
2016	460
2017	400
2018	540
Teachers	20
Total	**1420**

Table3.2: Programme offered by students

Programme	2016	2017	2018
General Science	320	280	350
General Arts	110	98	144
Business	30	22	46
Total	**460**	**400**	**540**

Table 3.3: Gender of Students

Gender	2016	2017	2018
Male	377	332	405
Female	83	68	135
Total	**460**	**400**	**540**

3.5 Sampling Technique and Sample Size

According to Pannerselvam (2007), sampling is a process of selecting a subset of population for a study. The usual goal is to produce a representative sample that is similar to the population on all characteristics. According to Yin (2003), the rationale

for sampling is to make generalization or draw inferences based on the study of the samples about the population from which the samples are taken.

Both random and non-random sampling techniques were adopted for the selection of the sample size. These were stratified, simple random, purposive and snowball sampling. Stratified sampling technique is adopted when a proportional representation of different sub-groups or strata is required for a study. The Stratified sampling technique was in the first place, used to identify the various year groups who would form the nucleus of the research. Thus, WASSCE results from the year groups (2016, 2017 & 2018). The students from the year groups were selected because they had studied both core and elective mathematics for a period of three years, have taken both standardized and non-standardized examinations on the subjects and have rich experience to share when it comes to answering the research questions posed for the study. To select a sample size from a population of 1,400 students, with different year groups, there was the need to choose a sampling technique which could give a fair sample representation and not to give undue advantage to any of the three selected year groups, hence, the proportional stratified random sampling was adopted.

To achieve this, the Krejcie and Morgan (1970) Table for determining the sample size was used. According to the Table, a population of 1400 gives a sample size of 302 with a 95% confidence level and 0.05 margin of error gave. This is expressed as:

$$S = \frac{x^2 NP(1-P)}{d^2(N-1) + x^2 P(1-P)}$$

Where S = the required sample size

X^2 = the table value of chi-square for one degree of freedom at the desired confidence level. At the 5 percent confidence level, the X^2 table value is 3.84.

N = the population size

P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size)

d = the degree of accuracy expressed as a proportion (0.05).

Therefore, for a population of 1400 and assuming a 95% confidence interval, the minimum sample size determined using the equation can be estimated as:

$$S = \frac{3.841(1400)(0.5)(1-0.5)}{(0.05)^2(1400-1)+3.841(0.5)(1-0.5)}$$

$$S = \frac{1344.35}{4.45775}$$

$$S = 301.576$$

$$S = 302$$

The distribution for the year groups was given as 99, 86 and 117 for 2016, 2017 and 2018 respectively.

After obtaining the sample size, for the three cohorts there was the need to find out whose results in each year group qualified to be selected. This was because all results had equal opportunity to be selected for the study. The simple random sampling technique was adopted to give equal opportunity to those whose results were to be selected for the study. The simple random sampling was therefore adopted. Simple random sampling is used when each and every member of the population has equal and independent chance of being selected.

To perform this task, all the WASSCE results in each year group were captured in an exercise book and assigned numbers according year after year, starting from 2016. Thus, the results for 2016 were numbered from one up to the total population (460), after which pieces of paper were numbered to match the captured results in the exercise book. These pieces of paper were folded, put in a bowl, and shuffled for about two minutes after which the folded pieces were picked one after the other until the sample

size was obtained. In other words, 99 pieces of folded paper, collected were opened and their corresponding were chosen to represent the sample for 2016. This process was repeated for 2017 and 2018.

The purposive sampling technique on other hand, was adopted to select both the year studied both core and elective mathematics. It is obvious that not all SHS students offering the various programmes such as Science, General Arts, and Business, among others, study both core and elective mathematics. Therefore, there was the need to identify the results of such for the year groups. According to Creswell (2013), this sampling technique is adopted when selecting people who in one's judgement are better positioned to provide the needed information for a study. Cohen, Manion and Morrison (2007) believe that this choice has the potential to offer opportunities to choose cases that are deemed appropriate to involve in the sample on the basis of perceived judgment and typicality or build up a sample considered satisfactory to specific needs.

With regard to the selection of mathematics teachers for the interview, 16 out of 20 were also purposively selected for the study. There was the need to exclude four teachers because they joined the staff after the students under consideration had completed and left the school. This means that they were not privy to the peculiar challenges or factors that could make them contribute meaningfully to the achievements of the students' core and elective mathematics within the period.

In terms of questionnaire administration, it must be emphasised that the people were scattered over Ghana, and identifying them was difficult. This required identifying persons who could also help identify other colleagues to identify and contact others for a smooth and successful research, hence snowball sampling. According to Kumar (2011), snowball technique is used when selecting a sample using networks. Thus, a few individuals in a group or organization are first identified for information after which

they also identify other people in the group or organization. In this practice, the people selected become part of the sample. These individuals or people are used as informants to put in touch with others who qualify for inclusion and they, in turn, identify yet others. The exercise continues until the required number constituting the sample is achieved. This approach according to Cohen et al. (2007), is useful for sampling a population where there exist some difficulty in getting access to individuals who might be in a position to aid in finding answers to the research questions.

In this study, one past student who completed Tepa SHS in 2017, and was working at Tepa was first contacted. He then gave the direction of another colleague who completed in 2018 in a nearby village. He also gave the direction to another person. This process continued for about four weeks until the questionnaires were sent to respondents who were ready to be part of the study. It must be emphasised that in some instances, the distance did not permit face-to-face interaction. Instead, such respondents accepted the questionnaire on condition that they would be posted to them through the post office. In such instances, contact addresses were taken and the questionnaire subsequently posted.

3.6 Instruments for Data Collection

The instruments employed for data collection were questionnaire, semi-structured interview and results from 2016 to 2018 WASSCE examination. The use of multiple data collection instruments ensured validity and reliability of data generated through triangulation. Creswell (2005) is of the view that the selection of appropriate method for a study is influenced by the purpose of the study, the needed information and resources availability and not philosophical considerations. After taking the results from Tepa SHS, there was the need to make follow-ups to ascertain whether everything

was moving as expected. As mentioned earlier, the sample group was scattered over a wider geographical area in Ghana, and therefore, soliciting information from them required an instrument which could help reach them at a faster rate and cheaper cost. Therefore, the choice of questionnaire was in line with Kusi (2012) and Awanta, (2011) who are in support that data collection through questionnaire is easy in terms of its collection and analysis.

The semi-structured interview for teachers was also a follow-up approach to have a deeper view and appreciation of the major issues raised in the research questions. In other words, there was the need to gather data from the teachers who had taught the past students for a certain number of years and had gathered enough information to contribute to the discussion. According to Fraenkel, Wallen, and Hyun (2012) semi-structured interviews are often best conducted toward the end of a study as they tend to shape responses on perceptions and how things are.

Documents consisting of West African Senior School Certificate Examination results from 2016 to 2018 were collected and used. These documents helped a lot with the acquisition of the secondary data for further analysis. According to McMillan and Schumacher (2014), the five most significant advantages of using secondary data are the benefits of time efficiency, cost effectiveness, data quality, increased sample size, and in many cases, lack of need to obtaining Institutional Review Board (IRB) approval. Using secondary data saves individuals from spending any time designing the research study and collecting primary data because data has already been taken. It offers students completing coursework, master's thesis, or doctoral dissertations the opportunity to expedite their efforts. It is concerned with data quality. Depending on the dataset being used, the results from secondary analyses may as well have a high degree of validity and reliability. Next advantage is its ability to yield large sample size that allow for

reliable and valid population estimates. With large samples, the results produced could be reliably considered as statistically significant that have little practical significance. Many people find it easy to use secondary source data due to the fact that there is usually no need for any approval.

Data collection instruments are therefore, first and most immediate recording of a situation. Without this kind of recorded data, it would be difficult to make sense of anything but the simplest phenomenon and be able to communicate the facts to others. Multiple data collection instruments were used to ensure validity and reliability of data. The use of interview on the other hand, is considered very fast in getting the needed information and less costly too as compared to the other instruments of data collection.

3.6.1 Data from Students' WASSCE Results

The quantitative data collected from students' WASSCE results were coded. Coding refers to the process of organizing data by bracketing chunks (or text or image segments) and writing a word representing a category in the margins (Rossman & Rallis, 2012). It involves taking text data or pictures gathered during data collection, segmenting sentences (or paragraphs) or images into categories, and labelling those categories with a term, often a term based in the actual language of the participant (called an in vivo term). By coding data, researchers classify and attach conceptual labels to empirical objects under study in order to organize and interpret them in the given research context. The WASSCE grades collected for this research were subsequently transformed by assigning values to them. For each grade in core mathematics and elective mathematics, A1 was assigned a value of 9. B2 was assigned a value of 8, B3 was assigned a value of 7, C4 was assigned a value of 6, C5 was assigned a value of 5, C6 was assigned a value of 4, D7 was assigned a value of 3, E8

as 2 and finally F9 taking a value of 1. The values assigned to the grades made it feasible for an easy computation or calculation using the computer. The values assigned to the grades paved way for statistical analysis to be performed. It therefore made it possible for the mean values and standard deviation to be calculated to facilitate the intended comparison in this study.

3.6.2 Questionnaire

As stated earlier, a questionnaire was prepared and used for the study**.** This was to collect factual information on factors contributing to core and elective mathematics achievement and factors that could influence such achievements. The questionnaire which was meant for students who completed 2016 to 2018 made up of three sections, namely sections A, B and C. Section A was designed to seek information on respondents' bio data. The section elicited information on respondent's background such as gender, age group, year of completion, programme pursued and educational background of parents or guardians. The section consisted of nine items made up of close and open-ended. The choice of close-ended items in this regard, was motivated by Kumar (2011), who asserted that choosing close-ended items provides a 'ready-made' categories within which respondents could reply to the questions asked. The items ensured that information needed was obtained for easier analysis. Supporting the choice of close-ended items, Fraekel et al. (2012) believe they are easy to use, score, and code for analysis, particularly, on a computer. This is because all subjects or respondents, respond to the same options and standardization of data is provided. Unlike the close-ended items, open ended items allow for more individualized responses. They allow more freedom of response and permit follow-ups (Fraekel et al., 2012).

