UNIVERSITY OF EDUCATION, WINNEBA

ASSESSMENT OF FACTORS INFLUENCING ACHIEVEMENT IN GEOMETRY AMONG SENIOR HIGH SCHOOL (SHS) STUDENTS

SAM, STEPHEN EBO

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(8150110009)

A DISSERTATION IN THE DEPARTMENT OF MATHEMATICS EDUCATION, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF PHILOSOPHY IN MATHEMATICS EDUCATION

OCTOBER, 2017

DECLARATION

Student's Declaration

I **Sam, Stephen Ebo** hereby solemnly declare that, except for references to other peoples' work, which have been duly acknowledged, this thesis is the result of my own research work carried out in the department of mathematics education and that it has neither in whole nor in part been presented for another degree in this university or elsewhere.

SIGNATURE: ……

DATE: ……..

Supervisor's Declaration

I hereby affirm that the preparation and presentation of the project work was supervised in accordance with the guidelines on project laid down by the University of Education Winneba.

SUPERVISOR'S NAME: DR. C.K. ASSUAH

SIGNATURE: ……

DATE: ……

DEDICATION

This dissertation is dedicated to the Almighty God for the physical and mental strength to accomplish this work within the prescribed period. It is also dedicated to the sweet memory of my late mum- Margaret Ekua Kukua Sam, a rare spacemen of motherhood whose strong desire for academic pursuit has inspired to this far. It is unfortunate that her rather premature demise will not make her witness the product of her hard work, and to my dearest wife Ernestina Mensah for her unwavering love and encouragement during the most difficult period of my life.

TO GOD BE THE GLORY

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I am full of gratitude to all relations, friends and all the people I have come into contact with, and who, in one way or the other have helped shaped my life for the better. You are the unsung heroes of my life. To my M.Phil. Mathematics 2017 colleagues, I say kudos for your company and support. My special recognition also goes to the four sampled secondary school teachers and students who participated in this study. Their interest in my study and their unreserved cooperation that made my fieldwork quite comfortable is gratefully acknowledged. I acknowledge finally, with gratitude all whose work I cited for this project.

None of those mentioned above, however, is responsible for any omissions or errors arising from the thesis, for which I accept full responsibility.

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ABBREVIATIONS AND ACRONYMS

CRDD	Curriculum Research Development Division
DFID	Department for International Development
GES	Ghana Education Service
ISSER	Institute of Statistical, Social and Economic Research
ITTC	Initial Teacher Training Colleges
JICA	Japan International Cooperation Agency
MDG	Millennium Development Goal
GAT	Geometric Achievement Test
FTSQ	Form Three Students Questionnaire
MTQ	Mathematics Teachers Questionnaire
MOE	Ministry of Education
MOESS	Ministry of Education, Science and Sports
NCTM	National Council of Teachers of Mathematics
SPSS	Statistical Package for Social Science
SSSCE	Senior Secondary School Certificate Examination
TED	Teacher Education Division
TIMSS	Trends in International Mathematics and Science Study
USAID	United States Agency for International Development
WAEC	West African Examinations Council

ABSTRACT

The purpose of the study was to assess the factors influencing achievement in geometry among senior high school students in Agona district in the central region of Ghana. The study was guided by the following objectives: to assess the extent to which teaching strategies, students' study habits, curriculum implementation and evaluation contribute to students' level of achievement in geometry, and also to determine some of the problems faced by teachers and students in teaching/learning of geometry. Using a multi-stage sampling procedure (stratified, simple random and purposive sampling techniques), a sample of four schools; two in each zone, 252 respondents comprising 12 mathematics teachers and 240 students were selected for in-depth study. The descriptive survey design was employed for the study in which questionnaire was used for data collection. Students' level of understanding on the contents of geometric concepts covered in the syllabus was tested using geometric achievement test (GAT). Descriptive and inferential statistics were used to establish the relationship between the aforementioned factors and the achievement of geometric concepts among the SHS students. The key issues postulated in the study revolved around teachers' teaching strategies, study habits, curriculum implementation and evaluation on students' level of achievement in geometry The key findings indicated a significant positive relationship between students' achievement in geometry and curriculum implementation and evaluation with *(r=0.402, p=0.000<.01)* and *(r=0.242, p=0.000<.01) at N=220* respectively. Furthermore, regression analysis showed that teachers' teaching strategies *(β = 0.231, P < 0.01)* and curriculum implementation *(β = 0.254, P < 0.01)* were predictors of students' achievement in geometry *[F=17.399 and P=0.000 (< 0.01)]*. In view of these findings, the study concludes that strategies used by teachers, curriculum aids in teaching geometric concepts and students' learning practices contributed to the poor level of achievement in geometry. On the basis of the findings, the following recommendations were made; interactive methods of teaching which are core to improving students' holistic understanding of geometrical concepts needs to be used by mathematics teachers. Also ministry of education and umbrella groups should harmonize the policy of teaching mathematics by organizing in-service trainings for mathematics teachers on the use of activity-oriented teaching, resource improvisations and monitoring of students work by teachers and teachers work by HoDs or Head teachers.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter discusses the background to the study, statement of the problem, purpose of the study, objectives of the study, the research questions that guided the study, significance of the study, limitations of the study, delimitations of the study, operational definition of terms and organization of the study

1.1 Background to the Study

Mathematics, which is one of the oldest fields of study in the history of mankind, has long been one of the most central components of human thought. It has been believed for centuries that mathematics sharpens the human mind, develops their logical thinking; enhances their reasoning ability and spatial power (Anthony & Walshaw, 2009). It is also seen as a pivotal subject, both in its own right and because of its important connections with diverse fields such as the natural sciences, engineering, medicine and the social sciences (Keith, 2000). Salman (2005) described it as a precursor of scientific discoveries and inventions. The importance of mathematics to man may account for its inclusion in school curriculum as a compulsory subject for every child of school going age to acquire the appropriate mathematical skills that will enable him cope with life challenges. Despite the relevance of mathematics in national development, the problem of poor achievement in mathematics has continued to rear its head (Blum 2002; Törner & Sriraman 2006).

Education is an element in stimulation of social economic development as advanced by several government policy documents and various scholars (Selina 2012). According to Todaro (2004), a country which is unable to invest in education to develop knowledge and skills of her people and utilize them effectively in national

economy will be unable to develop anything else. Hallack (1990), states that education has been identified Worldwide as an important component that determines character and social economic development of any nation. Developed countries like USA and Japan have a large pool of highly skilled human resources. This has enabled them to not only exploit local natural resources but also to identify and negotiate for resources of other countries. Education is fundamental ingredient for creating economic development. In the United States, it has been more important than increased capital in accounting for worker productivity and US economic growth (Smith, 2003).

The performance of education is evaluated based on examinations given and attainments of students in such examinations. Examinations have been accepted by educationists and other stakeholders as an important aspect of any education system (Musau, 2015). The importance placed on examination has seen stakeholders come up with strategies aimed at improving learners' performance in examinations (Juma, 2011). Eze, Ezenwafor and Molokwu (2015) noted that to facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods that best suit specific objectives and level exit outcomes. In the traditional epoch, many teaching practitioners widely applied teaching methods to impart knowledge to learners' comparative. Adumola (2011) also maintained that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered.

Mathematics is one of the educational disciplines that have a universal attraction because of its unique nature. It cuts across all subject areas which has made some countries to study it as a core subject so that it will form a basis for students to build their future academic pursuit. Curriculum Research and Development Division

(CRDD) Ghana (2015) stated that the strong mathematical competencies developed at the basic and secondary levels are necessary requirements for effective study in mathematics, science, commerce, industry and vocations as well as those students terminating their education at the Junior High School (J.H.S) level. Secondary school mathematics is designed to help students in working out solutions to problems with accuracy, precision and speed both academic and functional life situation. According to Kinyua, Maina and Odera (2003), Mathematics helps the students to improve their skills in measurement, approximation and estimating. Such skills are necessary for any quest, be it academic or business. It also aids students in collecting, representing and interpreting data, which they can manipulate and add meaning to Mathematics, therefore helping the learner to develop investigative and problem solving skills, thus enabling them to understand better and manage their personal and collective life (Costello, 1991). Despite the relative importance of mathematics, it is very disappointing to note that the students' performance in the subject in both internal and external examinations have remained consistently poor (Blum 2002; Törner and Sriraman 2006).

The governments of Ghana and other stakeholders in the education sector have introduced a number of initiatives to promote effective teaching and learning of Mathematics with the aim of making the subject more enjoyable (Anku 2008). For example, in 2003 the Ministry of Education (MoE), in collaboration with the Teacher Education Division (TED), reviewed the teacher education curriculum and upgraded all Initial Teacher Training Colleges (ITTC's) to diploma awarding institutions with the aim of improving teachers' knowledge of content and pedagogical skills in the various subject areas. In addition, the Ministry of Education, in collaboration with other international agencies such as the Japan International Cooperation Agency

(JICA), the United States Agency for International Development (USAID) and the Department for International Development (DFID), have continuously shown enormous commitment by embarking on mathematics and science projects to improve the teaching and learning of mathematics and science at the basic, secondary, teacher training and tertiary levels (Ampiah et al. 2000). The latest of these initiatives was the introduction of a new mathematics curriculum in September 2015, which showed a paradigm shift in the teaching and learning of Mathematics and other school curriculum subjects in the country. Although there is no consensus as to what constitutes good Mathematics teaching and learning practices in Ghana, the 2015 curriculum offers new ideas and directions based on the principles of constructivism. The main rationale for the introduction of the new curriculum was to enable all young Ghanaians acquire a conceptual understanding of mathematics, Mathematical skills, insights and attitudes and adhere to values that will contribute successfully to their chosen careers and daily lives (MoESS 2010).

In spite of all these noble initiatives, the problem of poor achievement in mathematics continues to rear its head in the nation's public examinations. The subject is a hurdle to be cleared by all students who wish to enter into the university. It is required of a student to pass three core subjects in addition to three elective subjects to guarantee a university admission in Ghana. One of these three core subjects happens to be mathematics and this has triggered the urge of students in second cycle level to do everything possible to pass mathematics. This needed achievement creates an unnecessary tension on both students and mathematics teachers any time the external examination draws closer and closer. The solution to the above anxiety lies in the ability of mathematics educators to assess what learning opportunities have been provided to their students to learn mathematics in their

various schools. Mathematics educators need to make such an assessment because Linn and Baker (1993) emphasised that it was prudent to provide adequate and timely instructions of specific content and skills prior to an examination. Therefore, educational assessment and its achievement must depend on the learning opportunities that have been created for students to learn. Ysseldyke, Thurlow, and Shin (1995) have defined opportunity to learn as the criteria for, and the basis of assessing the sufficiency or quality of the resources, practices, and conditions necessary at each level of the education system to provide all students with the needed material in national curriculum. It also includes the provision of curricula, learning materials, facilities and instructional experiences that enable students to achieve high standards (Schwartz, 1995).

The instructional experiences involve that aspect of the learning process that is provided by the teacher during the lesson delivery. Teachers by this measure have to design their lesson activities to benefit all, (the high, average and weak students). This can be done by the teachers' effort to blend assessment and instructional activities intermittently to know students grasp of content at different levels during a lesson delivery. An experienced mathematics teacher would get close to his or her students to know in depth what are their weaknesses, interests, capabilities and needs are in studying mathematics (Barwell et al.2007).

A close examination of the Secondary School Mathematics Syllabus indicates that geometry covers a large portion of the content approximately 43.75% (CRDD syllabus, 2007). This geometrical content, according to Henderson (1982), can be classified into five areas that is Plane geometry; the geometry that deals with figures in two dimensional plane, Solid geometry which deals with figures in three dimensional space, Spherical geometry dealing with figures on the surface of the

sphere, Euclidean geometry which deals with plane and solid based on Euclid's postulates and analytical geometry that deals with the relationship between algebra and geometry, using graphs and equations of lines, curves and surfaces to develop and prove relationships (Henderson, 1982).

This study examines the core topics in geometry where the problems of teaching and learning occur most in Mathematics. The common topics in geometry, according to Curriculum Research and Development Division (CRDD syllabus, 2007) include: plane and solid shapes, measurement of plane and solid shapes, polygons, geometrical ratio, geometrical transformation, latitude and longitude among others are generally identified to be difficult by both students and teachers. Geometry is an aspect of Mathematics which deals with the study of different shapes. These shapes may be plane or solid. A plane shape is a geometrical form such that the straight line that joins any two points on it wholly lies on the surface. A solid shape on the other hand is bounded by surfaces which may not wholly be represented on a plane surface. Since large proportion of the content in the syllabus is geometry, these prompted the researcher to closely examine the content of this strand in the WASSCE Examination of the years 2010 and 2016. This implies that a student who does not understand mathematical geometrical concept may not end up attaining high grades in Mathematics.

Students' performance is considered a vital indicator of good schooling, so the poor performance of Senior High School (SHS) students in mathematics and geometry in particular has not only led to public outcry, but also educationists have been increasingly occupied in their attempt to identify factors that influence students' performance especially in Secondary School Certificate Examination. According to the West Africa Examination Council, chief examiner's report (WAEC, 2005, 2006 &

2007) on students' areas of deficiency in the Senior Secondary School Certificate Examination (SSSCE) Mathematics (core), showed that students least understood geometry concepts. Most candidates avoided geometry questions and the few who attempted it were unable to solve the problems accurately because they did not know the approach needed to solve the problem. The WAEC (2010) report indicated that candidates performed poorly in the construction question, which they were required to inscribe a circle. According to the report, there was misconception of the concept leading to wrong interpretation, hence the poor performance in the question. The same old story repeated itself in the 2015 release of the West Africa Secondary School Certificate Examination (WAEC) results by West Africa Examination Council which declared that only 25.04% of the candidates were successful in Mathematics (WASSCE, 2015), that is, obtaining between grades A1 and C6. Observation made by AnamuahMensah, Mereku and Ghartey-Ampiah (2008) with regard to the general performance of Ghanaian students' in mathematics from the Trends in International Mathematics and Science studies (TIMSS) (2007) report brings to light the teachers' delivery approach. According to Anamuah-Mensah et al. (2008), they were of the view that in Ghana, there seem to be rapid movement from one topic to another suggesting that the level of the subject taught was rather superficial, with students often failing to acquire deeper understanding of any particular topic.