Section B, which sought information on respondents' responses on core and elective mathematics achievements was made up 22 items. These consisted of 4-point Likert Scale items designed to collect data for the research question stated. According to Ary, Jacobs, Sorensen and Razavieh (2010), the Likert scale is one of the most widely used techniques to measure attitudes. It is popular, easy to construct, administer and score. The items used ranged from "4 = Strongly Agree (SA), "3 = Agree" (A), "2 = Disagree" (D) to "1= Strongly Disagree" (SD). In some cases, provision is made for "Neutral" category in Likert scale to create a safe option for respondents who may not prefer to make a choice. Such situations provide a safe haven for individuals who may want to stand in the middle for a precise question at hand (Neuman & Robson, 2014). The exclusion of the neutral option in this circumstance was to compel respondents to make choices instead of hiding behind the neutral option.

Section C of the questionnaire was also made up of 14 items comprising another 4-point Likert scale items and open-ended items. These sought to find out information on factors which were likely to contribute to students' achievement in core and elective mathematics.

3.6.3 Interview

The interview schedule used to gather further data has been attached as Appendix B. As stated earlier, the semi-structured interview was used as a follow-up to have a deeper view and appreciation of major issues emerged from the administration of the questionnaires. Wragg (2002) as cited in Kusi (2012) posits that: "this instrument allows the interviewer to ask initial questions, followed by probes meant to seek clarification of issues raised. Probes are either pre-stated or posed in the course of the interview, making the interview process flexible (p.46)".

Unlike the structured interview, the semi-structured type gives room for the individual to ask follow up questions and also seek clarifications, where necessary (O'Leary, 2017; Wragg, 2002). This strategy was therefore employed to help delve deep into some of the responses provided by the students. It also created space for follow up questions on possible ways of solving or dealing with the challenges that were raised during the administration of the questionnaire.

3.7 Validity of Instruments

Validity refers to the appropriateness, meaningfulness, correctness, and usefulness of the inferences made in the study (Fraenkel et al., 2012). In order to ensure the validity of the questionnaire, a stringent validation process was followed. The first draft was given to the Head of Mathematics Department, Tepa SHS. He used his expertise to judge whether the collection of items adequately covered the topic or whether it unduly weighted towards some aspects of the domain compared with others. He made very comprehensive comments which were used to tremendously improve the content of the instrument. The second draft was given to a lecturer in the Department of Mathematics Education, UEW, who also commented on the wording and length of the questionnaire. After incorporating the views, the third draft went to my Supervisor who also gave thought-provoking comments on the content, wording and the layout of the instruments. The comments went a long way to ensure both high face and content validity of the questionnaire. The interview guide followed the same processes before it was administered finally for the main research.

3.8 Pilot Study

A pilot study was conducted using 12 candidates who had just written the WASSCE and were awaiting their results for the questionnaire. Four students each from General Science, Business and General Arts classes and offered both core and elective mathematics were selected for the study. These students were used for the pilot study because they were not part of the sampled group and had similar characteristics of the sampled group. The questionnaire was made up of mostly close-ended items in the form of 4-point Likert scale type with a few open-ended items. The open ended gave the freedom for students to give their views on issues about the study.

It took the sampled group thirty minutes on average to complete the questionnaire. After completing and handed over the questionnaire, the participants were made to answer the following short post-pilot questions: as recommended by Bell and Waters (2014). These were:

- How long did it take you to complete?
- Were the instructions clear?
- Were any of the questions unclear or ambiguous? If so, will you say which and why?
- Did you object to answering any of the questions?
- In your opinion, has any major topic been omitted?
- Was the layout of the questionnaire clear/attractive?
- Any comments?

After the pilot study, the responses of the questionnaires were statistically analysed. Based on this analysis and their responses to the post-pilot questions, a few changes were made to the questionnaire before the final version was printed for the main fieldwork. The changes took the form of rewording some questions for easy reading and clarification and deleting some of them. A few spelling mistakes and

grammatical errors were also corrected. With regard to the interview guide, it was piloted using four mathematics teachers of Tepa SHS who did not form part of the teachers selected for the actual research because they joined the staff after 2018.

3.9 Reliability of Instruments

Reliability is the degree of accuracy or precision in the measurement made by a research instrument. It deals with the consistency of scores or answers from one administration of an instrument to another, and from one set of items to another (Fraenkel et al., 2012). Reliability is based on the assumption that there is a single reality and that studying it repeatedly will yield the same results. Reliability checks whether the instrument used will yield the same results at all times when repeated under constant conditions. In other words, the lower the degree of error in an instrument, the higher the reliability (Kumar, 2011).

To test for reliability of the questionnaire used in this study, a reliability test was conducted for the items after the pilot test. These were made up of the group of items measuring mathematics achievement and factors contributing to the achievement. A reliability test on the instrument yielded Cronbach's Alpha coefficients of 0.7762 and 0.7656. This coefficient indicated that the questionnaire was reliable to be used for the study.

3.10 Data Collection Procedure

According to Creswell (2002), respecting the site where a research takes place and gaining permission before entering a site is very paramount in research. To undertake this research, an introductory letter was obtained from the Head of Department of Mathematics Education, University of Education, Winneba (See Appendix E), to the

Headmaster, Tepa Senior High School. This letter was also to seek permission to take the results of past students who studied core and elective mathematics and completed in 2016, 2017 and 2018. The Headmaster upon receipt of the letter ordered his secretary to issue the results in a form of broadsheets. These broadsheets consisted of all the results of the students, who completed in the years mentioned. The needed results were painstakingly recorded by separating the results of those who studied both core and elective mathematics from others who did not study both. This was started with 2016-year group, followed by 2017 and 2018 respectively in an exercise book. In all 1,400 results were copied, comprising, 460, 400 and 540 respectively. For authenticity the gender and programmes of candidates were recorded as shown in Tables 3.2 and 3.3. Their corresponding grades were recorded (see Appendix C). The exercise took two days to complete.

Moreover, each questionnaire administered to the past students required some protocols to be followed. In other words, the introductory letter received from the Head of Mathematics Department, UEW and my student's Identity Card were shown to give assurance that request was coming from a credible source before administering the questionnaire. This helped to clear doubts from the minds of respondents and gave them confidence to accept me. To assured anonymity and confidentiality, the respondents were told not to write their names on the questionnaire. They were also given ample time to complete, after which another time was scheduled for collection. In all it took two months to complete the exercise. Even though, using snowball sampling technique to some extent is laborious, expensive and also could have strong biases as noted by Fraenkel, Wallen, and Hyun (2012), this method was considered appropriate under the prevailing circumstances. In cases where respondents could not be met face-to-face, they were talked to on the telephone. Such persons arranged to have the questionnaire

posted to them and subsequently gave their contact addresses for easy postage. It must be noted that postage stamps and envelopes were added to the questionnaires.

With regard to the semi-structured interview, the needed protocols were followed. Even though, I was a member of staff and knew the teachers at the Department, I formally sought permission from the Head of Department about my intensions to interview him and some of the teachers in the Department. All the mathematics teachers were then informed about the interview after which some selected ones were approached. This was done to win the support of the teachers so that they could offer their support. After the interview, I took the opportunity to thank them for their massive support and assured them that a copy would be made available at the Department's Library after publishing the work.

The interviews were conducted on a face-to-face basis. Much efforts were made to meet the teachers on the dates and times agreed upon by each of the interviewees. All discussions were held in their respective convenient places. While some were interviewed in offices others were held in their bungalows. An average of 30 minutes was spent in each case. Since the respondents were all colleague teachers in the school, interactions were more friendly but very formal.

3.11 Data Analysis Procedure

Out of the 100 copies of questionnaire sent to the past students who completed 2016 to 2018, 78 were returned, giving the response rate as 78%. The returned questionnaires were scored and coded for analysis and answering of the research questions. In trying to analyse the results obtained from WASSCE, the results were in the first place grouped into Core and Elective. These results were arranged and coded using Microsoft Excel and SPSS. The results were grouped according to achievement. A1 →9, B2→8,

B3→7, which imply that A1 was assigned value of 9, B2 was assigned a value of 8, B3 as 7 until the final grade F9, was coded as 1 (See Appendix D). Data were arranged and analysed both quantitatively and qualitatively. The quantitative data (See Appendix C) were analysed using inferential statistical tools such as Paired T-Test to establish the difference in mean, achievement between students' core and elective mathematics, the average score or mean of each of the subjects. Descriptive statistics involving the use of frequencies and cross tabulation were used to present data collected. The frequencies were converted into tabular representation to establish the direction of respondents and conclusion drawn.

Thematic analysis was also adopted to analyse the qualitative data which was gathered from personal semi-structured interview. Themes were generated and vivid description of various information given by the respondents was provided. In addition, verbal responses from the respondents interviewed were quoted to support issues as they emerged in the study report.

3.12 Ethical Considerations

The consideration of ethical issues is necessary for the purpose of safety to the privacy and safety of participants. Among the significant ethical issues considered in the research process include consent and confidentiality. An introductory letter from the University of Education, Winneba, through the Department of Mathematics Education, was shown to the Headmaster, the students and teachers where the study was carried out.

Initial contact was made with the Head of Tepa SHS to seek permission for the secondary data from the school. The next move was to seek permission from all identified individual past students who were used for this study. The final move was to seek the consents of the teachers to interview them.

Before the interview with the teachers, phone calls were made few days preceding the day of the interview. Those I could not call on the phone were approached face-to-face not solely to show my seriousness but to continue to seek their consent to partake in the exercise and relay all important details. The teachers were able to appreciate the gravity of their role in the completion of the research. They were also made aware that they could withdraw from the study if they so wished.

Another ethical guideline was to protect the teachers' identity. This was accomplished by exercising anonymity and confidentiality. To avoid any confusion, the cover letter clearly identified the study as confidential with regard to responses and the reporting of results. Participants' identity were kept confidential and were only used to determine who had not responded for follow-up purposes. The confidentiality of the participants was also maintained to avoid disclosing their names or personal information in the research.

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CHAPTER 4

RESULTS AND DISCUSSION

4.1 Overview

This chapter provides results and discussion of the data. The demographic data of participants who answered the questionnaire were first indicated, followed by each research question, its results and its discussions.

4.2 The Demographic Data of Questionnaire Respondents

Table 4.1 Gender distribution of past students who answered the questionnaire

Gender	Frequency	Percent (%)
Male	54	69.2
Female	24	30.8
Total	**78**	**100.0**

Source: Field Data, 2019

From the Table 4.1, it could be noticed that more males participated in the study than females. The percentage of male respondents who took part in the study was 69.2% as against 30.8% who were females. This indicates that it is not out of nothing that many people continue to yearn for more female participation in the learning of sciences. It has been reflected here too that when it comes to the study of science and its related subjects, males continue to dominate. It also confirms the views of many Ghanaians about male dominance in all spheres of the economy. Despite the efforts being made to bridge the gap between male and female in the learning of mathematics and science, it looks as if extra efforts need to be introduced.

Table 4.2 Age distribution of past students who answered the questionnaire

Age	Frequency	Percent (%)
below 18	23	29.5
18 or above	55	70.5
Total	**78**	**100.0**

Source: Field Data, 2019

From Table 4.2, it would be realised that a majority (70.5%) of respondents was 18 years or above, while the minority (29.5%) was below age eighteen. These are people who have completed secondary education and are supposed to further their education in tertiary institutions of Ghana. Per the requirements of tertiary institutions of Ghana, a good pass (at least C6) particularly in core mathematics and other subjects are required in order to gain admission into these tertiary institutions. Thus, a candidate who fails to pass mathematics would either have to join the bandwagon of candidates who are doing remedial classes to better their grades or join the frustrated youth in the society who have given up education as a result of their inability to get a good pass in core mathematics.

Table 4.3 Residential status of students

Residential status	Frequency	Percent (%)
Day	63	80.8
Boarder	15	19.2
Total	**78**	**100.0**

Source: Field Data, 2019

From Table 4.3, it would be realised that a majority (80.8) of respondents who participated in this study were once "Day" students, while the rest who were in the minority (19.2%) constituted Boarders. The majority of respondents coming from "Day" status reflected the actual situation of the school. Tepa SHS is a less endowed school which lacks many of the boarding facilities such as dormitories to accommodate

many of the students on campus. This further supports the claim by (Gegbe, Sundai, & Sheriff, 2015; Gitaari & Nyaga, 2013) that less endowed schools lack facilities that facilitate teaching and learning. Besides, a good number of Day students could be located within the Ahafo-Ano Municipality and could be located for the study, compared to the boarders who came from various destinations in Ghana and therefore made it difficult to contact them.

Table 4.4 Educational level of the fathers of respondents

Father education level	Frequency	Percent (%)
No formal education	6	7.7
Basic education	18	23.1
Secondary	33	42.3
Tertiary	21	26.9
Total	78	100.0

Source: Field Data, 2019

On the educational background of respondents' fathers, Table 4.4 shows that 7.7% of the respondents said that their fathers had no formal education; 23.1% revealed that their fathers ended at the basic education level, 42.3% also said that their fathers had secondary education and that of those with the tertiary education was 26.9%. Majority of their fathers falling below the tertiary level on the educational ladder gives an insight into the kind of perception they hold about the education of their wards. The parents could therefore be described as not knowledgeable enough when it comes to the issues on education. This results also means that majority of the fathers lack the ability to offer the respondents the requisite support system on the issues relating to wards' education.

Table 4.5 Educational level of mothers of students

mother educational level	Frequency	Percent (%)
No formal education	6	7.7
Basic education	45	57.7
Secondary	24	30.8
Tertiary	3	3.8
Total	**78**	**100.0**

Source: Field Data, 2019

On the educational background of respondents' mothers, Table 4.5 shows that 7.7% indicated their mothers had obtained formal education; 57.7% revealed that their mothers ended at the basic education level, 30.8% also said that their mothers had secondary education and that of those with tertiary education 3.8% as shown in Table 4.5. The story here is not different from that of the fathers' level of education. Thus, only a few mothers had obtained secondary and tertiary education to be able to assist their wards in mathematical concept. This is consistent with the study by Johnson (2014), which found parents' inability to understand higher-level of mathematics as a great barrier to their wards engagements. In other words, students wished their parents could teach them certain mathematics concept the way their teachers taught them. These results could also mean that majority of the mothers lacked the ability to offer the respondents the requisite support system on issues relating to their wards education.

Table 4.6 Occupation of fathers of students

Father occupation	Frequency	Percent (%)
Trader	9	11.5
Farmer	27	34.6
Teacher	15	19.2
Driver	3	3.8
Photographer	3	3.8
Business	3	3.8
Cocoa merchant	3	3.8
Prison officer	3	3.8
Electrician	3	3.8
Civil servant	3	3.8
Carpentry	6	7.7
Total	**78**	**100.0**

Source: Field Data, 2019

From Table 4.6, the major occupation of the fathers of the respondents is farming. It was realised that 34.6% of theirs fathers were actively involved in farming activities. Teaching was found to be the next occupation with a percentage of 19.2%. The next occupation to the teaching was trading. The remaining of the fathers were found to be actively involved in Carpentry, Photography, Electrical works, Prison service, Business, Driving, Civil service and Cocoa Merchant. Greater number of fathers being farmers as peculiar to Ghana and for that matter other developing countries bring to the knowledge the kind of low levels of education they possess.

Table 4.7 Occupations of Mothers of students

Mothers' occupation	Frequency	Percent (%)
Trader	40	51.2
Farmer	30	38.4
Teacher	2	2.6
Nurse	2	2.6
Seamstress	2	2.6
Hairdressing	2	2.6
Total	**78**	**100.0**

Source: Field Data, 2019

It was not surprising from Table 4.7 that 51.2% of the mothers of the respondents were involved in petty trading activities as trading is a common occupation among women in the cities and urban centres in Ghana. The next occupation in which the mothers are highly involved is farming. It was realised that 38.4% of mothers of the respondents were actively involved in farming activities. Many of the mothers were found to be engaged in hairdressing, nursing and seamstress. The percentage of parents involved in each occupation was 2.6%. The dominance of trading activities among the mothers in a way also says a lot about the educational levels of the parents. In the Ghanaian society, majority of elites are found in the civil service. The dominance of trading activities therefore posits that most of the mothers did not further their education to the tertiary level.

Table 4.8 Programmes Students Pursued

Programme pursued at SHS	Frequency	Percent (%)
Gen Science	60	76.9
Gen Arts	18	23.1
Total	**78**	**100.0**

Source: Field Data, 2019

From Table 4.8, it can be seen that 76.9% of respondents offered General Science as their programme of study while the rest 23.1% offered General Arts. Unfortunately, there was no Business student as can be seen from Table 4.8. A greater percentage of students pursuing General Science is a reflection of what pertains to the school. Unlike the other programmes, it is only General Science that has all the students studying a combination of Elective and Core Mathematics. It is therefore not surprising that a majority is offering General Science as shown in Table 4.8.

Table 4.9 Year Respondents completed SHS

year completed SHS	Frequency	Percent (%)
2016	18	23.1
2017	21	26.9
2018	39	50
Total	**78**	**100.0**

Source: Field Data, 2019

On the issue of the year students completed school, it would be seen from Table 4.9 that 18 respondents representing 23.1% completed senior high school in 2016, while 21 representing 26.9% also completing in 2017. The majority representing 50% completed in 2018.

4.3: Analyses of Research Questions

4.3.1 Research Question One: What is the trend of students WASSCE results in Core and Elective Mathematics?

Table 4.10 The Students Means from 2016 - 2018 WASSCE Results.

	Core	Elective
2016		
Mean	6.64	7.56
N of students	99	99
Std. Deviation	1.297	1.222
2017		
Mean	6.65	7.01
N of students	86	86
Std. Deviation	1.028	.728
2018		
Mean	5.62	5.79
Number of students	117	117
Std. Deviation	1.524	1.623

Source: Field Data, 2019

From Table 4.10, the total number of students' grades used for the year 2016 was 99. The students Mean in core mathematics was 6.64 and that of elective mathematics turned out to be equal to 7.56. It is obvious that the mean grade of students' achievements in core mathematics is lower than that of elective mathematics. Comparatively, the standard deviation of Core Mathematics was higher than that of Elective Mathematics. The standard deviation obtained for core maths was 1.297 and that of elective mathematics was 1.222. Comparatively, students performed well in the elective mathematics since the mean achievement of students' in the elective exceeded that of the core mathematics. From the same Table 4.10, the total number of students used to find the mean for the year 2017 was 88. The reduction in the number of candidates' results used was lower than the previous year following the cancellation of some of the candidates' WASSCE results. From Table 4.10, the average achievement of students in core mathematics was 6.65 which indicates a rise in achievement as compared to that of 2016. The Mean grade of students' achievements in Elective mathematics was 7.01. The average achievements in Elective mathematics unlike the Core Mathematics dropped as compared to that of the 2016. It is clear that the mean of students' achievements in Core Mathematics is lower than that of Elective mathematics. Comparatively, the standard deviation of core mathematics was higher than that of elective mathematics.

As can also be seen in Table 4.10, the standard deviation obtained for core mathematics was 1.018 and that of elective mathematics obtained was 0.719. It could therefore be concluded that the achievements of students in elective mathematics was far better than that of their achievement in core mathematics. It can also be observed from the Table 4.10 that the total number of students used for the year 2018 was 117. As shown in Table 4.10, the Mean achievement of students in Core Mathematics was

5.62 which shows a further drop in achievement in the subject as compared to the candidates' achievement in the previous years. Also, the mean grade for the elective mathematics was 5.79. The achievement of students in Elective Mathematics in this particular year too showed a further drop as compared to the previous years. It is clear that the mean grade of students' achievements in Core Mathematics was lower than that of Elective mathematics. The standard deviation of core mathematics on the other hand was lower than that of Elective mathematics. From Table 4.10, the standard deviation obtained for Core Mathematics was 1.524 and that of Elective mathematics obtained was 1.623. The achievements of students in core mathematics exceeded that of their achievement in elective mathematics. Generally, the mean grade of Core Mathematics from 2016 to 2017 increased by 0.01 which is somehow insignificant. The grade of the Elective mathematics on the other hand decreased by 0.55 which is largely significant. The mean grade of Core Mathematics from 2017 to 2018 decreased by 1.03. This difference is really high and shows a high dwindling nature of students' achievement in Core mathematics. The mean grade of Elective Mathematics from 2017 to 2018 also decreased by 1.31 which is very significant. Conclusively, students' WASSCE achievements in core mathematics generally decreased over the period indicating an unacceptable achievement. Students' WASSCE achievements in Elective Mathematics also generally decreased over the period indicating an unacceptable achievement. The graph of students' achievement over the years is shown below.