Teaching was largely by exposition with little opportunities for learners to engage in practical and problem solving activities. However, in high achieving countries in TIMSS (2007), the report stated that teachers tend to have students struggle with a problem and then participate in a discussion about how to solve it. The teacher's role was to engage the students and help them understand the problem so they can attempt to solve it. These views made by Anamuah-Mensah et al. (2008) suggest that teacher

pedagogies in the teaching of mathematics needed to be given a second look both at the in-service level and tertiary so that learners can gain deeper insight into mathematical concepts taught.

A cluster of variables has been implicated as responsible for the dismal performance of students. These include, government related variables, curriculum-related variables, examination body related, teacher, student, home and text-book related variables. Apart from these variables, Amazigo (2000) has identified poor primary school background in Mathematics, lack of incentives for teachers, unqualified teachers in the system, lack of learners' interest, perception that Mathematics is difficult, large classes and psychological fear of the subject as factors responsible for the dismal performance of students in the subject. Also, Anamuah-Mensah (2010), an educationist attributed lack of effective supervision and monitoring at school, lack of motivation for teachers and inadequate number of qualified teachers to fill empty classrooms to the poor performance. In the same vein, Diaz (2003) found factors such as intellectual ability, poor study habit, achievement motivation, lack of vocational goals, low self-concept, low socio-economic status of the family, poor family structure and anxiety as contributing to educational performance. It goes without saying that poor academic achievement in school may be the result of interplay of several factors.

If what has been described above are necessary constituents that facilitate students' achievement, then what should be the teachers' role, the students' role, parents' role and schools' roles in ensuring its success in the teaching and learning of mathematics? How can we be sure teachers and students are playing their respective roles to enhance mathematics achievement at the SHS level? This study was based on the basic Mathematics geometrical concepts that are the foundation of the further

geometry studied in secondary school syllabus. Hence, this study was carried out to investigate the factors influencing students' achievement in geometry at the senior high school (SHS) level

1.2 Statement of the Problem

Educational performance is perhaps the most imperative meter for measuring adolescents' well-being. It is the marker for successful college and university enrolment, scholarship, awards and future job success (Ajayi, 2006). In Ghana, much emphasis is placed on education because it is believed to be the only avenue for national development (Nyarko, 2011). However, this can only be achieved if students who are the citadel of learning get actively involved in academic activities which will enhance their academic performance.

Teaching and learning of mathematics consistently generates interest among scholars over the years. This is because of the importance of mathematics to humanity. Mathematics is an intellectually stimulating subject that affects every facet of human activity such as politics, economy, science and technology. Salman (2005) described it as a precursor of scientific discoveries and inventions. The importance of mathematics to man may account for its inclusion in school curriculum as a compulsory subject for every child of school age to acquire the appropriate mathematical skills that will enable him cope with life challenges.

Despite the relative importance of mathematics, it is very disappointing to note that the students' performance in the subject in both internal and external examinations has remained consistently poor (Blue 2002; Torner and Sriraman 2006). The poor performance of students in mathematics has been a thing of concern to mathematics educators, parents and government. The chief examiner's annual reports in mathematics in the Senior School Certificate Examinations (SSCE) conducted by the

West African Examinations Council (WAEC) and National Examinations Council (NECO) are good testimonies of those facts. Mathematics educators have put in effort aimed at identifying the major problems associated with secondary school mathematics. Despite all these noble efforts, the problem of poor achievement in mathematics has continued to rear its head. Table 1.1 shows the performance trend analysis of core mathematics in the WASSCE results, Ghana.

Table 1.1: Performance Trend Analysis of Core Mathematics, Ghana

Year of Exams	A1 – C6	D7 – E8	F9
2015	25.29%	29.75%	37.17%
2016	32.83%	27.68%	38.10%
2017	42.73%	37.0%	20.0%
2018	38.33%	30.09%	31.58%

Source:(WAEC, 2015, 2016, 2017 & 2018)

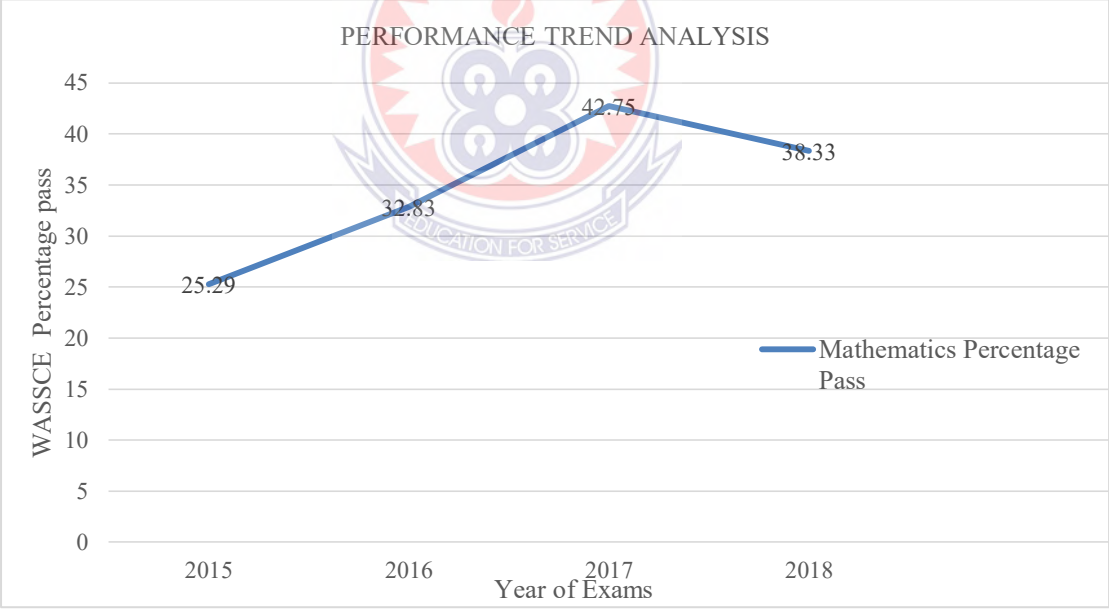

Figure 1.1: National Mathematics Percentage Pass for 2015 to 2018 WASSCE Results

Source:(WAEC, 2015, 2016, 2017 & 2018)

Figure 1.1 shows an improvement in attainment in mathematics but like it or hate it, notwithstanding the improvement that have been chalked within the past years using 2018 as a reference point, the result dropped drastically. More so, performance

statistics by West Africa Examination Council (WAEC) from 2015 to 2018 shows that majority of the mathematics candidates did not obtain the pass grade ($A_1 - C_6$) to qualify for admission to tertiary education. Evidence from research and West African Examination council (WAEC) Chief Examiners' Reports in Ghana has pointed towards students' poor performance in geometry. The WAEC (2005, 2003,) cited in Okigbo and Osuafor (2008) in Nigeria observed that candidates were weak in Geometry of circles and 3- dimensional problems. According to their reports, most candidates avoided questions on 3-dimensional problem, and when they attempt geometry questions; only few of the candidates showed a clear understanding of the problem in their working. The Examination Council (2017) examiners' report showed that questions on geometry topics such as transformational geometry were very poorly answered. The same report concluded that teachers did not get adequate support in the area of geometry (transformation) in their teacher preparation programme. Thus, they went into the field with the same challenges that they had when they were students themselves in schools. According to the West Africa Examination Council, chief examiner's report (WAEC, 2010, 2015 & 2017) on students' areas of deficiency in the Senior Secondary School Certificate Examination (SSSCE) Mathematics (core), showed that students least understood geometry concepts. Most candidates avoided geometry questions and the few who attempted it were unable to solve the problems accurately because they did not know the approach needed to solve the problem. The WAEC (2018) report indicated that candidates performed poorly in solving problems involving geometry, such as cyclic quadrilaterals, tangent and chord theorem. According to the report, there was misconception of the concept leading to wrong interpretation, hence the poor performance in the question.

Mathematics content in high school revolves around geometry e.g plane figures, coordinate geometry, trigonometry, transformation among others. A student whose spatial ability has not developed may not perform well in mathematics. Spatial ability to visualize figures is developed in geometry. A close examination of the Secondary School Mathematics Syllabus indicates that geometry covers a large portion of the content approximately 43.75%, (CRDD syllabus, 2007). Since large proportion of the content in the syllabus is geometry, these prompted the researcher to closely examine the content of this strand in the WASSCE examination of the years 2010 and 2016. This implies that a student who does not understand mathematics geometrical concepts may not end up attaining high grades in mathematics. Students' performance is considered a vital indicator of good schooling, so the poor performance of Senior High School (SHS) students in mathematics and geometry in particular has not only led to public outcry, but also educationists have been increasingly occupied in their attempt to identify factors that influence students' performance especially in Secondary School Certificate Examination.

Several studies have been conducted in this field, for instance, Odundo (2003) noted that students who experience a mismatch between instructional strategies used during teaching and their preferred styles often feel that their learning needs are being addressed using an unfamiliar language. The mismatch poses a difficulty for some students in internalizing the materials delivered, leading to lower grades (Odundo, 2003). Similarly, Zeeb (2004) indicated that students whose styles are not matched with learning methods that are chosen by teachers are less likely to develop interest in learning. In the absence of learner interest in a subject, concentration level drops and learning achievement is greatly impaired.

It is worth noting that most of the studies in this field such as Odundo (2003) and Zeeb (2004) focused on mathematics as a subject. This study however focused on geometry. Poor performance of secondary schools in the Country undermines students' chances of joining institutions of higher learning and jeopardizes opportunity for job placement, and in most cases reduces an individual's active participation in national development. The pertinent questions to address, therefore, are what are the causes of this poor academic performance of student? Is the fault entirely that of teachers or students or both of them? It based on these facts that this study identifies and examine related factors that influence academic achievement. This study therefore, sought to analyse the relationship between selected teachers' teaching strategies, students' study habits, curriculum implementation and evaluation, and academic achievement of students in geometry among secondary school in Agona District of Central Region, Ghana.

1.3 Purpose of the Study

The purpose of this study is therefore to assess the factors influencing achievement in geometry among Senior High School (SHS) students in Agona district in Central Region of Ghana. Specifically, the study sought to understand the underlying relationships among teaching strategies, study habits, curriculum implementation, and evaluation, and students' achievement in geometry. The study further identifies some of the challenges faced by teachers and students in their teaching/learning of geometric concepts and give recommendations which if implemented would improve the study of geometry and eventually mathematics achievement at schools and national examination in the country of study.

1.4 Objectives of the Study

The study sought to assess the factors influencing achievement in mathematics, particularly geometry among secondary school students. In view of this assertion, the study critically examines:

1. The relationship between students' achievement in geometry and mathematics teachers' teaching strategies, study habits, curriculum implementation and evaluation, and also the extent to which they predict students' achievement in geometry.
2. The challenges teachers and students face in teaching/learning of geometric concepts at senior high school level.

1.5 Research Questions

The study addresses the following fundamental questions:

1. What are the effects of teachers' teaching strategies on students' level of achievement in geometry at the Senior High School (SHS) level?
2. How do students' study habits influence their level of achievement in geometry at the Senior High School (SHS) level?
3. What are the effects of school curriculum implementation on students' level achievement in geometry at the Senior High School (SHS) level?
4. How does evaluation influence students' academic achievement in geometry at the Senior High School (SHS) level?
5. What are the challenges teachers and students encounter in teaching and learning of geometric concepts at the Senior High School (SHS) level?

1.5.1 Hypotheses of the Study

The study sought to test the following hypotheses:

1. There is a statistically significant relationship between students' academic achievement in geometry and teachers' teaching strategies.
2. There is a statistically significant relationship between students' academic achievement in geometry and school curriculum implementation.
3. There is a statistically significant relationship between students' academic achievement in geometry and evaluation.
4. There is a statistically significant relationship between students' academic achievement in geometry and their study habits.

1.6 Significance of the Study

Significance to Teachers

The results of the study will contribute to mathematics education literature; it will open up new possibilities for teachers to evaluate their teaching approaches and adopt those which improve performance in mathematics instructions. Mathematics teachers will benefit from the study for it will give them an elaborated description of the importance of the interactive teaching methods in geometry. It will give information about teachers' qualifications, subject majors, years of experience, professional development and teaching practices, and how they affect students' achievement in mathematics in the context of Ghana.

Significance to Students

The students at the sampled schools would benefit by performing better academically, progressing successfully through the stages of education. They would therefore have more life opportunities and also improve their family lives and socio-economic conditions.

Significance to School Administration/ Policymakers

The findings and conclusions from this study will improve the current situation by providing evidence for debate with regard to how mathematics is taught and learned in schools. This, in turn, may provide valuable insights into how future curriculum restructuring, teacher training and development may better serve the needs and aspirations of the people. Moreover, the data gleaned from this study may provide information about the challenges posed by the new mathematics curriculum and the possible ways forward. In turn, this may contribute to the existing body of literature and also help towards building a theory of mathematics teaching and learning within the Ghanaian context. In this study, the classroom context is considered to be complex in nature and particular emphasis is given to understanding how the subject is taught and learnt from multiple perspectives. Methodologically, the use of the mixed methods strategy in the present study has the potential to extend our understanding of how mathematics is taught and learned in our schools by providing both quantitative and qualitative data about the situation. The use of a mixed methods approach enables access to different kinds of empirical evidence which cannot be achieved by using a single approach. It may pose issues that may motivate and/or serve as a reference material for other researchers and policy makers who are in need to fill the gap in the area.