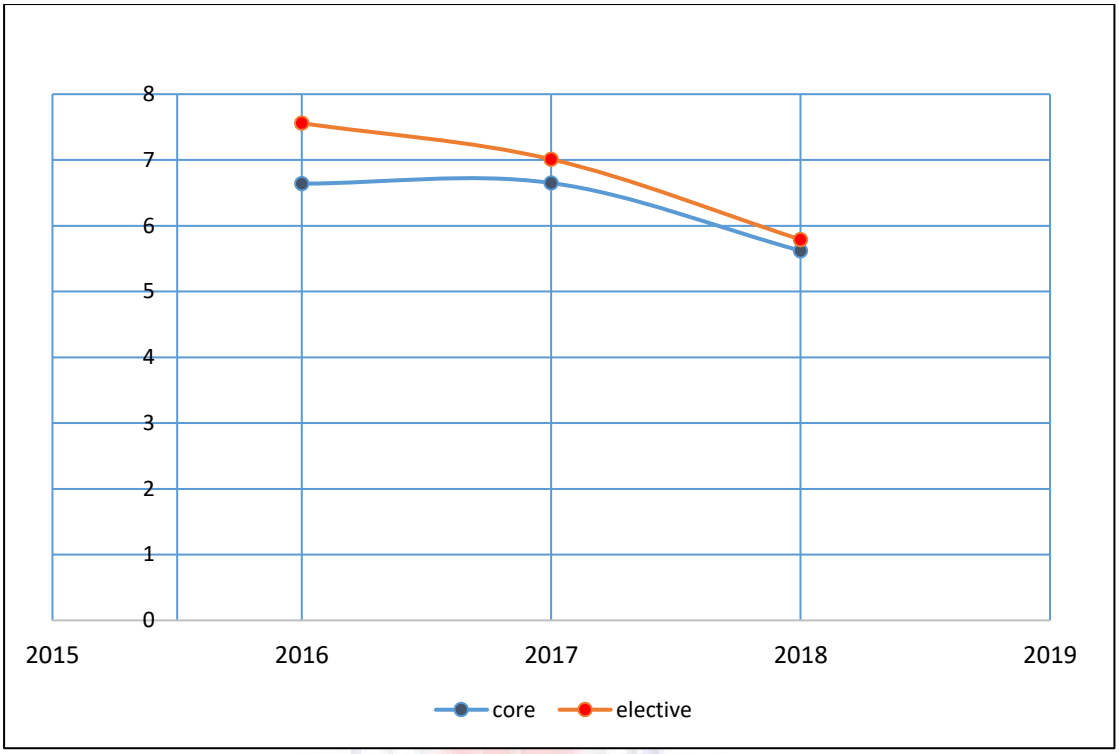

Figure 2. A Graph showing trend of students' WASSCE results

4.4 Discussion of Results for Research Question One

The analysis of the WASSCE grades of students showed a downward trend or retrogression in the achievements of students' Elective mathematics, while that of core mathematics went up and decreased. The results from the study by Musa and Dauda (2014) on the trend of students' mathematics achievement in WASSCE indicated that the achievement of students in mathematics does not follow a particular pattern. Their study is consistent with the student's achievement in Core Mathematics which indicated a rise in Mean initially and then declining in this study. Their study is not consistent with this study which showed a continuous reduction in the Mean achievements over the period. However, the downward trend in the achievement of students in core and Elective Mathematics is inconsistent with the study carried out by Olunloye (2010) whose findings indicated that there was an unacceptable trend of high failure rate in students' WASSCE results and described it as a national disaster. The implication here,

of this outcome according to Sarfo and Adusei (2016) is that there is an increasing mathematics anxiety among students in the senior high school and continue to influence students' achievement in both Core and Elective Mathematics. Another implication as claimed by Battey and Leyva (2013) is that this persistent poor achievement of students in mathematics has the tendency of taking their interest from learning the subject, and if nothing is done to overcome the situation, it will deny the state of future mathematicians, engineers and statisticians, among others whose roles are indispensable. Lawsha and Waheed (2011) believe that development of positive attitude towards mathematics, places an individual on the high levels of achievement. It is also important to note that motivation is one of the means students could overcome their challenges in the subject area as noticed by Oluwole (2016).

4.5 Research Question Two: Are there differences in the achievements of students in Core and Elective Mathematics?

Table 4.11 shows the Mean of students' WASSCE scores from the year 2016 to 2018 in both core and elective mathematics.

Table 4.11 Students' WASSCE Results from the year 2016 to 2018 in Core and Elective Mathematics.

	Core	Elective
Mean	6.25	6.72
N	302	302
Std. Deviation	1.410	1.498

Source: Field Data, 2019

From Table 4.11, the actual number of candidates WASSCE results used for the above analysis was 302. This result was obtained when Krejcie and Morgan table was used to determine the sample for the population of 1400. As can be seen from Table 4.11, the actual mean for core mathematics is 6.25 and that of elective mathematics is 6.72.

Standard deviation for Core mathematics is 1.410 which is obviously less than that of elective mathematics being 1.498. Comparatively, the means of both Core mathematics and Elective mathematics present a slight difference in students' achievements in both subjects which stands at 0.47.

4.6 Discussion of Results for Research Question Two

From the analysis, it was observed that the Mean achievement for the Core mathematics and Elective Mathematics were different with that of the elective mathematics being greater than the core mathematics. To find out whether the difference is actually significant, the hypothesis that there is no significant difference between students' achievement in core mathematics and elective mathematics was tested using paired samples t-test. The results are shown in Tables 4.12 and 4.13 respectively.

Table 4.12: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Core	6.25	302	1.410	.081
	Elective	6.72	302	1.498	.086

Table 4.13: Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Core - Elective	-.467	1.358	.078	-.621	-.313	-5.974	301	.000

Source: Field Data, 2019

From Table 4.13, p-value is 0.000, which means the difference in means is significant. Since the mean for the elective mathematics is greater than that of the core mathematics, it confirms that the students' performed better in elective mathematics than core mathematics.

As learned by Asante (2010), the kind of perception held by a student about a subject alters his or her attitude towards it. This, as inferred could be the underlying factor for the differences in students' achievements. According to Linero and Hinojosa (2012), people are more likely to develop positive attitude towards an 'attitude object' they are frequently exposed to than the one they are not exposed to. This further explains that when much efforts are put in the study of any subject, higher achievement is expected from it. The implication of the high achievement of students in Elective mathematics than the core is that students might be more exposed to the Elective than the Core mathematics.

4.7 Research Question Three: What factors accounted for students' achievements in Core and Elective Mathematics?

To answer research question three, series of items was set and responses solicited. These are shown in Table 4.14.

Table 4.14 Reasons students attribute to effective learning of Mathematics

STATEMENT	SA F(%)	A F(%)	D F(%)	SD F(%)	TOTAL F(%)
1 Elective Maths was more difficult for me than Core Maths at the SHS.	15(19.2)	36(46.2)	15(19.2)	12(15.4)	78(100)
2 I spent much time and resources on Elective Maths than Core Maths at SHS.	30(38.5)	24(30.8)	24(30.)	0(0.0)	78(100)
3 I performed better in Elective Maths than Core Maths at the WASSCE.	12(15.4)	9(11.5)	33(42.3)	4(30.8)	78(100)
4 We finished the Elective Maths Syllabus before writing my WASSCE.	15(19.2)	15(19.2)	18(21.3)	30(38.5)	78(100)
5 We finished the Core Maths Syllabus before writing my WASSCE.	27(34.6)	12(15.4)	30(38.5)	9(11.5)	78(100)
6 The same master taught me both Core and Elective Maths at SHS 3.	6(7.7)	9(11.5)	0(0.0)	63(80.8)	78(100)
7 The same master taught me both Core and Elective Maths at SHS 2.	6(7.7)	6(7.7)	15(19.2)	51(65.4)	78(100)
8 Different masters taught me Elective and Core Maths at SHS 1.	63(80.8)	6(7.7)	6(7.7)	3(3.8)	78(100)
9 My maths masters encouraged me more on Elective maths than the Core.	3(3.8)	21(26.9)	30(38.5)	24(30.8)	78(100)
10 Many of our students do better in core maths than Elective Maths.	18(23.1)	33(42.3)	21(26.9)	6(7.7)	78(100)
11 I had a negative attitude towards Elective Maths than Core Maths at the SHS.	12(15.4)	18(23.1)	27(34.6)	21(26.9)	78(100)
12 I had a negative attitude towards both Elective and Core Maths at the SHS.	6(7.7)	0(0.0)	48(61.5)	24(30.8)	78(100)
13 The way my Maths Masters taught us made me dislike Mathematics in general.	3(5.8)	9(11.5)	27(34.6)	39(50.0)	78(100)
14 We had enough copies of Core Maths Textbooks to use in class.	18(23.1)	30(38.5)	18(23.1)	12(15.4)	78(100)
15 We had enough copies of Elective Maths Textbooks to use in class.	15(19.2)	30(38.5)	24(30.8)	9(11.5)	78(100)
16 Our Core Maths masters made teaching practical and easy for me.	24(30.8)	39(50.0)	15(19.2)	6(7.7)	78(100)
17 Our Elective Maths masters made teaching practical and easy for me.	27(34.6)	24(30.8)	24{30.8)	3(3.8)	78(100)
18 I had a good relationship with my Core Maths master and this made me like the subject.	36(46.2)	24(30.8)	15(19.2)	3(3.8)	78(100)
19 I had a bad relationship with my Elective Maths master and this made me dislike the subject.	6(7.7)	18(23.1)	27(34.6)	27(34.6)	78(100)
20 Our maths masters had enough time and patience to explain new concepts to us.	30(38.5)	30(38.5)	15(19.2)	3(3.8)	78(100)
21 I consider myself as a maths phobia.	15(19.2)	30(38.5)	18(23.1)	15(19.2)	78(100)
22 No matter how I learn mathematics I am unable to understand.	0(0.0)	18(11.5)	27(34.6)	42(53.8)	78(100)

Source: Field Survey, 2019

Table 4.14 illustrates the responses of respondents on factors that are likely to contribute to students' achievements in Core and Elective Mathematics. With respect to whether respondents considered Elective Mathematics as more difficult for respondents than Core Mathematics at the SHS, 51 respondents representing 65.4% responded in affirmative, while 27 (34.6) disagreed. On the question of whether students spent more time on elective Mathematics than Core mathematics at SHS, 54 representing 69.3% answered in affirmative, while 24, which represents 30.7% shared contrary view. To also find out whether the respondents performed better in Elective Maths than Core Maths at the WASSCE, 21, representing 26.9% answered in affirmative while 57, representing 73.1% disagreed.