1.7 Limitations of the Study

According to Baumgartner, Strong & Hensley (2002), limitations are conditions beyond the control of the researcher that place restrictions on the conclusion of the study and its application. The limitations on which the present study was based were as follows:

- The anticipated number of teachers who were needed for this research was not achieved due to the fact that some of them were feeling reluctant to participate in the research exercise.
- Although, there might be many factors that facilitate achievement in geometry, this study was restricted to those factors that were not beyond the control of educators. This decision was based on the fact that certain factors might be home and family-related and these could be very difficult to change.
- Owing to the limited time and financial resources available, the study was limited to only four senior high schools and form threes since it assumed that they have covered up to form two syllabuses.
- The data collection instruments were limited to questionnaires and geometry achievements test (G.A.T) due to factor of time.

1.8 Delimitations of the Study

It is believed in research that large data cases increase reliability of the information that would be gathered. Therefore, it would have been proper to cover all Senior High Schools in the study Region to have a larger sample size for the study so that meaningful generalization could be drawn to cover the entire Region. However, in view of constraints such as time, proximity, finance and materials, the study covered only four Senior High Schools which happen to be Swedru Senior High School (SWESCO), Swedru School Business (SWESBUS), Nsaba Presbyterian Senior High School, and Nyakrom Senior High School within the Central Region. It is also delimited to only third year students of those selected Senior High schools. This was because the third year students had covered almost all aspects of geometric content in the syllabuses at the time the study was conducted.

1.9 Definitions of Operational Terms

It is important to define some key concepts that have been used in the study in order to clarify the context within which they are being used.

Academic achievement: refers to a successful accomplishment or performance in a particular subject area. It is indicated as by grades, marks and scores of descriptive commentaries. It includes how students deal with their studies and how they cope with or accomplish different tasks given to them by their teachers in a fixed time or academic year (Hawis & Hawes, 1982 cited in Dimbisso, 2009). In order to avoid monotony, different terms such as academic performance and student performance are used in this study. All meant to refer to academic achievement.

Activity-Oriented Teaching: Methods of teaching encouraging participation and involvement of learners in planned class activities.

Discussion method: An orderly process of face-to-face interaction in which people exchange ideas about an issue for the purpose of solving a problem, answering a question, enhancing their learning, or making a decision.

Experience: Experience is defined in terms of a teacher's number of years of teaching practice. That is the number of years the teacher has taught mathematics in secondary school.

Factor: In this study, a factor is taken to mean any element, force, condition or circumstances that has a causal influence or can contribute to the students' achievement in mathematics (geometry).

Geometry: is the branch of Mathematics that deals with space, figures in space and with properties of those figures such as size and shape.

Learning: a permanent change in behaviour as a result of sustained practice or experience.

Lecture Method: a teacher centred approach in which the teacher delivers the content in a highly structured format, directing the activities of the students.

Strategy: is the overall way in which the process of instruction is organised and executed.

Syllabus: is a document that shows the content to be covered in a given subject and time at a particular level.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

In this review, literature was provided to support the study under the following thematic areas include: theoretical framework, conceptual framework, concept of Geometry, teaching strategies, students' achievement in geometry, intervention factors. The study further considered the empirical review which focuses on the following sub-headings include: teachers' characteristics (academic and professional qualifications, subject majors and years of experience), strategies for teaching and learning of geometry, level of understanding of geometric concept, effect of the strategies used in teaching and learning on performance, problems faced in teaching and learning of geometry, research gaps and finally summary of the literature review.

2.1 Theoretical Framework

Over a period of years, models have been examined, reviewed, revised and edited to fit into today's modern society, beginning with Carroll's (1963) model to date. During these periods, several models were developed to explain the teaching and learning process. One of this models that has been adapted to support this research in terms of theory is that of Bertalanffy and Ludwig (1973). This study is anchored on system theory. System theory is a framework for elaborating increasingly complex systems across a continuum that encompasses the person-in-environment (Carter, 2011). Systems theory was proposed in the 1940's by biologists Ludwig and Von Bertalanffy, who suggested that real systems are open to and interact with their environment, and that they can acquire qualitatively new properties through emergence, resulting in continual evolution. Rather than reducing an entity to the properties of its parts or elements, system theory focuses on the arrangement of and

relations between the parts which connect them into a whole (Bertalanffy & Ludwig, 1973). In this study the system theory explains that teaching/learning process is dynamic and has input and output. Input includes the characteristics of teachers and students that they bring to the teaching learning process. Process include the thinking, feeling, commitment and action of teachers and students within the classroom or learning situation as well as interaction patterns and description of the learning environment that results from this interaction (Mcllrath & Huiti, 1995). Output includes specific measurement or measurement of learning.

It is argued that understanding of geometric concepts leads to students' achievement in Mathematics. The best results are achieved when the most suitable materials are used in the teaching/learning system in the best way possible. The study was based on teaching strategies that involve students that lead to worthwhile learning of geometry than expository teaching method. It was also based on the fact that some students study habits if employed can result to correcting understandings of mathematical geometry concept. It looked into school curriculum implementation, teaching strategies, students study habits and evaluation effect on the level of achievement in geometry. The study will further be guided by the social constructivist theory by Woo and Reeves (2007). Social constructivist theory suggests that knowledge is first constructed in a social context and then appropriated by individuals. It involves learners constructing knowledge which would not be possible alone. This theory emphasizes that individuals make meaning through the interactions with each other and with the environment that they live in. In this theory Vygotsky observed that when children were tested on tasks on their own they rarely did as well as when they were working with others. Constructivism is a theory that gives teachers another perspective to rethink how learners learn and to focus on the process and provide

ways of documenting change for transformation. It also reminds teachers to look for different ways to engage individual learners and to provide a rich environment for explorations. The teacher's role is to prompt and facilitate learning (Vygotsky, 1978).

2.2 Conceptual Framework of the Study

This study contented that students' poor performance in mathematics, particularly geometry could be influenced by various factors, such as teaching strategies, students study habits, curriculum implementation and evaluation. The researcher felt that if these issues are enhanced, students' performance in geometry would be improved. Students' achievements, as an output, is produced by inputs in the educational process. Simkins cited in Adeyemi (2008) argued that the education system is a productive system that has outputs. The outputs are generally defined in terms of students' test scores which denote academic achievement (Worthington, 2001). Simkins expressed that the components of an education system could be represented in an input – process – output model. According to Wobmann (2004), student achievement is produced by several inputs in the educational process. Such inputs include but are not limited to student's study habits, class size, availability of teaching and learning materials, curriculum implementation, and evaluation and teacher characteristics. The teacher as an input is the principal factor in education provision and thus affects the quality of education in a significant way. According to Ankomah, Koomson, Busn and Oduro (2005), teacher factors that have an effect on academic achievement include the number of teachers on post, teacher student's ratio, teacher qualifications and the personal characteristics of the individual teacher. The personal characteristics include academic qualifications, pedagogical training, content training, aptitude, and years of service/experience. A teacher brings these characteristics to class to facilitate the learning process. The extent to which other inputs can improve

the quality of education is directly related to the extent to which teachers effectively use the inputs to improve the teaching and learning process. According to Sifuna and Sawamura (2011), the process quality is therefore the quality of the teacher-student interaction in the teaching learning process. This study therefore sought to investigate the influence of selected teaching strategies, students study habits, curriculum implementation and evaluation on the academic achievement of secondary school students. The model of Input-Process-Output is used in this conceptual framework. Figure 2.1 summarizes the factors that play a role in students' performance in mathematics.

Independent variables

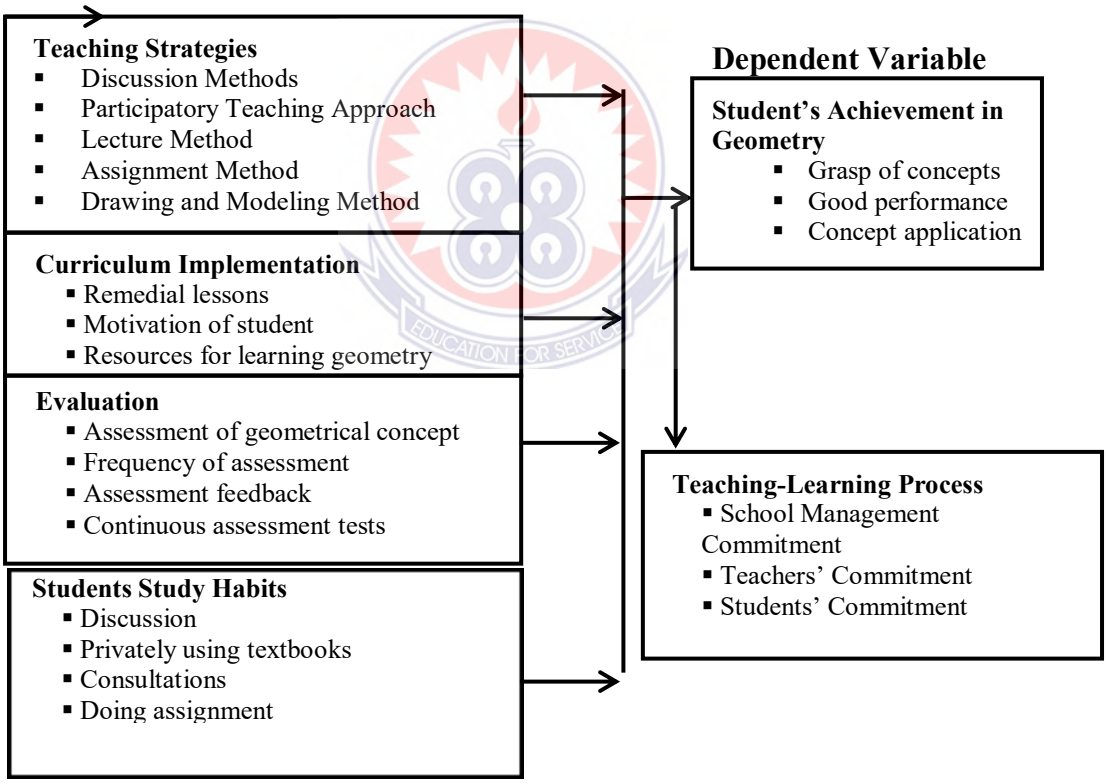

Figure 2.1: Relationship between factors influencing students' learning and achievement in geometry

Source: Wanjohi (2004)

The study conceptual framework is based on the variables used in the study. The independent variables are embedded in mathematics teachers' teaching strategies, curriculum implementation, evaluation and students' study habits. The intervening factors are presented as possible interventions and were considered to be the ones that catalyse the improvement of the results. Students' improved performance is shown as the possible outcome.

2.3 The Concept of Geometry

Geometry is a branch of Mathematics. Its study enhances our appreciation of the world. It can be found in the structure of solar system, in geological formations and others. Geometry can develop problem- solving skills and this is one of the major reasons for studying Mathematics. Geometry, to the ancient Greeks means 'earth measure' thus: geo means, 'earth' and metreo means 'measure'. The role of geometry in the elementary classroom has increased significantly since the release of the common core state standards for Mathematics which is adopted by the majority of the states in the United States of America (Common Core State Standard, Initiative, 2010). Geometry has captured the attention of nearly every civilization throughout the ages (Brown, Harrison, Janet, Punch & Watson, 1992).

Royal Society and Joint Mathematics Council (2001) reported that the aims of teaching geometry can be summarized as follows;

- To develop spatial awareness, geometrical intuition and the ability to visualize;
- To provide a breadth of geometrical experiences in 2 and 3 dimensions;
- To develop knowledge and understanding of and the ability to use geometrical properties and theorems;

- To encourage the development and use of conjecture, deductive reasoning and proof;
- To develop skills of applying geometry through modeling and problem-solving in real world contexts;
- To develop careful Information Communication Technology skills in especially geometrical contexts;
- To gender a positive attitude to Mathematics; and
- To develop an awareness of the historical and the contemporary applications of geometry.

Welle (1998) also reflects on the importance of geometry with regards to its inclusion in the Mathematics curriculum. To him, the study of geometry brings logical beauty to the individual and above all, gives deeper insight into the wonderful details and complexities of our world. According to Jones (2001), teaching geometry effectively involves, amongst other things, appreciating the history and cultural context of geometry, knowing how to recognize interesting geometrical problems and theorems, understanding the many and varied uses to which geometry is put, and incorporating all these things into the practice of teaching in the classroom. In support of this, the US Conference Board for the Mathematical Sciences (CBMS) (2000) has been examining the issue of what kind of geometry Mathematics teachers need knowledge of in order to be well-prepared to teach.

Their suggestions included the following:

1. Mastery of core concepts and principles of Euclidean geometry in the plane and space;

2. Understanding of the nature of axiomatic reasoning and the role that it has played in the development of Mathematics and facility in fundamental proof strategies.
3. Understanding and skill in use of a variety of methods for studying geometric problems; including synthetic, transformation, coordinate, and vector strategies;
4. Understanding of trigonometry from a geometric perspective and skill in use of trigonometric relationships to solve problems;
5. Knowledge of some significant modern aspects of geometry like tiling, computer graphics, robotics, fractals, and spatial visualization; and
6. Ability to use computer-based dynamic drawing tools to conduct geometric investigations emphasizing visualization, pattern recognition, and conjecturing.