To also verify whether respondents were taught by the same teacher in both Core and Elective Maths at SHS 3, 15(11.5%) of them answered in affirmative while 63, representing in 80.8% disagreed. On the question of whether the same teacher taught respondents both Core and Elective Maths at SHS 2, 12(15.4%) responded in the affirmative while 66(84.6%) said no. Also, the item on whether different teacher taught the respondents Elective and Core Mathematics at SHS1, received majority of 69, representing 88.5% responding in the affirmative while 9 (11.5%), disagreed. It can be seen from the Table 4.14 that 24(30.7%) of the respondents said their maths masters encouraged them more on Elective maths than the Core and that 69.3% which represents the majority were encouraged more on the study of core mathematics by the mathematics teachers.

In the case of whether respondents were in agreement that majority of their mates always performed better in Core Maths than Elective Maths, 51, representing 65.4% responded in the affirmative while 27, representing 34.6% shared a contrary view. It was also found that 30, which represents 38.5% of the total respondents said

they had a negative attitude towards Elective Mathematics than Core Maths at the SHS. To move further to find out from respondents whether they had a negative attitude towards both Elective and Core Maths at the SHS, 6, representing 7.7% answered in affirmative while 72, which represents 92.3% were in disagreement. It could also be seen from the Table 4.14 that 12, representing 17.3% of the respondents indicated that the way their Maths teacher taught them made them dislike Mathematics in general while 66, representing 82.7% of them disagreed. As to whether the respondents had enough copies of Core Maths Textbooks to use in class, 48 of them which represents 61.6%, answered in the affirmative while the minority which also represents 38.4% disagreed. It was also found that 45(57.7%) of the respondents had enough copies of Elective Maths Textbooks to use in class. The remaining 33(42.3%) respondents disagreed with the assertion that they had enough copies of Elective Maths Textbooks to use in class. A majority 63(80.8%) of the respondents agreed that their Core Maths masters made teaching practical and easy for them while 21(19.2%) disagreed. Similarly, a majority 51(65.4%) of the respondents agreed that their Elective Mathematics teachers made teaching practical and easy for them while 27(34.6%) disagreed.

To find whether maths masters made the teaching of both Maths abstract and difficult, only 15, representing 19.2% of the respondents agreed while the majority of them (63) which represents 80.8% expressed that their mathematics teachers did not make the teaching of the subject abstract for them. Again, the majority 60(77%) of the respondents expressed that they had a good relationship with their Core Maths teacher which made them develop love for the subject and 18(23%) on the other hand said their relationship with their mathematics teachers was not the best. It was also found that 24, representing 30.8% of the entire respondents affirmed that they had a bad relationship

with their Elective Maths teacher which made them dislike the subject. In fact, the majority 54, representing 69.2% were in disagreement that they had bad relationship with their Elective Mathematics teacher and has made them dislike the subject. On the issue of whether maths teachers had enough time and patience to explain new concepts to them, 60, representing 77% were in agreement while 18 of them, representing 23% shared the contrary view. It could be noticed from Table 4.14 that 45(57.7%) forming the majority consider themselves as maths phobia while (42.3%) said they did not consider themselves as maths phobia. Lastly, 18 respondents representing 11.5% said that no matter how hard they learned mathematical concepts they were unable to understand them while 88.5% indicated they do understand the concepts.

As part of the questionnaire to answer research questions three, some open-ended items were set to solicit views from respondents on the factors they perceived to have accounted for the difference in achievement in core and elective mathematics; why students are unable to complete mathematics syllabus; why students allocate more time on one mathematics subject than the other; factors students attribute their core mathematics achievement; and factors students attribute their elective mathematics achievement to. These are discussed under sub-headings 4.7.1, 4.7.2, 4.7.3, 4.7.4 and 4.7.5 respectively.

4.7.1 Factors students accounted for the differences in achievements in core and elective mathematics

When respondents were asked to enumerate the various factors that could contribute to better achievement in one mathematics subject than the other, various responses were obtained. One such response was students' time allocation to one subject than the other. In other words, students would achieve better in core mathematics than the elective if

much time, energy and resources are allocated to core mathematics. In the same way, they would perform better in the elective if time and energy are spent on elective mathematics. The respondents explained that mathematics deals with difficult concepts which require continuous practice to become conversant with and therefore investing time and energy would help students to develop interest and achieve better results. The respondents specifically mentioned resources such as textbooks and past questions as the necessary ingredients to enhance students understanding and achievement. Another factor mentioned was teachers' preparedness and willingness to introduce different teaching techniques for effective teaching and learning. The respondents hinted that using appropriate methods can help students understand mathematics concepts taught by their teachers.

Moreover, the respondents were emphatic that when teachers are friendly and approachable, it enhances the trust students have in them (teachers) and also helps students to follow the teaching of concepts taught. The respondents emphasized that such a friendly atmosphere creates a bond between students and their teachers, and promotes better understanding of what they are taught. It was again indicated that better achievement in one subject could arise when the syllabus is completed as against the other that is not completed before WASSCE is written. The respondents were of the view that ability to complete the syllabus enhances the chance of mastering questions from a wide range of topics. They explained that students' inability to complete the syllabus limits them to a few topics which eventually could narrow their chances of passing the WASSCE examination.

4.7.2 Factors that account for students' inability to complete mathematics syllabus

When respondents were asked to list factors that could cause students inability to complete the syllabus, they came out with varied responses. Among the responses was the short duration of the senior high school programme. The respondents indicated that though the syllabus is made for a three-year duration, students are unable to exhaust all the three years studying. They explained that the first year students enter the schools (SHS) when the first term is half way through. Besides, final year students start and end their final examination half way into their final term. In effect, students cover about two and a half years instead of three years. To compound the problems, co-curricular activities such as inter-colleges, cultural activities, Students Representative Council (SRC) week, among others, are found to reduce greater part of the instructional time making it impossible to complete the syllabus. This also confirms the assertion made by Amanyi, Owuba and Adjabui (2013) that SHS students spend less time in learning Mathematics while teachers have limited duration to teach many topics in Ghana. They argued that mathematics instructional time ranges between five and six periods of 40 to 45 min per period and due to inadequacy of the treatment duration, the syllabus has become overloaded in terms of topics and contents. Interruptions such as holidays, sporting activities, excursions, among others, affect teacher-student contact hours. As teachers are unable to complete their syllabus, they resort to extra classes before and after the normal school hours.

The respondents claimed that an incompetent teacher can waste precious contact hours to explain just one concept for several weeks and make it impossible to complete the syllabus. Another important point raised by the respondents was centred on the rate at which students over-stay their mid-term holidays. Students who return to school on time after mid-terms holidays, sometimes have to wait two weeks for their counterparts

who over stay, before their teacher come to teach. This act slows down lesson delivery. Teacher absenteeism was also cited to be a cause of students' inability to complete syllabus.

4.7.3 What makes students allocate more time to one subjects than another?

When the respondents were asked to comment on factors which make them spend much time on one mathematics subject than the other, a great number (respondents) mentioned the difficult nature of a subject. The respondents indicated that some topics are more difficult to understand, and as they continuously focus on such topics their attention sometimes shifts from the less manageable subject. The respondents specifically tagged Elective mathematics as more difficult than the Core mathematics, and therefore require more time, energy and resources to study. Again, students' attitude towards a particular subject might result in committing more time to its learning or otherwise. Students who develop positive attitude toward one of the mathematics subjects turn to appreciate it more, love and devote time for its learning. They indicated that negative attitude developed towards a subject on the other hand could resort to students hating that subject to the extreme. Another reason why students devote much time to a subject is the encouragement and motivation received from their teachers and parents. The respondents noted that if students are encouraged by their teachers, and are provided with the required resources, they turn to develop love and interest towards studying that subject.

4.7.4 Factors students attribute their core mathematics achievement to

To verify from the respondents, the factors they attributed their achievement in WASSCE Core mathematics to, they came out with responses which could be divided

into two, positive and negative factors. On the positive factors, majority emphasized on issues such as sufficient preparation, hardwork and determination. Others include the availability of textbooks, and past questions, extra classes and competitive nature of individual's class. The negative factors have to do with limited duration of the senior high school system, negative attitude toward Core-mathematics, and students' inability to complete the syllabus.

The story for WASSCE Elective mathematics too was not different from that of the Core Mathematics. The response from the respondents could also be divided into two, the positive and negative factors. Indeed, majority of the respondents who emphasized on the positive mentioned, sufficient preparation, hardworking and determination, availability of textbooks, past questions and extra classes. They also mentioned, making the teaching and learning of the subject more practical, the kind of questions students get in an examination and competitive nature of individual's class. The negative factors which turn to lead to low achievement in the subject were: limited time for the senior high school education, having less interest in Elective Mathematics, students being taught by different Elective mathematics teachers from form one to form three.

4.7.5 Factors students attribute their elective mathematics achievement to

More importantly, when the respondents were requested to enumerate the factors they thought accounted for the differences in their achievement in both Core and Elective Mathematics, majority of them were of the view that the perceived difficult nature of Elective mathematics made them devote much of their time and resources to its learning. Respondents were of the view that students perform better in Elective Mathematics than Core Mathematics due to the fact that some Core mathematics

teachers fail to give the needed attention to General science and Arts students. Respondents revealed that some Core Mathematics teachers skip topics with the excuse that Elective Mathematics teachers would teach such topics or Elective Mathematics students are good enough to learn the topics on their own. Subject teachers' inability to complete syllabus was also noted to be one of the factors that accounted for their achievement in core mathematics. It was also mentioned that students' achievement in Elective mathematics also depends on whether same mathematics teacher is allowed to teach both core and elective mathematics.

4.8 Analysis of Interview Data from Respondents

4.8.1 Preference of one subject over the other

In order to answer the research question three, which is on factors that teachers attribute to students' core and elective mathematics achievements, several questions were asked during the interview. Among such questions was whether respondents had any preference of one subject over the other (Core and Elective Mathematics), and if so why.

In response to the question, varied answers were received from the interviewees during the interview. While some of the interviewees answered in the affirmative, others said no. In fact, one of the interviewees who said he had taught mathematics in the school for over a decade had this to say:

> *"I prefer Core Mathematics to Elective. This is because I have taught it for a long time and gained a lot of experience in teaching the topics. I have decided not to worry myself at all. Look! I am used to the topics and I have been handling them conveniently. Even if I close my eyes, I can teach without difficulty. I am not all that conversant with some of the topics in Elective Mathematics so why do I have to go and worry my head?"*

Another respondent who also responded in the affirmative said:

> "*I prefer to teach Core Mathematics than the elective because students always learn the basis at the JHS before they come. It is just building on*

> *the topics. These students, especially those in ……..... and other classes make the teaching difficult. You have to talk, and talk, and talk, but they won't understand.*

There was another teacher who hinted that he had taught both core and elective mathematics for several years and therefore said that:

> *Both Core and Elective mathematics are all mathematics. I have been trained for. There is no division in mathematics at the university level so I have the necessary qualification to teach any of the two. The topics of courses an Elective mathematics teacher learned is not different from what a Core mathematics teacher learned, and therefore do not exercise preference on one over the other.*

Another teacher also had this to say

> *I do not determine who to teach what. It is the sole responsibility of the head of department who does the classifications and class allocation. I only conform to what my Head of Department says. Surely, I am prepared to teach any of the two I am asked to.*

It is obvious from the above that some teachers prefer teaching one of the subjects to the other while others do not. Those who failed to make a choice between the two subjects want to suggest that they are masters of the mathematics and any division is out of their vocabulary. They claim they can teach any of the two subjects without difficulty. Others who skewed their preference toward one of the subjects considered their comfortability and the experience gained in teaching one of them. Some do not want to be the beginners but rather builders of an existing concept. That is the reason why "they have already gained the basis at JHS".

4.8.2 Seriousness attached to subjects

The seriousness students attach to their studies, serve as motivation for them to perform creditably in mathematics. Ali (2015) in a research found a significant and positive relation among motivational enhancement therapy and mathematics achievement. On the issue of which one of the two subjects' students attach seriousness to, majority of

the interviewees mentioned Elective Mathematics. A teacher who commented that he had taught the two subjects at SHS 2 and SHS 3 over a period of five years and knew which of the two subject attach seriousness lamented that:

> *Even now that teachers are not allowed to organise extra classes, some of Elective mathematics teachers secretly conduct classes with their students and the response is on the high level. No student wants to miss Elective Mathematics lessons as compared to Core Mathematics. Students always go extra mile in terms of their preparation, buying learning materials and doing extra classes when it comes to Elective Mathematics.*

Another teacher commented that:

> *The science students always say that once they study Elective Mathematics, Core mathematics become a bonus for them. In this case, their attention is always focused on the study of Elective Mathematics. They are always prepared to learn the elective and most of their resources are jeered toward the study of it.*

From the above comments, it is clear that students in general have developed positive attitudes toward the learning of Elective mathematics. They have developed high respect for the subject and want to do everything possible to maintain better achievement in it. The comments also suggest that students' attitudes toward learning of Core Mathematics is not encouraging compared to that of the Elective Mathematics.

4.8.3 Completion of syllabus

One factor which contributes to students' achievement in mathematics is the completion of the syllabus. The question asked to ascertain whether teachers are able to finish their syllabus before students write their WASSCE, generated responses that were in twofold. While some of the interviewees responded in the affirmative, their counterparts who formed the majority believed otherwise. Factors given by interviewees who responded why they are unable to complete the syllabus included co-curricular activities such as inter-SHS sports, cultural activities, Students

Representative Council (SRC) Week, and Mid-Term Holidays, among others. An interviewee who said he had taught for six years lamented that:

> *"The duration for the entire SHS education is not enough looking at the many topics one needs to cover. We were able to complete when the duration was four years. The 4-year duration was the best considering the level of these students before they come to SHS.*

Another interviewee also said that:

> *There are a lot of co-curricular activities and some of these co-curricular activities are not planned. I strongly expect school administration to plan well for those activities so that they do not interfere with any classroom business.*

Another interviewee also gave this response:

> *There are so many distractions. At times students could be asked to move out of the class to attend to punishment whilst classes are in progress. At times classes could be ended abruptly for students to attend unplanned programmes.*

It is obvious from the above comments that teachers blame their inabilities to complete the syllabus before students' WASSCE on factors that are beyond their control. They blame school administration for the continuous interruption of classroom activities by means of asking students to honour their punishment. They also see the various co-curricular activities as a threat to achievements. The continuous distraction of classes has been noted to also adversely affect students' achievements.

4.8.4 Subjects teacher expect students to perform better

When teachers were asked to indicate which of the two subjects they expect their students to perform better, majority of them indicated Core Mathematics. One respondent said that:

> *"I expect them to perform better in core maths. … any serious student can easily excel in core mathematics because most of the topics are basic and students who learn the concepts well at JHS can easily build on them and perform better. Unlike the Elective Mathematics where almost all the*

> *concepts are new to students and takes a very serious student to keep up with it, I think students should perform better in Core".*

Another teacher also said this

> *I expect students to perform better in Core Mathematics because good achievement in it brightens the chances of students' admission to tertiary institutions. A pass in Core Mathematics is a must and without it no tertiary institution would offer admission. But for Elective Mathematics, it is not a must because a student can still be admitted if obtain a pass in the other three Electives.*

On the contrary, there were other respondents who expected students to perform better in the elective than core. In trying to assign reasons, one of them had this to say:

> *I do expect them to do well in Elective Mathematics rather that core. This is because students over the years have been serious with the learning of the subject. They sometimes organise themselves for extra classes, and are encouraged by the teachers to be serious and perform better. Others think core mathematics is too cheap and therefore fail to pay attention to it.*

One other respondent also hinted that:

> *The topics in Elective Mathematics are not as many as the Core. Besides, Elective mathematics questions are straight forward and therefore students can easily master the topics and perform creditably well.*

From the above comments, it is obvious that there is a high expectation of students to perform better in Core Mathematics than Elective Mathematics. Based on the important role Core Mathematics plays in the admission process to tertiary institutions, teachers want their students to perform better in the subject. Some of the teachers are of the view that the kind of efforts students put up in studying Elective Mathematics must pay off. Another reason why students are expected to perform better is that Elective Mathematics questions are straightforward while the topics at the same time are not many, hence students expected to perform better.

4.9 Discussion of Results for Research Question Three

The study has revealed that majority of students consider Elective Mathematic very difficult as compared to the Core Mathematics and for that matter spend greater part of their time and resources towards its learning. Mathematics teachers were found to encourage students on the study of core mathematics more than the elective mathematics. This might be as a result that a pass in core mathematics is a prerequisite for tertiary admission. It became clear that majority of students have a negative attitude towards Core Mathematics than Elective Mathematics. This, as has been observed is consistent with the study by Linero and Hinojosa (2012). According to their study, people are more likely to develop positive attitude towards an 'attitude object' they are frequently exposed to than one they are not exposed to. Since students have been identified to be continuously practicing and spending most of their time on Elective Mathematics than the Core, they are likely to develop more positive attitudes towards the Elective Mathematics than the Core Mathematics. The study also found out that the way some mathematics teachers carry out their teaching eventually cause students to hate the subject. Battey and Leyva (2013) noticed that it takes a well-qualified teacher to know how to blend the topics and also have the skill to vary his or her methods for the enhancement of students understanding of the topics he or she teaches.

Another important revelation from this study is that majority of students in the senior high schools consider themselves as math phobias. It became clear that students are unable to complete their syllabus following the short duration for the senior high education.

Despite the limited duration for teaching and learning, it became known that co-curricular activities which cut or distract classes and majority of students over-staying in the house after the mid-term holidays deny students of precious contact hours. It was

observed that for a student to succeed in mathematics at WASSCE, there is the need to have a positive mind set toward the subject. Some of the factors considered as positive must be incorporated into ones' life. Factors such as sufficient preparation, hardworking and determination, availability of textbooks and past questions, having extra classes to enhance understanding, brightens the chances of individuals in examinations. This finding is largely supported by Butakor and Dziwornu (2018), who cited other school related factors which should be given attention by the school administration. They indicated that monitoring and supervision of teachers' teaching are of high influence on academic achievements.

Another important finding from this study is that some of the Core Mathematics teachers skip some important topics in Core Mathematics with the excuse that Elective Mathematics teachers would teach those topics or Elective Mathematics students are good enough to learn such topics on their own. Besides, the teaching method and teaching material as observed by Gegbe and Koroma (2014), can have a dire consequence on students' achievement. The analysis showed that the teaching of mathematics is a no go area for female teachers as the teaching of the subject is still dominated by men. All the teachers the researcher had an encounter with were all males. It was also found that majority of mathematics teachers prefer teaching Core mathematics to Elective Mathematics because they consider it to be easier. It was further noticed that majority of the teachers want to teach core mathematics because of the experience they want to gain.

Another finding from this study is that students attach more seriousness to the studying of Elective Mathematics than the Core mathematics. It was also realised that almost all the mathematics teachers are unable to complete their mathematics syllabus before students sit for WASSCE due to the continuous co-curricular activities

(specifically sporting activities) which distract the classroom activities or contact hours. Though Butakor and Dziwornu (2018) are of the view that school practices and factors should be given proper attention, their assertion is not consistent with the current study as some of the school practices hinder the completion of the mathematics syllabus. They indicated that monitoring and supervision of teachers' teaching are of high influence on academic achievements. Lastly, Elective Mathematics WASSCE questions have been found to be straight forward unlike that of the core mathematics. Due to the nature of WASSCE questions, teachers expect better achievement from their students in the Elective Mathematics than Core Mathematics.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Overview

This chapter summarizes the major findings and conclusions drawn from the study. Recommendations for students' high achievements in both Core and Elective mathematics are also presented.

5.2 Summary of the Study

The research comparatively studied the senior high school students' WASSCE achievement in core and elective mathematics from 2016 to 2018. The purpose of the study was aimed at assessing the trend of students WASSCE results in Core and Elective Mathematics at Tepa Senior High School. It was also aimed at finding the factors that accounted for students' achievements in both Core Mathematics and Elective Mathematics.