A study by Jacobson and Lehrer (2000), points to teachers' eliciting more sustained and elaborate patterns of classroom conversations about geometry when the teachers have enhanced knowledge of the typical milestones and trajectories in children reasoning about space and geometry. In Ghana, school geometry is structured based on Van Hiele (1999) model of five levels of geometric understanding. These levels are Visualization, Analysis, Abstraction, Deduction and Rigour respectively. The primary school is concerned with the first three levels while students in Junior High School are to be introduced to levels 4 and 5. In Senior High School, the students are to work almost exclusively at levels 4 and 5 (Martin, Afful, Appronti, Apesemah, Asare, & Atitsogbi, 1994). Therefore, Mathematics teachers must have mastery in all these levels to be well equipped to handle geometry at these basic levels.

2.4 Teaching Strategies

The learning of Mathematics is often viewed as an isolated, individualistic or competitive matter, one sits alone and struggles to understand the material or solve the assignment problems. This process can often be lonely and frustrating, Davidson Neil (1990). This can lead to "math avoidance" or "math anxiety". Davidson observed that small group cooperative learning could solve this. Small group provide a forum in which students ask question, discuss ideas, demonstrate to others, learn to listen to others and offer constructive criticism and summarise their discoveries in writing. According to Rukangu (2000) in his study on Students' development of spatial ability in Mathematics, he observed that one of the students' study habits was discussion between students and students, between teachers and students and between students and parents. This method of teaching enhances psychomotor skills, helps students to discern Mathematical relationship in objects and concretizes Mathematical concepts. Learning by doing also raises learner's level of recall and retention of Mathematical content in long-term memory (Kluwe, et al., 1990). Students do these practical tasks in either of the following environments: within the classroom and out of classroom environment. In both cases, Mathematics teachers are expected to provide materials and guidelines to the students on what to do. For instance, students can construct 3-dimensional models for teaching geometry or any other construction within the classroom. In out of class tasks, students calculate the dimensions of physical environment. They can be involved in measuring the dimensions of the school compound in tackling the topic: "scale drawing and survey." The task given to the student should be relevant to the learners and have Mathematical value. In a group, most students are usually active, cooperative and self-reliant in solving problems outside the normal Mathematics classroom. This method stimulates, motivates and

improves students' interest, retention and creativity. (Kluwe, et al., 1990; UNESCO, 1987). The current research aimed at investigating whether teaching strategies, students study habits, curriculum implementation and evaluation affect the level of achievement in geometry among secondary schools' students.

According to Mondoh (2001), games promote learning of Mathematics. Based on the students' rate of mastering concepts, facts, skills and principles, it makes Mathematical concepts interesting to the slow and average learners. These games have Mathematical contents and rules of the game are based upon the solution of a Mathematical problem. Winning a game motivates students to solve the Mathematical problems (UNESCO, 1987). Charles and Lynwood (1990), attest that geometry has the characteristic of both game and a puzzle; an intellectual game to be played under accepted rules and a puzzle to challenge the ingenuity of the student. They argue that these two characteristics in effect constitute the spirit of demonstrative geometry and when students can be brought to approach the subject in this spirit the problem of boredom cease to be a problem at all.

Tangrams can also be used to teach student to measure areas without formulas, an approach that should help student develop an intuitive sense of geometry. Tangrams are Chinese consisting of seven shapes, two larger right triangles, one medium sized right triangle, two small right triangles, one small right triangles and a parallelogram. Shapes can be fitted together as a large square, rectangle or triangle. They can be arranged in a variety of complex shapes including fanciful words. The player is shown a target shape and then asked to recreate that shape using the seven pieces (NCTM 2003).

2.5 Students' Achievements in Geometry

Every unit whether it is built around a particular kind of geometric property will aim at the understanding and mastery of several kinds of things (Charles et al 1990). This includes the mastery of an associated mathematical vocabulary, clarification of certain geometrical concepts, understanding of relationships within and among particular geometric figures under given conditions, the ability to make acceptable and helpful drawings and to use a suitable notation, the ability to understand certain geometric facts, (Charles et al 1990).

The role of the teacher is to provide a suitable learning situation and activities through which students will have optimal opportunity for attaining the desired understanding and abilities and to help the students in appropriate ways of mastery of the objectives towards which the instruction is aimed. The teacher may use numerous means at their disposal since the principle aim at this stage is knowledge and understanding rather than formal proofs. Direct measurement with measuring instruments including ruler & protractor, may be used to build clear understanding of the measuring and the approximate nature of measurements to provide numerical data for experimental study of geometric figures and their properties, chalkboard drawings accompanied by suitable explanatory comment serve to clarify many ideas, experiment in paper folding can lead to discovery of principles about angles and lines, cross-section paper facilitates understanding of relationships through the construction and interpretation of graphs.

2.6 Intervening Factors

There are many studies that have explored the relationship between teaching materials and other related inputs and students learning and achievement in developing countries (Chepkurui 2004). Among the most important instructional material that has

shown to have a significant influence in the teaching-learning process is text book. Their availability and use of such materials have a positive effect on students' achievement in Mathematics and in particular in geometry, since the students can use it as a guide in geometric skill development and offers exercise for further practice of learnt concept. Moreover, Greg et al (1992) assert that computers have had an enormous impact on the teaching of geometry. With the availability of good graphing programs and visualization software, teaching geometry has become more open-ended and exploratory than the traditional emphasis on memorizing theorems and proofs. This new approach is consistent with research findings that students pass through different levels of geometric thinking, visualization, analysis and deduction.

Clements and Batista (1990), argue that the computer language software has proved valuable in the teaching of geometry. It helps students move from empirical to logical thinking, encourages students to make and test conjectures, facilitate precision and exactness in geometric thinking, encourage the development of autonomy in learning. The fundamental characteristics of using logo in geometry classes is that students actively construct their own understanding of Mathematics, they use computers to create geometric shapes, change them, move them around, and combine them into new shape. They discuss what they have done with each other and the teacher, in doing so they progress to higher levels of geometrical thinking, hence high achievement in Mathematics. Many studies conducted have quite consistently shown that thoughtful use of calculators in mathematics classes improves student Mathematics achievement and attitude towards Mathematics. Research on the use of scientific calculators with graphing capabilities has shown positive effects on student achievement. Most studies have found positive effects on students graphing ability to relate graphical representation to other representation. Other content areas where

improvement has been shown these calculators have been used in instruction include function concepts and spatial visualization. The graphing calculator is particularly useful in helping to illustrate and develop graphical concepts and in making connections between algebraic and geometrical ideas.

2.7 Empirical Review

The following literature review discusses the conceptualised factors that influence students' achievement in geometry as discussed by different researchers. The factors are teachers' characteristics (qualifications, subject majors and years of experience), teaching strategies, students' study habits and problems faced in teaching and learning of geometry

2.7.1 Teachers' characteristics

In this study teachers' characteristics is used to encompass the teachers' qualifications (certificate, diploma or degrees obtained by the teachers), their subject majors and years of teaching experience. It is depicted by Figure 2 below.

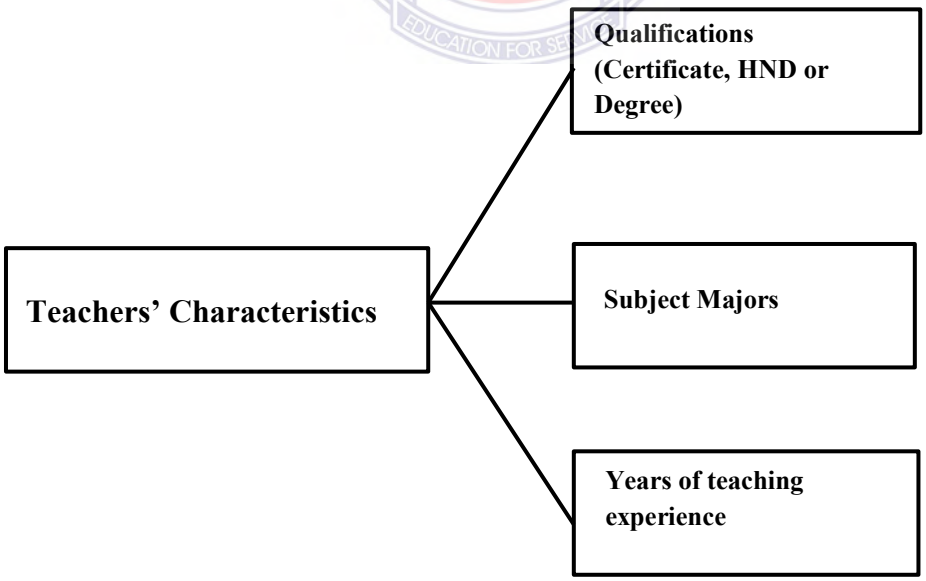

Figure 2.2: Teachers' Characteristic Factors

2.7.1.1 Teachers' Qualifications

According to *Longman Advanced American Dictionary*, to qualify is to have the right to do something. Thus a qualified mathematics teacher is one who has the right to teach mathematics. Although this right complies with the respective educational policies of each nation, there are two main and common components of the issue. These include the teachers' knowledge of the content, and the possession of appropriate teaching skills. More practically, this can be stated that a qualified secondary school mathematics teacher is one who majored or minored in mathematics.

Teachers' qualification in this study measures the educational attainment (education level) of the teachers. That is the highest qualification obtained by the teachers in any subject. It was categorised according to the highest qualification the teachers obtained, namely Certificate, Diploma, Bachelors, Masters or Doctoral degrees. A number of studies have examined the ways in which teachers' highest qualifications are related to students' achievement. Many of the studies found that teachers' qualifications correspond positively with students' achievement. For instance, Betts, Zau, and Rice (2003) found that teachers' highest degree correlates positively with students' achievement. Rice (2003) found that when teachers have an advanced degree in their teaching subjects it will have a positive impact on the students' achievements. Greenwald, Hedges, and Laine (1996) conducted a meta-analysis of studies that examined the relationship between school resources and student achievement; they found that there was a significant and positive relationship between teachers' qualification measured as having a master's degree or not having a master's degree and students' achievement. Goldhaber and Brewer (1996) indicated that an advanced degree that was specific in the subject taught was associated with higher

students' achievement. On the contrary, Wenglinsky (2000) and Greenberg, et al. (2004) said that postgraduate qualifications at Masters or higher level were not significantly related to students' achievement. Despite the contrary findings, it is likely that teachers' qualifications play a significant role in determining students' achievement in mathematics.

2.7.1.2 Teachers' Subject Majors

In this study the mathematics teachers were categorised as having a major in mathematics if they had reported having a college, undergraduate or graduate major in mathematics or mathematics education. The importance of the link between teachers' subject majors and students' achievement have repeatedly been acknowledged by leading education groups such as the Education Trust, the Education Leaders Council, and the National Commission on Teaching and America's Future despite being characterized by their diversity and commitment (Thomas & Raechelle, 2000).

Several other studies in the teacher preparation research have also shown a positive connection between teachers' subject majors and students' achievement in mathematics. For example, Wilson and Floden (2003) found that students of mathematics teachers with mathematics or mathematics education degrees demonstrate higher academic achievement in mathematics. However, they also indicated that there might be a limit at which more mathematics knowledge does not help the teacher. Goldhaber and Brewer (1996) found that specialisation in one's teaching subject is the most reliable predictor of students' achievement in mathematics and science. A review of a study of high school students' performance in mathematics and science by Darling-Hammound (2000) found that one having a major in his/her teaching subject was the most reliable predictor of students' achievement scores in mathematics and science.

Similarly, Wenglinsky (2002) and Greenberg, et al. (2004) said that mathematics teachers having a major in mathematics correlated with higher students' achievement in mathematics. However, a few other researchers reported inconsistent relationships between teachers' subject majors and students' achievement. For example, Ingvarson et al. (2004) reported that a number of studies on the relationship between teachers' subject majors and student's achievement in mathematics reported complex and inconsistent results. Similarly, Martin et al. (2000) and Wenglinsky (2000) found that having a major in mathematics was not associated with teacher effectiveness. The confusing findings bring to bear the need to investigate more into the relationship between teachers' subject majors and students' achievement in mathematics.

2.7.1.3 Teachers' Teaching Experience

A number of studies found teachers' years of experience to positively correlate with students' achievement. For example, Betts, Zau, and Rice (2003) found that teachers' experience significantly correlates with students' achievement in mathematics. A report by the Centre for Public Education (2005) stated that research has been consistent in finding positive correlations between teaching experience and higher students' achievement. Teachers with more than five years teaching experience are found to be the most effective while inexperience is shown to have strong negative effect on students' performance. Greemwald, Hedges, and Laine (1996) in their meta-analysis of data from 60 studies found that teachers' years of teaching experience positively correlates with students' achievement. In a related finding, Rivkin, Hanushek, and Kain (2005) showed that students of experienced teachers achieved better than students of new teachers (those with one to three years of experience).

Similarly, some other studies, for example Rosenholtz, (1986) quoted in Darling-Hammond (2000), and Hawkins, Stancavage, and Dossey, (1998) found teaching

experience to be related to students' achievement but that the relationship may not be linear; students of teachers who had fewer than five years of experience had lower levels of mathematics achievement but there was no difference in mathematics achievement among students whose teachers had more than five years of experience. The implication of that is that the benefit of experience levels off after five years. The curvilinear effect according to Darling-Hammond (2000) could be because older teachers do not continue to grow and learn and may grow tired of their jobs. Contrary to these findings, a few studies like Hanushek (1997), Martin et al. (2000) and Wenglinsky (2002) found that the number of years in teaching is not associated with students' achievement. These contrary findings could be due to the presence of very-well prepared beginning teachers who were highly effective.

2.7.2 Strategies/Approaches for Teaching and Learning of Geometry

The methods used in teaching mathematics are instrumental in determining ones' performance Keith (2000). Farrant et al (1997) argues that instructional methods contribute towards success in subject teaching. Mathematics teaching at all levels should include opportunities for exposition by the teacher, discussion between the teacher and the students and between the students themselves and appropriate work consolidation It also involves practice of fundamental skills and routines of problem solving (Morris 2001; Cockroft report 1982).

Kiminza et al (1999) in a study undertaken by K.I.E, found out that mathematics teachers mainly use participatory teaching approach. In their analysis of mostly frequently used methods, assignment method scored 50.6% followed by a class discussion 48.6%, demonstration 38.9%, drawing and modeling 34.4%. According to Kiminza et al (1999) participatory teaching method was prevalent despite the deteriorating performance over the years. This study wishes to establish teaching

strategies that enhance achievement of geometry concept. In his study, Edgar (1994) noted that many teachers forget the learner requires psychomotor and affective skills. He says that problems of motor learning are often overlooked by teachers. These can only be developed by certain teaching methods. This study was set to find out the strategies mostly used by teachers to teach geometry in the two districts of Agona. The learning of Mathematics is often viewed as an isolated, individualistic or competitive matter, one sits alone and struggles to understand the material or solve the assignment problems. This process can often be lonely and frustrating, Davidson Neil (1990). This can lead to "math avoidance" or "math anxiety". Davidson observed that small group cooperative learning could solve this. Small group provide a forum in which students ask question, discuss ideas, demonstrate to others, learn to listen to others and offer constructive criticism and summarize their discoveries in writing.

According to Rukangu (2000) in his study on students' development of spatial ability in Mathematics, he observed that one of the students' study habits was discussion between students and students, between teachers and students and between students and parents. Mathematics teachers in secondary schools provide students with worked examples of sample problems or use the ones provided in the textbook with the hope that students will determine the underlying principle or rule that govern the solution of the initial problem and transfer the learning to a new problem. According to Mayer (1992) and Horn (1995), students face the obstacles of inability to understand why the underlying rule worked correctly in the given example and are unable to use the underlying rule on a new problem. According to Horn (1995), teachers are advised to give adequate varied worked examples with various complexities; plan a series of worked examples and that students should work out similar examples immediately. This enhances students' achievement and ability to transfer learnt concepts to new

mathematical problems. Students can solve new problems by using what they already know from analogous problems.

2.7.3 Level of Understanding of Geometric Concepts

According to Charles and Lynwood (1990), mortality in high school geometry has traditionally been high and this has been ascribed to various causes such as the difficulty of the subject, others have to blame it to ineptitude or laziness on part of the student. While others have held that students lose interest in geometry because of its abstract nature which they regard as having no practical value. They argue that demonstrative geometry is not easiest subject to learn. It demands careful and sustained attention, perseverance and a measure of ingenuity; in order to attain a real mastery of its most, students do have to do some hard work. Charles and Lynwood argue that the real reason for much of the failure in geometry and apathy towards the subject lies mainly in poor motivation and failure to provide clear insights into the meaning and methods of the subject, they also assert that children will work hard at things that interest them and they delight in games and puzzles.

A study by Rukangu (2000) on students' development of spatial ability on Mathematics found that 67% did not enjoy learning spatial concepts because they are confusing, abstractly demanding a lot of thinking and difficultly to understand. This is an attitude formed by the students. To overcome this, he recommended that the teacher should understand, encourage and motivate their students. His study focussed on a wide content coverage on spatial ability while this study focuses on geometrical topics in form one and two syllabus. A study by Njeru (2010) on relationship between students' English language competence in solving word problems and Mathematics performance in secondary schools in Maara District observed that reading Mathematics textbooks provides students with opportunity to learn the language and

vocabulary necessary to improve their language competence hence better performance in Mathematics. He argued that Mathematics required understanding of concepts and constant practice to internalize them.

Njeru (2010) also found out that there was a positive correlation *(R=0.424)* between students' knowledge in translating English expression into mathematical symbols and mathematical symbols into English meaning. In his study, the teachers unanimously agreed that many English words can easily confuse students because they carry different meanings in the normal language usage from mathematical usage. For instance, words like volume, normal line, bearing, elevation, deduce, perpendicular, among others were identified.

2.7.4 Effects of the Strategies Used in Teaching and Learning on Performance

The study attempted to review literature on factors influencing the level of students' achievement in geometric concept in secondary school in Agona Swedru. Most of the scholars who carried out studies on teaching strategies focused on factors affecting the performance in Mathematics where, teaching methods were reviewed and also the techniques which enhance Mathematics achievement, for instance studies by Miheso (2002), Wasiche (2001), Kiminza et al (1999) among others. The above scholars did not address the geometry content part; hence this study was carried out to investigate the teaching strategies than enhanced understanding of geometry concept.

Other areas reviewed in this study include, school curriculum organization which may affect the student mathematics achievement. Such factors as remedial, provision of resources, motivation of the students' study habits reviewed in this study did not focus on geometry concept but focused on Mathematics content in general. Therefore, this study was set to investigate the students study habits specifically in geometry. From the resources available to the researcher very little has been done particularly on

geometrical evaluation and therefore this study was to investigate the mode of geometrical evaluation that enhanced geometry understanding.

2.7.5 Students Study Habits/Styles in Geometry

Study habits are those activities necessary to organize and complete schoolwork tasks and to prepare for and take tests (Robbins et al., 2002). The learning of Mathematics is often viewed as an isolated, individualistic or competitive matter, one sits alone and struggles to understand the material or solve the assignment problems. This process can often be lonely and frustrating, Davidson Neil (1990). This can lead to "math avoidance" or "math anxiety". Davidson observed that small group cooperative learning could solve this. Small group provide a forum in which students ask question, discuss ideas, demonstrate to others, learn to listen to others and offer constructive criticism and summarise their discoveries in writing. According to Rukangu (2000), in his study on students' development of spatial ability in Mathematics, he observed that one of the students" study habits was discussion between students and students, between teachers and students and between students and parents.

Mathematics textbooks act as a guide to the students since most of them have worked examples and exercise for practice (Kinyuaet al., 2003), students can study privately to exercise further what they learnt in class following the given examples by the teacher and the worked examples in the textbooks. According to Horn (1995), teachers are advised to give adequate varied worked example with various complexities, plan a sense of worked examples each with a new concept that should work out immediately thus enhance student achievement and ability to transfer learnt concepts to new mathematical problems. In case of any difficulties, further consultation with the teacher for clarification can ensue.

2.7.6 School Curriculum Implementation

School curriculum implementation entails what the school does to enhance understanding of mathematic geometry concept. The following were explored under school curriculum implementation, that is; remedial lessons, motivation of students, availability of resources among others. Orodho (2003), in his study on remedial lessons indicated that at the national level 69.5%of teachers offered remedial lessons during evenings and over morning preps and over the school holidays basically to cope with the broad 8-4-4 curriculum. This study revealed that students and teachers' perception towards remedial was positive with many indicating that it assisted both the weak and bright students especially in preparation of National Examinations. He also noted that regular teachers within the school premises and mainly in Mathematics and sciences carried out remedial lessons. From this study, remedial lessons were done particularly in Mathematics and science subjects, but did not indicate the specific topics in geometry, which poses difficult in teaching/leaning.

According to SMASSE base line survey (1998) and SMASSE curriculum review (2002) geometric concepts like vector geometry where midpoint of a vector and centroid of a triangle are a challenge to students' and three dimensional geometry especially angle between a line and a plane and angle between two planes, all these among others require remediation. Therefore, this study was aimed at determining whether the school organises for remedial lessons to improve geometrical understanding in Mathematics. There are many studies that have explored the relationship between teaching materials and other related inputs and students learning and achievement in developing countries (Chepkurui, 2004). Among the most important instructional material that has shown to have a significant influence in the teaching-learning process is text book. Their availability and use of such materials

have a positive effect on students' achievement in Mathematics and in particular in geometry, since the students can use it as a guide in geometric skill development and offers exercise for further practice of learnt concept. Greg et al (1992) assert that computers have had an enormous impact on the teaching of geometry. With the availability of good graphing programs and visualization software, teaching geometry has become more open-ended and exploratory than the traditional emphasis on memorising theorems and proofs. This new approach is consistent with research findings that students pass through different levels of geometric thinking, visualization, analysis and deduction. Clements and Batista (1989), argue that the computer language logo has proved valuable in the teaching of geometry. It helps students move from empirical to logical thinking, encourages students to make and test conjectures, facilitate precision and exactness in geometric thinking, encourage the development of autonomy in learning. The fundamental characteristics of using logo in geometry classes is that students actively construct their own understanding of Mathematics, they use computers to create geometric shapes, change them, move them around, and combine them into new shape. They discuss what they have done with each other and the teacher, in doing so they progress to higher levels of geometrical thinking, hence high achievement in Mathematics.

2.7.7 Evaluation of Geometrical Concepts

Assessment of geometrical concept should be a continuous process rather than just at the end of lesson, topic or course (KIE, 2006). In the class assessment that takes place is diagnostic. It reveals how much learners have understood various concepts for instance geometrical skills such as construction and therefore plan for remedial work accordingly. This assessment can be done by observation of learners as they solve given problems. The teachers assess the students as well as themselves in the light of

students' work (Kinyua et al 2003). The teacher is also to correct misconception. Assessment is also carried out on assignment given on problem solving. This gives feedback to the teacher whether the learners have understood the concept. The learners too are encouraged when they get feedback on their understanding of concepts and skills. Mathematics is learnt by doing and not watching others do it. The learners are encouraged/ motivated to work out prudently when teachers mark their work (KIE, 2006). Geometry requires that students should be assessed on practical such as modelling and the models should be awarded marks. This could be done in groups in order to promote collaborative learning. According to Kinyua et al (2003), the common assessments in secondary schools are class test also called continuous assessment, end of term, end of year test and MOCK examinations. Most of the questions performed poorly by students include questions on three-dimensional geometry (SMASSE 2009; KNEC 2010), vector geometry (SMASSE 2009), among others. They argue that, when setting a test especially in Mathematics; a table of specification is necessary in order to ensure that the test is balanced and valid. In geometry, the skills to be tested include cognitive skills such as knowledge, comprehension synthesis, and evaluation and should be few while the bulk of the questions should be at application and analysis. This study investigated the modes of assessment and how frequent assessment of geometrical concepts was done for enhancing their understanding.

2.7.8 Problems Teachers and Students Face in Teaching /Learning of Geometry

Chappell (2003) claimed that high school students' less than desirable background in geometry was due to middle school mathematics teachers' superficial geometry knowledge. Other studies by Duatepe (2000) and Halat (2008) charged that, pre-

service elementary school mathematics teachers' reasoning stages were below level - (III) (ordering). In support of this, Knight (2006) stated that the pre-service elementary school teachers involved in her study were not at a suitable van Hiele level to understand formal geometry and that their previous instructions had not helped them to attain knowledge of geometry consistent with level-IV. Although these results were for pre-service teachers, they will be useful in the investigation and understanding of in-service mathematics student teachers' challenges in transformational geometry. The study observed that, university trainee teachers were exposed to a broad content material which, in some cases, did not take into consideration what was obtaining in the Zambian secondary schools. In addition, the study revealed that UNZA prepared or trained teachers were weak in the delivery of subject matter (methodology).

Evidence from research and West African Examination council (WAEC) Chief Examiners' Reports in Ghana has pointed towards students' poor performance in geometry. WAEC Chief Examiners' report (2005, 2003) cited in Okigbo and Osuafor (2008) in Nigeria observed that candidates were weak in Geometry of circles and 3-dimensional problems. According to their reports, most candidates avoided questions on 3-dimensional problem, and when they attempt geometry questions; only few of the candidates showed a clear understanding of the problem in their working. The Examination Council (2006) examiners' report showed that questions on geometry topics such as transformational geometry were very poorly answered. The same report concluded that teachers did not get adequate support in the area of geometry (transformation) in their teacher preparation programme. Thus, they went into the field with the same challenges that they had when they were students themselves in schools.

2.8 Research Gaps

The study attempts to review literature on teaching strategies that can enhance understanding of Mathematics geometry concept. Most of the scholars who carried out studies on teaching strategies focused on factors affecting the performance in Mathematics where, teaching methods were reviewed and also the techniques which enhance Mathematics achievement, for instance, studies by Miheso (2002), Wasiche (2001), Kiminza et al (1999) among others.

The above scholars did not address the geometry content part; hence this study investigates the teaching strategies that enhance understanding of geometry concept. Other areas reviewed in this study include, school curriculum organization which may affect the student geometrical concept understanding. Such factors as remedial, provision of resources, motivation of the students. Assessment and evaluation reviewed in this study did not focus on geometry concept but focused on Mathematics content in general. Therefore, this study was set to investigate the evaluation specifically in geometry.

2.9 Chapter Summary

The chapter contains a review of previous literature related to this study. The review of the literature revealed that the strategies adopted by teachers contribute to the level of achievement of students in geometry. The attitude of the students was also established to be related with the level of achievement in Geometry. The review of the literature further revealed that curriculum organisation was among the challenges that hinder students' excellence in geometry. This chapter also provided some of the research gaps the study identified from the previous literature.

2.10 Organization of the Study

The success of any research work depends on how it is orderly organised. The study is organized in five different chapters consisting the following: chapter two tackles the review of the related literature on the study. Chapter three involves the methodology which comprises the research design, population and sampling, research instruments, data collection procedure and data analysis plan. Chapter four consists of results and discussion, while chapter five involves the summary, conclusion and recommendations.