The research design was an explanatory sequential mixed methods. This design was used because it helped to analyse the quantitative data followed by the qualitative data to find out the trend, differences in students' achievements and finally investigated the factors or reasons that accounted for the results. A sample of 302 candidates was selected after using stratified and simple random sampling. Besides, simple random technique was used to select the results of students who studied both Core and Elective Mathematics. Also, a sample of ninety-four (94) participants comprising of sixteen (16) mathematics teachers and seventy-eight (78) past students who completed school within the period were selected using purposive and snowball sampling approach. Snowball sampling approach was used to get students from the length and breadth of the country to answer the questionnaire. Teachers were purposively selected and semi-

structured interview conducted for them. The questionnaire was divided into three Sections, A, B and C. Section A requested respondents to supply the background information such as gender, age, sex and residential status, highest qualification of mother, among others. The section B requested students to answer questions on factors that affect their academic achievements, while section C sought to find out the difference in students mathematics achievement. The semi-structure interview guide was also prepared to solicit views from teachers on factors accounting for their students' achievements in core and elective mathematics. The data gathered were analysed and presented.

5.3 Summary of Major Findings

The study found a downward trend or a retrogression in the students' achievements in core and elective mathematics. The Mean grades of students in core mathematics and elective mathematics continued to reduce as the years progress with the Mean grade of Core Mathematics increased by 0.01 and decreased by 1.03 from 2016 to 2017. The Mean grade of the Elective mathematics on the other hand, decreased by 0.55, which is largely significant. It further dwindled in the subsequent year by 1.31, which is also very significant. By comparing the Mean grades of both Core and Elective Mathematics over the period, the Mean grade of Elective Mathematics was greater than that of the Core Mathematics. The difference in the Mean achievements in both Core and Elective Mathematics was 0.47. This value suggests a better achievement in Elective Mathematics over the period.

It was found that majority of students considered Elective Mathematics as more difficult than Core Mathematics and for that matter spent greater part of their time and resources towards its learning. Mathematics teachers were found to encourage students

to study core mathematics more than the elective. It became clear that majority of students adopted negative attitude towards the studying of Core Mathematics than Elective Mathematics. The study also found that the teaching styles adopted by some mathematics teachers eventually caused students to dislike the subject. Another important revelation from the study was that a majority of students in the senior high school saw mathematics as a difficult subject. Another important finding from this study indicated that students were unable to complete their syllabus following the short duration of the senior high school programme. Co-curricular activities and students' over-stay after the mid-term holidays deny students of precious contact hours. Factors such as sufficient preparation, continuous hardworking and determination, availability of textbooks and past questions, extra classes brighten the chances of individuals to pass their examination.

5.4 Conclusion

1. As indicated in the findings, it can be concluded that students perceive elective mathematics as more difficult than core mathematics. However, despite the perception, students' achievement in WASSCE is better than Core Mathematics. Among the reasons are the energies, time and resources students invest in elective mathematics, which by so doing students tend to accept the subject and grasp the concepts taught by their teachers. This is also consistent with other studies (Deci, Vallerand, Pelletier, & Ryan, 1991; Ames & Archer, 1988; Duda & Nicholls, 1992; Dweck, 1986) which indicate that when students enjoy a particular subject, they are not only more likely to choose it, but may actually find it less difficult, because they are better able to learn and engage with the materials present in the subject. Thus, students tend to focus on learning goals such as understanding and mastery of

concepts. Students are more likely to freely engage in subjects via the experience of intrinsic motivation (Deci, Vallerand, Pelletier, & Ryan, 1991) which is linked with greater academic performance, learning, understanding, and memory.

2. Additionally, students channel their energies and resources to the learning of elective mathematics with the excuse that core mathematics is cheap and once they (students) get the understanding of elective mathematics concepts, the core mathematics becomes a bonus. Some of the resources geared towards Elective Mathematics include extra-classes which students are made to pay extra fees for the teaching they receive from the teachers. This is contrary to the studying of core mathematics. In other words, students think they can on their own learn Core Mathematics without any effort, and therefore do not need to invest energy and resources to pass.
3. As noted by some teachers, a pass in Core Mathematics is a requirement for tertiary education admission and students ought to use their resources judiciously in order to serve needs of the subject.
4. A positive correlation was found to be between Elective Mathematics and Core Mathematics achievements in WASSCE.
5. It can also be concluded that majority of mathematics teachers and students desire to complete the syllabus before WASSCE. However, they are unable to do so because of co-curricular activities like prolonged sporting activities and students overstaying from break after mid-term holidays, which in effect prevent teachers from carrying out any meaningful teaching.
6. Finally, it can also be concluded that despite the limited duration of Senior High Education system, competent teachers have been identified with time management ability and ability to blend topics to facilitate students' achievements.

5.5 Recommendations

From the findings and conclusions, the following recommendations were made.

1 General science, General Arts and Business students who learn Elective Mathematics should be counselled on the need to spend much time, energy and resources on learning of Core Mathematics since it is a requirement for tertiary admission.

2 Management of schools must ensure that Core Mathematics teachers are made to handle or teach all important topics in the syllabus without skipping any of them, especially in the General Science, General Arts, Business classes where Elective Mathematics is taught.

3 School Managements should at the beginning of each semester schedule sporting activities and abide strictly by the timetable so that students and teachers get enough time for their lessons. When that is done, the possibility for teachers to complete the mathematics syllabus before the beginning of WASSCE will be high.

4 As a matter of urgency, Heads of institution and Department should put up measures to nib in the bud students who overstay their holidays to help teachers and students cover more topics in the mathematics syllabus.

5 Parents must endeavour to psyche their wards to develop positive attitudes towards the learning of Core Mathematics.

6 Teachers, parents and management of schools should inculcate the elements such as determination and hardworking into students as they have great bearing on their mathematics achievements.

7 It is recommended that a study should be carried out to do a comparative study between students' WASSCE achievements in both core and Elective Mathematics nationwide.

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APPENDIX A

Questionnaire for Students

UNIVERSITY OF EDUCATION, WINNEBA

QUESTIONNAIRE

Instructions: This questionnaire is intended to find out students' achievement in both core and elective mathematics at the WASSCE level. It is purely for academic exercise and you are sure of confidentiality. Kindly answer the questions as sincerely as possible. Do not write your name. Thanks in advance.

Please tick [✓] against the one which applies and write briefly where necessary.

SECTION A: PERSONAL DATA

1 Gender a.Male [ ] b. Female [ ]

2 Age group: a. Below 18 yrs [ ] b.18-22 [ ] b.23-27 [ ] c.28-32[ ] d.33yrs +[ ]

3 Residential Status : a. Day [ ] b. Boarder [ ]

4 Highest educational level of father. a. No formal education [ ] b. Basic [ ] c. Secondary [ ] d. Tertiary [ ]

5 Highest educational level of mother. a. No formal education [ ] b. Basic [ ] c. Secondary [ ] d. Tertiary [ ]

6 Father's occupation ……..

7 Mother's occupation …….

8 Which of the programmes did you pursue at the Senior High School?

a. General Science [ ] b. General Arts [ ] c. Business [ ]

9. Which year did you complete SHS?.....

SECTION B: CORE AND ELECTIVE MATHEMATICS ACHIEVEMENT.
Using the scales assigned to each statement below, indicate by ticking [✓] the appropriate box that answers the questions on Elective and Core Mathematics.

SA=STRONGLY AGREE, A=AGREE, D=DISAGREE, SD=STRONGLY DISAGREE.

S/N.	*Responses on core and elective mathematics achievement.*	**SA**	**A**	**D**	**SD**
10	Elective Maths was more difficult for me than Core Maths at the SHS				
11	I spent much time and resources on Elective Maths than Core Maths at SHS				
12	I performed better in Elective Maths than Core Maths at the WASSCE				

13	We finished the Elective Maths Syllabus before writing my WASSCE				
14	We finished the Core Maths Syllabus before writing my WASSCE				
15	The same master taught me both Core and Elective Maths at SHS 3				
17	The same master taught me both Core and Elective Maths at SHS 2				
20	Different masters taught me Elective and Core Maths at SHS 1				
21	My maths masters encouraged me more on Elective maths than the Core				
23	Many of our students do better in core maths than Elective Maths				

SECTION C: FACTORS ATTRIBUTE TO EFFECTIVE LEARNING OF MATHEMATICS

SA=STRONGLY AGREE, A=AGREE, D=DISAGREE, SD=STRONGLY DISAGREE.

S/N.	*Factors students attribute to effective learning of Mathematics.*	**SA**	**A**	**D**	**SD**
24	I had a negative attitude towards Elective Maths than Core Maths at the SHS				
26	I had a negative attitude towards both Elective and Core Maths at the SHS				
28	The way my Maths Masters taught us made me dislike Mathematics in general				
29	We had enough copies of Core Maths Textbooks to use in class				
30	We had enough copies of Elective Maths Textbooks to use in class,				
31	Our Core Maths masters made teaching practical and easy for me				
32	Our Elective Maths masters made teaching practical and easy for me				
34	I had a good relationship with my Core Maths master and this made me like the subject				
35	I had a bad relationship with my Elective Maths master and this made me dislike the subject.				
37	Our maths masters had enough time and patience to explain new concepts to us.				
38	I consider myself as a maths phobia.				
39	No matter how I learn mathematics I am unable to understand				

40. What do you think accounts for better performance in one subject than the other?

……

……

41. What accounts for your' inability to complete mathematics syllabus?

……

……

42. What can make you spend much time on one of the maths subjects than the other?

……

……

43. Which factors do you attribute your performance in WASSCE Core Mathematics to?……

……

44. Which factors do you attribute your performance in WASSCE Elective mathematics to? ..……

……

.