CHAPTER THREE

THE RESEARCH DESIGN AND METHODOLOGY

3.0 Overview

This chapter discusses the methodology that was used in carrying out this study in order to assess the various factors influencing achievement in geometry among Senior High School students in Agona district in the Central Region. It spells out the research design that was adopted for the study, the population, the sample and sampling techniques, the instruments that were used for data collection, the validity and reliability of the research instruments, the data collection procedures, the data analysis techniques, and the discussion of logistical and ethical considerations.

3.1 Research Design

The study was carried out using descriptive survey design in its attempt to determine, describe and analyse relationship between the factors (teaching strategies, students' study habits, curriculum implementation and evaluation) and student academic achievement in geometry. The design was considered most appropriate since questionnaire was the main instrument used for data collection from the segment of the population of interest. Survey is more economical since many subjects can be studied at the same time (Mitchell & Jolley, 2004). Even though this design may produce unworthy results, it was chosen because it elicits a very good amount of responses from a wide range of people. It helps to completely and accurately describe the variables in the research work. Some additional considerations were made to justify the choice of survey as a strategy for this research. One of these was the characteristics outlined by Alhassan (2006) that:

1. it is cross-sectional in nature in that a single design could be administered to every respondent in a targeted group.
2 it collects data from a relatively large number of respondents
3. it investigates phenomena in their natural settings

Descriptive survey is easily influenced by distortions through the introduction of biases in the measuring of instruments. The researcher gave critical attention to the above characteristics, and thought it expedient and most appropriate for the current study to use the design as it aided the researcher to draw meaningful conclusions from the data obtained.

3.2 Population for the Study

The population for this study comprised all SHS three students and their mathematics teachers in the Agona district in Central Region of Ghana during the period of the study. Agona district comprises of two administrative Assemblies. These are Agona West Municipal Assembly (AWMA) created out of the former Agona District Assembly (ADA) on 25th February, 2008 by LI 1920 with Agona Swedru as the capital and Agona East District Assembly with Agona Nsaba as the capital. Agona has a population of 225,566 as at December, 2010 with respect to the 2010 Population and Housing Census. The District is borded by the following municipal and district Assemblies; Birim South, Asikuma-Odoben-Brakwa, Ajumako-Enyan-Essiam, Gomoa West, East and Central and Awutu-Effutu-Senya.

Statistics gathered from the Central Regional Directorate of the Ghana Education Service (GES) of the Ministry of Education indicated that; there were about fifty-nine (59) SHSs (excluding Technical Institutes) out of which eight (8) are in the selected study area. The estimated number of form three students offering mathematics in the district was two thousand, four hundred and twenty-one (2,421) and seventy-two (72)

mathematics. The final year students were selected because they had covered most of the geometrical topics in the mathematics syllabus and were exposed to different teaching methods by their mathematics teachers. The mathematics teachers were included in the study because by virtue of their experience, they are knowledgeable and informative about phenomenon under study. Therefore, they provided useful information for this study.

3.3 Sample and Sampling Techniques

A sample according to Gerrish and Lacey (2010) is a subset of a target population, normally defined by the sampling process. Stratified sampling technique was used to select schools from the two educational zones of Agona district. Two secondary schools (operating both as boarding and day schools) were randomly selected from each stratum. This gave a total of four schools for the study which is fifty per cent of secondary schools in the district as recommended by Mugenda and Mugenda (2003). The two zones share a common boundary and implement the same government educational policies as pertained everywhere in the country. It is important to note that in Ghana all Senior high schools operate a common national curriculum. The four (4) schools were Swedru Senior High School (SWESCO), Swedru School of Business (SWESBUS), Nsaba Presbyterian Senior High School and Nyakrom Senior High School.

Simple random sampling was used to select the targeted students needed for the research in all the sample SHSs. There were three (3) different forms in each school. These were form one (F1), form two (F2) and form three (F3). The researcher purposefully selected the form three (F3). Within F3, we had students in different classes who were offering different programmes. Therefore, simple random sampling was used to select classes where class prefects were asked to pick ballot papers of

which four were Yes and the rest No. This balloting helped the researcher to have the number of classes for the study and for each school, the researcher selected four (4) classes giving a total of sixteen classes from the four selected schools. The systematic sampling method was then used to select students who were needed to complete the questionnaire. A sample frame which represented names of students of the selected classes from the selected schools was requested from the schools' administration. Using the class list as the frame, one (1) of every four (4) persons was selected from each class. The use of this procedure was to avoid unfairness in sampling of students for the purpose of the study. A total number of 15 students were selected from each class in each of the schools. In all, 240 students were selected for the research exercise.

Further, Purposive sampling (sometimes referred to as purposive, judgement, or judgemental sample) was used to select the targeted number of the mathematics teachers needed for the research. Purposive sampling, according to Newman (2000), occurs when one selects cases with a specific purpose in mind. To Brink (1996), this method is based on the judgement of the researcher to select teachers who are representative to the phenomenon and well-versed with the issue at hand. Purposive sampling was preferred to other sampling technique because the researcher selected mathematics teachers based on their willingness to support this research with relevant and appropriate responses. Twelve (12) teachers (three from each of the four (4) sampled schools) participated in the study. Since this represents almost 17% of the population, the number could be taken as representative of the mathematics teachers in the district. The number of respondents selected from each school by type and sampling technique used are shown in Table 3.1 and Table 3.2.

Table 3.1: Distributions of Samples by School

Educational Zone	Selected Schools	Type of School	Selected Teaches	Selected Students
Agona West	Swedru School of Business	Mixed-Sex	3	60
	Nyakrom Senior High School	Mixed-Sex	3	60
Agona East	Swedru Senior High School	Mixed-Sex	3	60
	Nsaba Presbyterian Senior High School	Mixed-Sex	3	60
Total			**12**	**240**

Source: Field survey, 2017

Table 3.2: Distribution of Sample Respondents by Sampling Techniques

Category of population	Sampling procedure	Sample
Teachers	Purposive Sampling	12
Students	Simple Random Sampling	240
Total		**252**

Source: Field survey, 2017

3.4 Data collection Instruments

For the purpose of this study, field data were collected using two instruments. These were: questionnaires and achievement test. Although questionnaires and achievement test have been mentioned as the two main instruments for the data collection, the questionnaire was dominantly used in this research. This is because Walonick (2004) asserted that questionnaires have the following advantages:

- There is uniform question presentation and no middle-man bias. The researcher's own opinions are not allowed to influence the respondent to answer questions in a certain manner.
- There are no verbal or visual clues to influence the respondent.
- It can cover large sample sizes and large geographical areas and is easy to analyse.
- Almost everyone has had some experience completing questionnaires and they generally do not make people apprehensive.
- It permits wider coverage for a minimum expense both in money and effort (Osuala, 2001).

According to Borg et al. (1993), survey research typically employs the questionnaire or interviews to determine the opinions, attitudes, preferences and perceptions of a person's interest to a study and since this research is on assessing opinions, experiences, thought and attitudes of teachers and students in connection with geometry, it was appropriate to use questionnaires. The anonymity of questionnaires was also considered a relevant issue which made it a preferred option. The general benefits of a questionnaire which were thought to make it appropriate were: consistency of presentation of questions to the respondents, a greater perception of anonymity for the respondents and less time-consuming to administer (Lewis & Munn 1987; and Munn & Drever 1990). On the other hand, geometric achievement test was also used as an instrument. The choice of geometric achievement test was based on the need to collect quantitative data that was approximately normal in nature so as to allow the use of inferential statistics in its analysis.

3.4.1 Questionnaire

Two (2) different sets of questionnaires were constructed. These include: Form Three Students Questionnaire (FTSQ) - Intended for collecting data related to students learning experiences in geometry (see Appendix B). Mathematics Teachers Questionnaire (M.T.Q.) - Intended for collecting data related to the teaching and learning of Mathematics as a follow up of the students' responses (see Appendix A). The questionnaires were used to answer the three research questions. In developing the questionnaires, the researcher in consultation with the supervisor compromised on a five point Likert Scale having the following options; Strongly Agree = S.A, Agree = A, Neutral = U, Disagree = D and Strongly Disagree = S.D. The scale descriptors were: 1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. Again, each questionnaire was scrutinised using the relevance and the

potential of the item in answering the research questions as a yardstick. The use of questionnaire was to enable the researcher obtain more information with respect to answering research questions which were in line with the claim that questionnaires permits wider coverage for a minimum expense both in money and effort (Osuala, 2001). Each questionnaire was made up of eleven (11) questions and divided into five sections.

Form Three Students' Questionnaire (FTSQ)

The student questionnaires had both closed-ended and open-ended question items and were aimed at collecting information on the students' learning experiences and evaluation of teachers' teaching techniques. (Appendix B). The students' questionnaire is divided into five sections. The first section deals with students' demographic information on variables like gender and age. Section B had one closed ended question to elicit information about students' own assessment of their mathematics performance. Here, a five-point performance ranking scale (Excellent, Very Good, Good, Weak and Very weak) were given students to tick. Section C, D and E of the students' questionnaire elicited students' views on effects of teaching strategies, students study habits, curriculum and evaluation on students' level of achievement in Mathematics (geometry). The final section of the students' questionnaire was an open-ended question item. It was intended to assess challenges faced by students in learning Mathematics (geometry). This open ended question item was to allow students to bring out what the closed-ended aspect of the questionnaire could not provide.

Mathematics Teachers' Questionnaire (MTQ)

The teachers' questionnaire is semi-structured with 11 questions and is divided into five sections each consists of independent items (Appendix B). Section "A"

comprising seven questions. The first four questions essentially elicited information about the teacher's background such as gender, age, academic and professional qualification. In Ghana, teachers' professional qualifications fall into two categories: trained and untrained teachers. Trained teachers have completed a teacher's certificate 'A', a diploma in education and a degree in education from an institution of higher learning. Untrained teachers, on the other hand, are teachers who have not completed any of the above mentioned programmes, but are nevertheless teaching. Question five was used to collect information about teacher's number of years of teaching Mathematics (geometry). Question six and seven solicit information about teachers' professional development (in-service). This was in tune with the research since these variables helped the researcher to make deductions from views of respondents whilst sections B and D comprise questions based on the research objectives. The final section being section E involves an open ended question that allow the respondents (teachers) share their views on factors they think contribute to learners' poor achievement in geometry. The purpose of this open ended item was to prevent the omission of any possible factors that would enrich the findings of this research but might have been restricted in the case of closed ended questionnaire.

3.4.2 Geometric Achievement Test

Tests are a set of questions, exercises or practical activities to measure someone's skill, ability or knowledge. It is used to determine the weaknesses or strengths of students in a lesson (Baumgartner, Strong & Hensley, 2002). A Geometric Achievement Test (GAT) was prepared and administered to the students. This enabled the researcher to collect the needed data that were analysed with regards to their level of understanding in geometrical content. The items in the test were based on form one and two CRDD syllabus of Ghana Education service which constituted content on

plane and solid figures (See Appendix C). The first twelve questions were primarily based on plane figures and the last eight questions were based on solid figures. In all 20 test items were answered by students. The questions centred mainly on content knowledge, comprehension, application and analysis categories on the cognitive levels as required by the Ministry of Education regulation. The questions were supply type multiple choice questions and therefore students were expected to supply their own answer to all questions. All other questions carried equal marks of five.

3.5 Pilot- Testing of the Instruments

For the suitability of the instruments for collecting data to be determined, it became necessary to pre-test the instruments (questionnaires and test). The rationale for the pre-testing was to examine the validity and reliability of the questionnaires and achievement test. Piloting of the instruments (questionnaires and test) in a sister senior high school (siddiq senior High School) in the Central Region was done to refine the questionnaires and the achievement test. The reason for the choice of this school had to do with proximity and accessibility to the researcher. A sample of forty (40) respondents including 34 students and 6 mathematics teachers were used for the pilot study. A total of 40 questionnaires were used for the pre-testing. However, 37 questionnaires were returned giving a response rate of 93.2%. The administration of the questionnaire and the test took one day. During the administration of the questionnaires, it was observed that most of the items were not clearly stated and they posed difficulties for the respondents. The questionnaires were then refined and used for the actual data collection. The pilot exercise proved very useful since it helped to streamline and reduce the number of items on the questionnaire by six. More importantly, it helped to improve the quality of the questionnaires and the test for the study.

3.6 Validity and Reliability of the Instruments

Validity and Reliability are the fundamental components used in assessing the quality of instruments (Mayer, 1999). The validity of an instrument is the degree with which the measured value reflects the characteristic it is intended to measure. In other words, validity is the degree to which results obtained from the analysis of the data actually represent the phenomena under study. The purpose of validity is to measure the accuracy with which the questions measure the factors under study (Mugenda & Mugenda, 2003). while the reliability refers to the degree with which repeated measurements, or measures taken under identical circumstances will yield the same result (Lewis, 1999). Reliability of an instrument is based on that instrument's ability to elicit the same response each time the instrument is administered. There are basically three forms of validity: content validity, construct validity and criterion validity. Construct validity refers to the consistency between the questions on a questionnaire and accepted theoretical construct related to the subject being studied. It is based on logical relationship between variables (Babbie, 2001). Criterion validity refers to the degree with which an instrument yields results that are consistent with an independent external criterion. Content validity, which was used in this study, refers to the degree with which the content of a test or questionnaire covers the extent and depth of the topics it is intended to cover. It is a useful concept when evaluating educational tests and research questionnaires (Lewis, 1999).

Reliability can be assessed by the following methods: inter-rater method, test-retest method, split-half method, alternate form method, or by calculating the Cronbach's alpha coefficient. Calculation of the Cronbach's alpha coefficient was the test used in this study. It measures how well a set of items (variables) measures a single unidimensional latent construct (Lapsley, 2006).

3.6.1 Validity of research Instruments

In this study, to ensure that the questionnaires and achievement test measured what they purported to measure and are true reflection of the content domain, their content validity were tested by involving experts in the field of mathematics education. The experts judged if the questionnaire reflected the content domain of the study. They did ascertain that the items in the questionnaire explored information concerning teachers' teaching strategies, study habits, curriculum implementation and evaluation.

However, in order to ascertain the content validity of the achievement test, the senior high school syllabus for the senior high school was consulted as well as some prescribed mathematics textbooks for students. The purpose was to gain insight into what learners are expected to learn so that the instrument is developed accordingly. After constructing the test items, my supervisor was consulted to cross check them as Durrheim (1999) suggests that the researcher approach others in the academic community to check the appropriateness of his or her measurement tools. To further ensure that the content chosen is within the prescribed domain of the study for the respondents concerned, the tests were given to some tutors in some sister schools to cross check and contribute to the geometric content areas that were being tested in the study. They established that the questions were in line with the syllabus content and were appropriate for the time allocations before the tests were adopted for the purpose of the examination.

3.6.2 Reliability of Instruments

The reliability of the questionnaires and achievement test was tested using Cronbach's alpha coefficient. This was seen to be appropriate because it requires only a single test administration and provides a unique quantitative estimate of reliability for the given administration. It is also considered to be a conservative (lower bound) estimate of

reliability-meaning that the true relationship is likely to be no lower than this estimate (Lapsley, 2006). The questionnaire was pre-tested with form three students and their mathematics teachers, and the reliability was calculated using Statistical Package for Social Science (SPSS). The reliability of each section was tested separately since each section measures a separate and single unidimensional construct. The internal consistency reliability of score for the questionnaire as a whole was found to be 0.92. Table 3.3 shows the Cronbach's alpha (α) values of scores for the four subscales of the instrument: namely teachers' teaching strategies, students' study habit, school curriculum implementation and evaluation. The questionnaires were used for the study because the alpha coefficient (α) value obtained on each section was greater than 0.70. The values agree with the recommendation that for an instrument to be used its internal reliability Coefficient-Cronbach's alpha (α) must be at least 0.7 (Santos,1999). Castillio (2009) provide the following rules of thumb: that a cronbach alpha of $\alpha>0.9$ = Excellent, $\alpha>0.8$ = Good, $\alpha>0.7$ = Acceptable, $\alpha>0.6$ = Questionable, $\alpha>0.5$ = Poor and $\alpha<0.5$ = Unacceptable. The acceptable value of $\alpha=0.7$ was used as a cut–off of reliability for this study.

Table 3.3 Coefficient alpha (α) scores

Instrument	Subscale	Coefficient alpha (α)
Questionnaire	Teachers' teaching strategies	0.89
	Students' study habits	0.96
	Evaluation	0.95
	School curriculum implementation	0.88
Test	Geometric Achievement	0.72

3.7 Data Collection Procedures

Prior to embarking on the data collection exercise, the researcher made preliminary contacts with Heads of Mathematics Departments (HoDs) in the selected schools. The HODs organized the selected teachers for a meeting where the purpose of the study

and why the schools were chosen were explained to the respondents. The respondents were told that the exercise was for academic purpose only and that confidentiality was assured in order to encourage them to give their response without suspicion. After preparing the research instruments, an introductory letter was obtained from the researcher's department. Copies of these letters were sent to the heads of the sampled schools. The departmental heads were given a number of questionnaire to be given to the sampled teachers and the departmental heads in turn distributed the questionnaires to the sample teachers to fill; however, the questionnaires results were collected on the following day.

The case of students' questionnaire administration was not that straight forward as in the case of the teachers. This was because the study was not to involve all students; therefore, sampling procedure had to be followed. This made the researcher to get involved in the data collection procedure to ensure students were given equal chances of being selected. In order to ensure a maximum response rate, the student respondents from each school were assembled in place and were informed in advanced and given adequate explanations especially on their teachers' teaching strategies and in order to have time to look for geometrical instruments if they did not have any. The Student respondents were assembled again the next day in one of the halls of each school for the questionnaires and achievement to be administered. the researcher sought the assistance of mathematics teachers in each sample school. The teachers assisted the researcher to distribute the questionnaires among the students. The administration of the questionnaire and test took four (4) days, thus a day for each selected school. Both the questionnaires and geometric achievement test were attached together and administered to each of the candidates. The administration of the test followed standard examination regulations. Thu students were given an hour

each for the written test and completion of the questionnaire on the same day. At the end of the exercise, the questionnaires and tests were collected for further analysis. The researcher then sent a letter of appreciation to the schools through the heads of department.

3.8 Data Analysis Procedures

The collected data from the questionnaires and achievement test were organized and analysed quantitatively. Descriptive statistics and inferential statistics (correlation and regression analysis) were used for the analysis in a three phase methodological approach.

Phase 1- Descriptive Statistics

In this first phase of the data analysis, version 21.0 of the IBM Statistical Package for Social Sciences (SPSS) and the Microsoft Excel computer software programme were used for data storage, calculation of central tendencies, frequencies and percentages. Descriptive analysis seeks to organize and describe the data by investigating how the responses are distributed on each construct, and by determining whether the responses on different constructs are related to each other (Durrheim, 1999). Therefore, responses from the questionnaires and the test for the sample schools were organized into frequency tables. The frequency tables were constructed to show the understanding of geometric concept. Data collected on both questionnaires were used to answer the questions of whether teaching strategies, students study habits, school curriculum implementation and evaluation enhance the understanding of geometry, and to what extent they do so. The frequency tables were further used in phase 2 of the data analysis.

Phase 2- Correlation Analysis

In this phase, correlation analysis model was employed for the data analysis of students' achievement with teachers' teaching strategies, school curriculum implementation and evaluation was carried out. Correlation analysis was carried out in order to find a relationship between the dependent variable (students' achievement) and the independent variables (teaching strategies, school curriculum implementation and evaluation). The test statistic of SPSS for significant testing comes with its degree of freedom (*df*), correlation coefficient or *F*-value and probability (*P*-value) of the test result. A *P*-value=0.01 was used for this study, meaning 1% significance level or 99% confidence interval.

Phase 3- Regression Analysis

In this phase, regression analysis was carried out between students' achievement and the correlated variables identified in phase 2 to ascertain deterministic relationships between variables. Thus, it was to find how the variables that significantly correlated with students' achievement in phase 2 can predict students' achievement. The regression model to be tested is:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$

Where: - Y = Level of Achievement/performance in Geometry test

Explained Variations of the Model = $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$

X_1 = Teaching Strategies

X_2 = students study habits

X_3 = Curriculum Implementation

X_4 = Evaluation

ε = Unexplained Variation that is error term, it represents all the factors that affect the dependent variable but are not included in the model either because they are not known or difficult to measure.

B_0 = Constant. It defines the level of achievement in Geometry without inclusion of predictor variables.

B_1, β_2, β_3, β_4 = Regression Co-efficient. Define the amount by which Y is changed for every unit change of predictor variables. The significance of each of the co-efficient was tested at 99% level of confidence to explain the variable that will explain the most of the problem.

3.9 Logistical and Ethical Considerations

Ensuring the validity and reliability of a research process involves conducting the investigation in an ethical manner throughout (Merriam 1998). In any research, including the present study, some ethical considerations need to be adhered to and they include the need for the researcher to: protect their participants and develop a bond of trust with the participants and promote the integrity of the research (Creswell 2003; Bryman 2004; Creswell 2009). Denscombe (2007) identifies three ethical principles that social science researchers ought to consider during the data collection, analysis and dissemination of the research findings stages of their study. Firstly, the interests of the participants should be protected and participants should not suffer as a consequence of their involvement with a piece of research. That is, there is a need to ensure participants do not experience any physical, psychological or personal harm as a result of their involvement in the research.

Secondly, the researcher should avoid deception or misrepresentation by operating in an honest and open manner with respect to their investigation. Thirdly, participants should give informed consent to indicate their willingness to take part in the study.

That is, participation in research should be voluntary and participants should be given enough information about the study to arrive at a reasoned judgement as to whether or not to take part in the research. Similar to the ideas of Bryman (2004) and Denscombe (2007), the major ethical considerations in the present study include: avoiding harm to participants, ensuring informed consent, respecting privacy and anonymity, avoiding deception and my role as a researcher.

To address these ethical issues, I first visited the selected schools to familiarise myself with the premises and people, introduce myself and seek permission to conduct the research. In addition, the purpose of the research was informally communicated to the selected schools and they were given the assurance that they would have the chance to decide whether they wanted to be part of the study or not. Consent to undertake the research was negotiated with key personnel in the various schools selected. I then met the various mathematics teachers in these schools to discuss the purpose of the study. The mathematics teachers in these schools then introduced me to their respective classes and I had an informal discussion with the students at which I informed them of the purpose of the study and sought their consent informally.

All the participants were made aware that their involvement in this research project was voluntary and they also had the right to withdraw subsequently, without given any reason, and their participation or lack of it would not affect their academic work and whatever they say would not be disclosed to any other person. A letter of appreciation was later sent through the same heads to the schools for their dedication and commitment during the exercise.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION

4.0 Overview

The purpose of the study was to determine the relationship between students' achievement in geometry and teachers' teaching strategies, students' study habits, curriculum implementation and evaluation, and also the extent to which they predict students' achievement in geometry in Agona District in Central Region of Ghana. In order to meet this purpose and also to answer the stated research questions, data were gathered from SHS three students and their respective mathematics teachers. This chapter seeks to analyse and discuss the results that have emerged from the data collected by means of questionnaires and achievement test. The results of the study are presented and discussed in relation to the five research questions, namely:

1. What are the effects of teachers' teaching strategies on students' level of achievement in geometry at the Senior High School (SHS) level?
2. How do students' study habits influence their level of achievement in geometry at the Senior High School (SHS) level?
3. What are the effects of curriculum implementation on students' level of achievement in geometry at the Senior High School (SHS) level?
4. How does evaluation influence students' academic achievement in geometry at the Senior High School (SHS) level?
5. What are the challenges teachers and students encounter in teaching and learning of geometric concepts at the Senior High School (SHS) level?

Discussions on the five research questions were based on quantitative analysis of data collected from questionnaires and achievement tests. The Statistical Package for Social Sciences (SPSS) was used to tabulate the results from which the analysis was

done. Both descriptive and inferential statistics (correlation and regression analysis) were used to analysis the data. First, the chapter presents the descriptive statistics of data collected from respondents, followed by the correlation analysis and regression analysis of the variables with students' achievement. Using these data analyses techniques, the research hypotheses were tested.

4.1 Return Rate, Response Rate and Reliability

This section presents the response rate and reliability of the teachers' and students' questionnaires. Questionnaire return is the proportion of the questionnaires returned after they have been issued to the respondents. The study was conducted on two hundred and forty (240) students and twelve (12) mathematics teachers from the four sampled secondary schools. The return rate of the questionnaires is shown in Table 4.1.

Table 4.1: Questionnaire Return Rate

Category of response respondents	Sample numbers	Frequency	Percentage by category
Students	240	220	91.7%
Teachers	12	12	100%
Total	**252**	**232**	**95.85%**

Source: Field Survey, 2017

Results in Table 4.1 show that, of the 12 teacher's questionnaires administered, all the twelve (12) were dully filled and returned, represented a 100% response rate, which is considered satisfactory to make conclusions for the study; however, two of the questionnaires were not fully completed. Since each individual questionnaire had consent form attached to it, the researcher was able to identify the two teachers who did not fully complete their questionnaires. The reasons they gave for not answering those questions were that they wanted to be reassured regarding the confidentiality of their responses, despite the fact that this assurance was discussed in the participants' information letter. The researcher approached the teachers to confirm that their

answers and responses were confidential and that their names would not be disclosed to anyone or be mentioned in the final report. The two teachers then completed the missing information.

On the other hand, the students' questionnaire and achievement test were administered to 240 students in the four (4) selected secondary schools, and of this number, twenty (20) of the completed students' questionnaires and achievement test were found not to have students' assigned codes and for that reason became difficult for the researcher to match each one of the questionnaires to its geometric achievement test. Since the study intended to determine the relationship between students' achievement and the instructional factors, the researcher did not include such students' questionnaires and achievement tests in the data analysis. However, 220 completed questionnaires and achievement tests with assigned student codes on both were obtained, representing 91.7%. These return rates were above 90% showing that the respondents' participation was very high, giving a high level of confidence in conclusions drawn and hence deemed adequate for data analysis. This can be related to Mugenda and Mugenda (2003) who said a 50% response rate is adequate, 60% good and above 70% rated very good. With a response rate of 91.7%, the study results and findings could be replicated to other settings if the same research process was used.

4.2 Demographic Characteristics of the Study Respondents

The study sought to establish the general characteristics of the sampled respondents, especially those that have a great bearing on the interpretation of data collected on the various objectives of the study. The main demographic features of the study respondents highlighted in this section include: gender status and age groups of the students and mathematics teachers. It also considers the academic and professional

qualifications, number of years of service, in-service training among other characteristics. The respondents for this study were two hundred and thirty-two (232) which comprises two hundred and twenty (220) students and twelve (12) mathematics teachers. The results of the Findings are as follows:

4.2.1 Responses on Students' Demographic Characteristics

Gender and Age

Section "A", items 1 and 2 on the students' questionnaire were used to answer this question. Data in Table 4.2 discloses the results of the analysis on students' gender and age groups.