APPENDIX B

Semi-Structure Interview Guide

UNIVERSITY OF EDUCATION, WINNEBA

1 How long have you been in your present post? …….. years

2 Do you teach both Core and Elective Mathematics? a. [ ] Yes b [ ] No

3 Which one do you comfortably teach?

4 How long have your taught the one in question?

5 Do you prefer teaching any of the two subjects?

6 What accounts for it if your response is yes?

7 Which of the two do your students attach more seriousness to?

8 Have you taught a third year class before?

9 Did you complete the syllabus before WASSCE if yes?

10 What accounts for not completing if answer is no?

11 What factors do you think contribute to students' ability to perform better in WASSCE maths?

12 What factors do you think contribute to students' inability to perform better in WASSCE maths?

13 Which of the two do you think your students perform better?

14 What reasons can you assign to your answer?

APPENDIX C

Results of Candidates selected from 2016 - 2018

CORE AND ELECTIVE MATHEMATICS RESULTS OF CANDIDATES SELECTED FROM 2016 – 2018 YEAR GROUPS

2016		2016		2017		2017		2018		2018	
Core	Elective	Core	Elective	Core	Elective	Core	Elective	Core	Elective	Core	Elective
B3	C4	B3	B2	A1	A1	C4	B3	C6	C6	C5	C4
C4	B3	B3	A1	B3	B3	C5	B3	B3	B3	C6	B3
B3	B3	B3	B2	B3	C4	C4	B3	B2	B2	C6	C4
C5	B3	B3	A1	B3	B3	C6	B3	C6	C6	B3	B2
B3	B3	B2	B3	B2	B3	B3	A1	C6	C5	C5	D7
B2	A1	B3	A1	B3	B3	C4	B3	C6	B3	C6	B3
A1	A1	C4	B3	B3	B3	B3	B3	B3	C4	E8	E8
A1	A1	C4	C5	B3	B3	C4	B3	B3	C4	C6	C6
B2	B2	B3	B3	B3	B3	B3	B3	C6	C6	C6	C6
B3	B3	B3	B2	B3	C4	C4	B3	C6	C6	C4	C5
B3	B3	B3	B2	B2	B3	C5	B3	C6	C5	C5	C5
B3	B2	B3	A1	B3	B3	C5	B3	C6	C4	C4	C6
B3	A1	C4	A1	C4	C4	C5	B3	C4	C6	B3	B3
C6	C4	A1	A1	B3	C4	C4	B3	C6	C5	C4	B3
C5	C4	B3	B3	B3	A1	C4	B3	C6	D7	B3	A1
B3	B3	B2	A1	B3	B2	C5	B3	B3	C6	C5	B3
B3	B2	C4	B2	B3	B3	B3	C4	B3	B3	C6	C5
C6	B3	C4	B2	B3	B3	B3	B2	C5	C6	D7	C6
B3	B3	B3	A1	C5	B3	C6	B2	C6	C6	C5	C4

B3	C4	B3	A1	C4	C4	D7	B3	C6	C5	C6	D7
B3	B2	C6	A1	B3	B3	B3	B2	C5	C5	C5	C4
B3	B2	C5	B2	B3	B3	B3	B3	C5	C4	C4	C4
B2	B3	C4	B2	B3	C4	C4	B2	C5	C5	C4	B3
C6	C4	C5	B2	B3	C4	B3	B3	B3	A1	C5	C6
C6	C4	B3	A1	B3	B3	B3	B3	C6	B3	C4	C5
C5	B3	C6	B3	C4	B3	B3	B2	B3	C6	C6	C5
C5	B3	D7	B2	B3	C4	B3	C4	C5	B3	C4	C4
C5	C6	C4	B3	B3	C4	B3	B3	C5	C6	B3	B3
B3	C5	C4	B2	B3	B3	B3	B2	C6	D7	C6	C4
B3	B3	B3	A1	B2	A1	B3	A1	C6	C5	C4	B3
A1	B2	C4	B2	C4	B3	B3	C4	C6	B3	C6	C6
B3	C6	C4	B2	B3	B3	B2	B3	C4	C6	C4	B3
B3	B2	B3	A1	B3	C4	B3	B3	C5	C4	B2	B3
C5	B3	C4	B3	B2	C4	B3	B3	B3	C4	B3	C4
B3	C5	A1	B2	B3	B3	B3	B2	B3	C5	B2	A1
B3	C4	A1	B2	B3	B3	C4	B3	B3	B3	B3	B3
B3	B2	B3	A1	B3	B3	B3	C4	B3	C6	B2	A1
B3	A1	B3	B2	B2	B3	B2	B3	C6	C5	B2	A1
B3	B3	B3	B2	B3	C4	B3	B3	B3	C6	B3	B3
B3	B2	B3	B2	B3	B3	B3	B3	C5	D7	B3	B3
B3	B2	B3	B2	B2	B3	C6	B3	B3	C4	B3	C4
B3	B2	B3	C4	B3	B3	C6	B3	C5	C4	B2	B3
B3	C4	B3	B2	B3	C4	B3	B3	B3	C4	B3	B3
B3	B2	C4	B3					B3	C6	D7	D7
C4	B2	E8	D7					B2	B2	C6	C6

B3	B2	B2	A1					C6	C6	C6	C5
B2	B2	C4	B2					B3	B3	B3	C4
B3	B3	A1	B3					B3	A1	B3	B3
B3	B2	B3	B2					B3	C4	C5	C4
B2	A1							A1	A1	B3	B3
								B3	C4	C5	C4
								C5	B3	A1	A1
								C5	C5	C6	C4
								C5	C4	C5	C4
								B2	C4	C5	C4
								C6	C6	C5	B3
								C6	C6	B3	B2
								A1	A1	C6	C6
								C4	B3		

APPENDIX D

Coding of WASSCE Results

HOW THE WASSCE RESULTS WERE CODED AND VALUES ASSIGNED TO GRADES

A1 = 9

B2 = 8

B3 = 7

C4 = 6

C5 = 5

C6 = 4

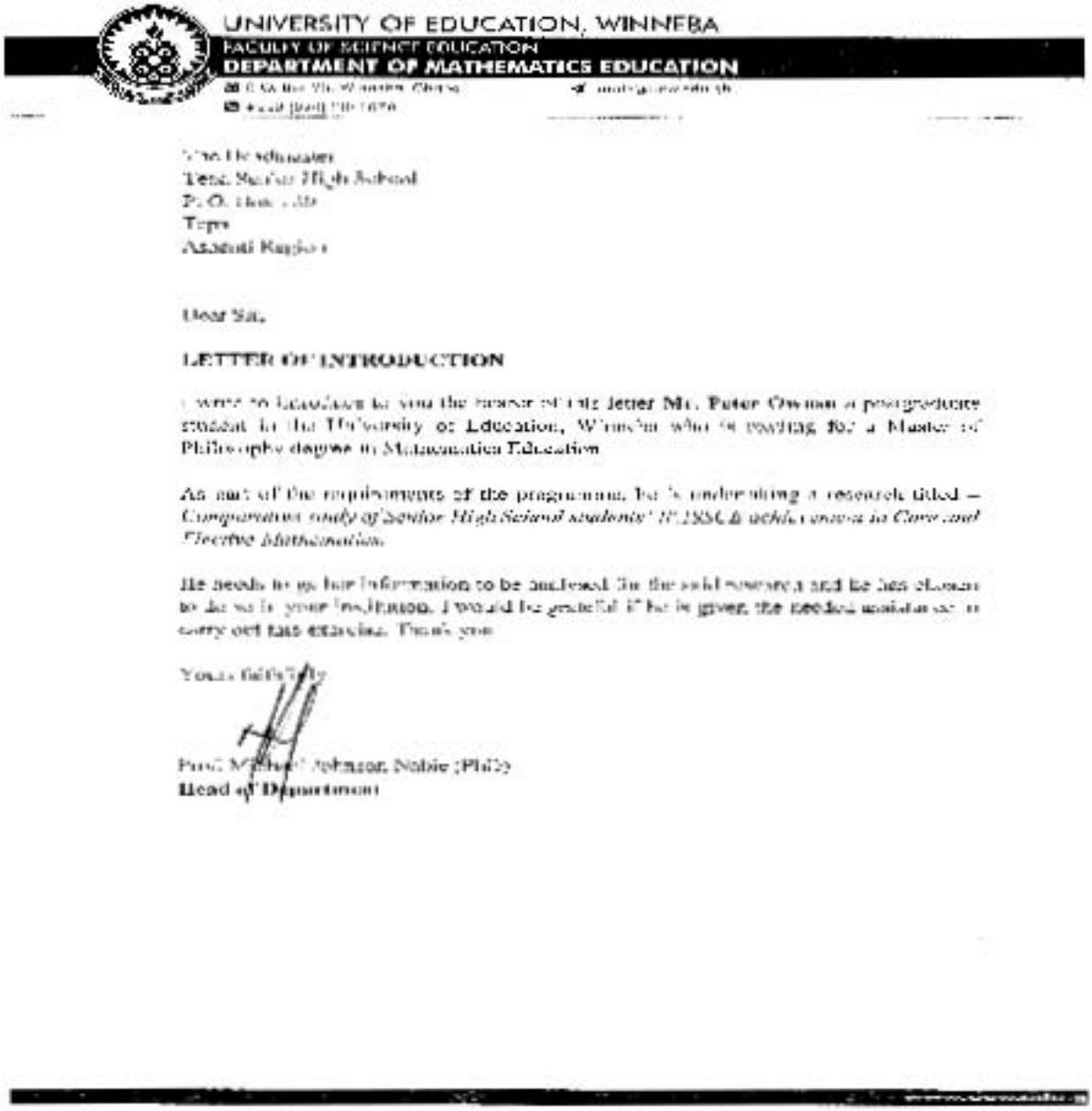
D7 = 3

E8 = 2

F9 = 1

APPENDIX E

Introductory Letter



UNIVERSITY OF EDUCATION, WINNEBA
FACULTY OF SCIENCE EDUCATION
DEPARTMENT OF MATHEMATICS EDUCATION

The Headmaster
Tepa Senior High School
P. O. Box ...
Tepa
Asanti Region

Dear Sir,

LETTER OF INTRODUCTION

I write to introduce to you the bearer of this letter Mr. Peter Owusu a postgraduate student in the University of Education, Winneba who is reading for a Master of Philosophy degree in Mathematics Education.

As part of the requirements of the programme, he is undertaking a research titled – *Comparative study of Senior High School students' ICT use in Core and Elective Mathematics.*

He needs to get his information to be analysed in the said research and he has chosen to do so in your institution. I would be grateful if he is given the needed assistance to carry out his studies. Thank you.

Yours faithfully,

Prof. Michael Johnson Nobie (PhD)
Head of Department