Table 4.2: Distribution of Gender and Age by Student Respondents (N=220)

Variable	Labels	Frequency	Percent
Students' Gender	Male	122	55.5%
	Female	98	44.5%
	Total	**220**	**100**
Students' Age	Below 18 years	37	16.9%
	18 – 20 years	159	72.3%
	21 – 24 years	18	8.1%
	Above 24 years	6	2.7%
	Total	**220**	**100**

Source: Field Survey, 2017

Statistics gathered in Table 4.2 showed that out of the two hundred and twenty (220) student respondents who returned the completed questionnaires, 55.5% (n=122) were males while 44.5% (n=98) were females. This gives credence to Salmon's (2001) assumption that gender differences increase at secondary school level, particularly in situations that require complex reasoning. Results in Table 4.2 also depicts that, majority of the students constituting 72.3% (n=159) were aged from 18-20 years, 8.1% (n=18) from 21-24 years whilst 16.9% (n=37) had ages below 18 years. Only 2.7% (n=6) of the students were above 24 years. From this it is concluded that, 83.1% (n=183) of the students had ages from 18 years and above. Of this number, 59.2% (n=108) were males and females formed 40.8% (n=75). This implies that majority of

the students are mature enough and could explain how their performance was influence by the stated related factors.

4.2.2 Responses on Teachers' Demographic Characteristics

Teachers are very important in students' learning process. Their contribution to students' achievement in mathematics is significant; (Hyde & Jaffe, 1998). Hence, examining various characteristics of the teachers and their influence on students' achievement in mathematics, particularly geometry was necessary. Responses to the first seven items on the teachers' questionnaire were obtained. Data in Table 4.3 showed the gender, age groups and working experiences of the sampled teachers.

Table 4.3: Distribution of Teachers by Gender, Age Group and Years of Teaching Experiences (n=12)

Variable	Labels	Frequency	Percent
Gender	Male	8	66.7%
	Feale	4	33.3%
	Total	**12**	**100**
Teachers' Age	Below 35 years	2	16.7%
	Between 34 and 46 years	5	41.7%
	Between 45 and 51 years	4	33.3%
	Above 50 years	1	8.3%
	Total	**12**	**100**
Teaching Experience	1 – 5 years	7	58.3%
	6 – 10 years	3	25.0%
	11 – 15 years	1	8.3%
	16 – 20 years	1	8.3%
	Total	**12**	**100**

Source: Field Survey, 2017

Results in Table 4.3 show that, out of the 12 teacher respondents 66.7% (n=8) were males and 33.3% (n=4) were females. From this it can be deduced that although the study sampled both gender, majority of the respondents were male. This implies that the most employed gender in the teaching profession were male teachers. The results further depict that 41.7% (n=5) of the respondents were between the ages of 34-46 years, 33.3% (n=4) of the teachers were between the ages of 45-51 years whilst 16.7% (n=2) out of the total sample were below 35 years. Only 8.3% (n=1) of the teachers was 50 years and above. These imply that, most of the teachers who participated in

the study were above 35 years old giving an indication of respondents being matured enough to understand factor underlying the achievement of students in geometry. Furthermore, 58.3% (n=7) of the 12 teacher respondents had 1-5 years of teaching experience, 25.0% (n=3) teachers had between 6-10 years of teaching experience, 8.3% (n=1) respondents indicated teaching experience of 11 - 15 years and 8.3% (n=1) respondents indicated teaching experience of 16 - 20 years. This implies that majority of teachers at the SHS level had five (5) years or below of teaching experience.

The study further sought to find out the highest academic qualification and professional development of teachers. The selected mathematics teachers were asked for their experiences. The teachers provided their opinions through filled up questionnaires. Below in Figure 4.1 is the distribution of teachers by academic qualification.

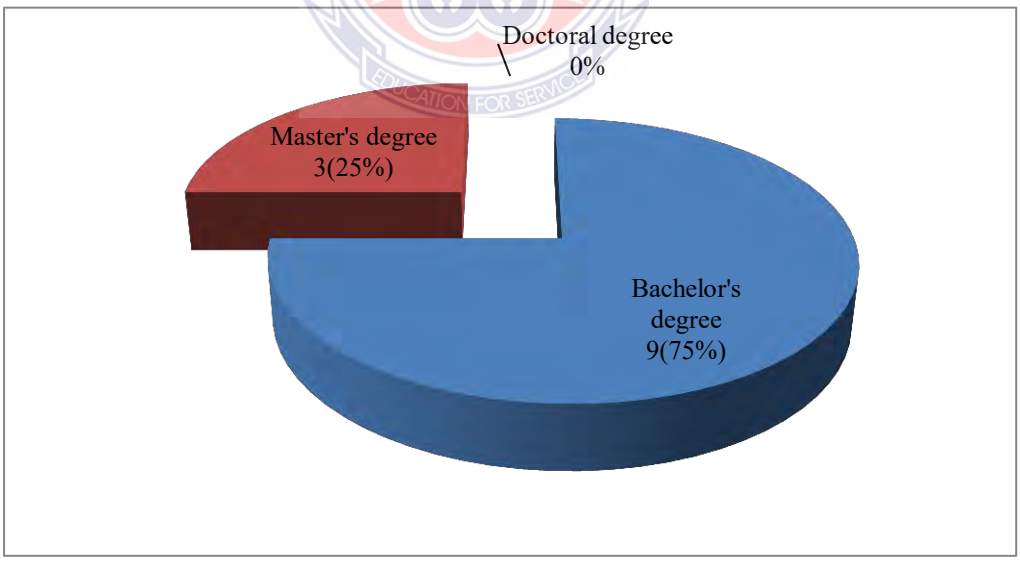

Figure 4.1: Distribution of Teachers' by Highest Academic Qualification (n=12)

Source: Field Survey, 2017

Results in Figure 4.1 show that, 9(75%) out of the twelve teacher respondents from the District had attained bachelor's degree, 3(25%) teachers had master's degree,

whilst none of the teacher respondents out of 12 had obtained the doctoral degree. These results imply that students in the study District were taught by qualified teachers as in Ghana, the requirement to recruit a mathematics teacher at the secondary level is that one has to have a bachelors' degree in mathematics with education. This attests to a generally high standard of education for the teachers but as to how higher education translates into effective teaching of geometric concepts is another researchable issue. Since academic qualification does not necessary guarantee professionalism, data was collected to ascertain how many of the teachers were professionals or how many were not professionals. Data presented in Figure 4.2 shows the summary of their responses.

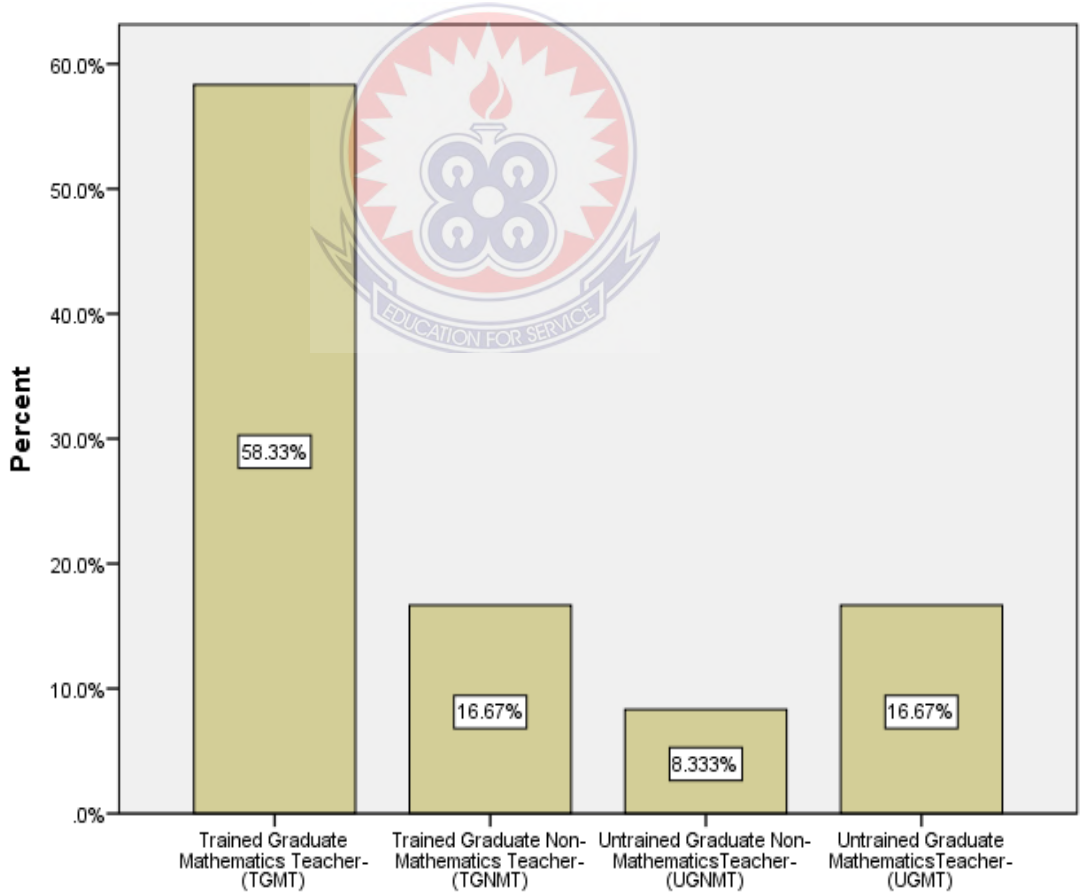

Figure 4.2: distribution of teachers' professional qualification (n=12)

The results in Figure 4.2 indicate that 70.0% (n=9) comprising Trained Graduate Mathematics Teachers (TGMT) and Trained Graduate Non-Mathematics Teachers (TGNMT) of the respondents were professionals and 30.0% (n=3) constituting Untrained Graduate Mathematics Teachers (UGMT) and Untrained Graduate Non-Mathematics Teachers (UGNMT) representing non-professionals. The results also show that more than half of the teachers (58.33%) were professionally qualified mathematics teachers. Professionalism is a stronger feature when it comes to teaching because teaching is not an activity that can be effectively performed by anybody at all as perceived by some people. Teaching is a skill that needs to be developed to enhance proficiency in persons who have the desire to impart knowledge at all educational levels. It is for this reason that two tertiary institutions namely, University of Cape Coast (UCC) and University of Education, Winneba (UEW) have been entrusted to train teachers for Ghanaian SHS classrooms. Therefore, the 16.67% of participants who indicated not being professionals but did mathematics should be provided with professional development opportunities to enhance their proficiency in teaching.

Furthermore, teachers were asked to indicate whether they have attended any in-service training or workshop on mathematics teaching. The purpose of this questionnaire item was to establish how often teachers do update themselves in their field of work. The results from the responses of the respondents revealed that, 66.6% (n=8) of the teachers had not attended any in-service training on the teaching of mathematics and 33.4% (n=4) in one way or the other had attended a training. Below in Figure 4.3 shows the graphical representation of their response.

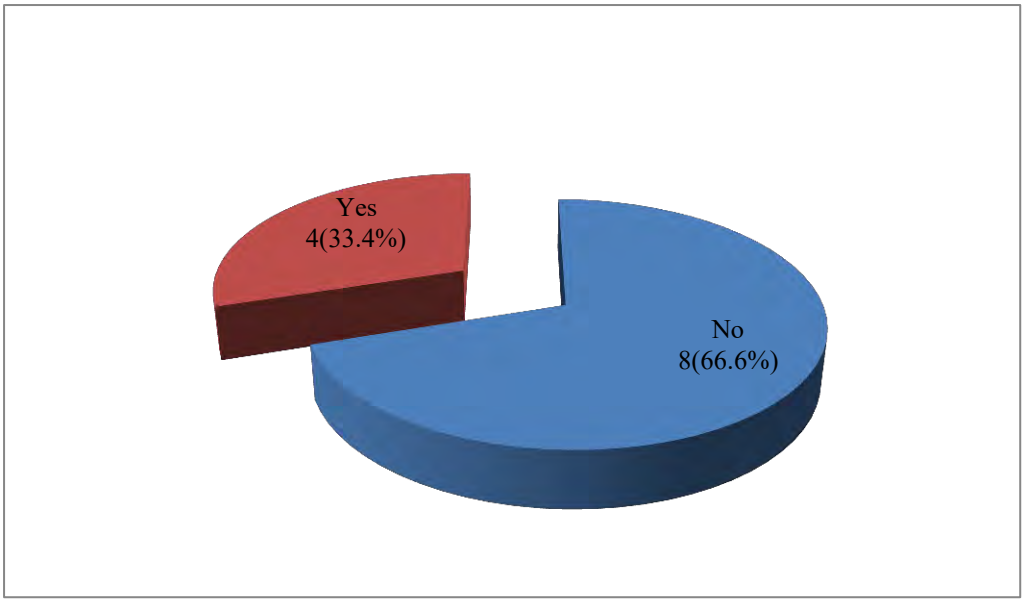

Figure 4.3: Teachers' Responses on In-service Training (n=12)

Source: Field Survey, 2017

4.3 Students' Level of Understanding of Geometric Concepts Covered in the Syllabus

The study used geometry achievement test to assess the students' level of understanding in geometry. The sampled students were first asked to answer a questionnaire item pertaining to their level of performance in mathematics after which they were presented with written test items to confirm their earlier responses to the questionnaire item. Section B, item 3 of students' questionnaire requested for students' level of performance. This was to enable students' rate their level of understanding pertaining to mathematics on a five point Likert-type rating Scale *(1=very weak, 2=weak, 3=good, 4=very good and 5=excellent)*. Below in Figure 4.4 is a pie chart showing the various percentages of responses that were given by students with each performance ranking.

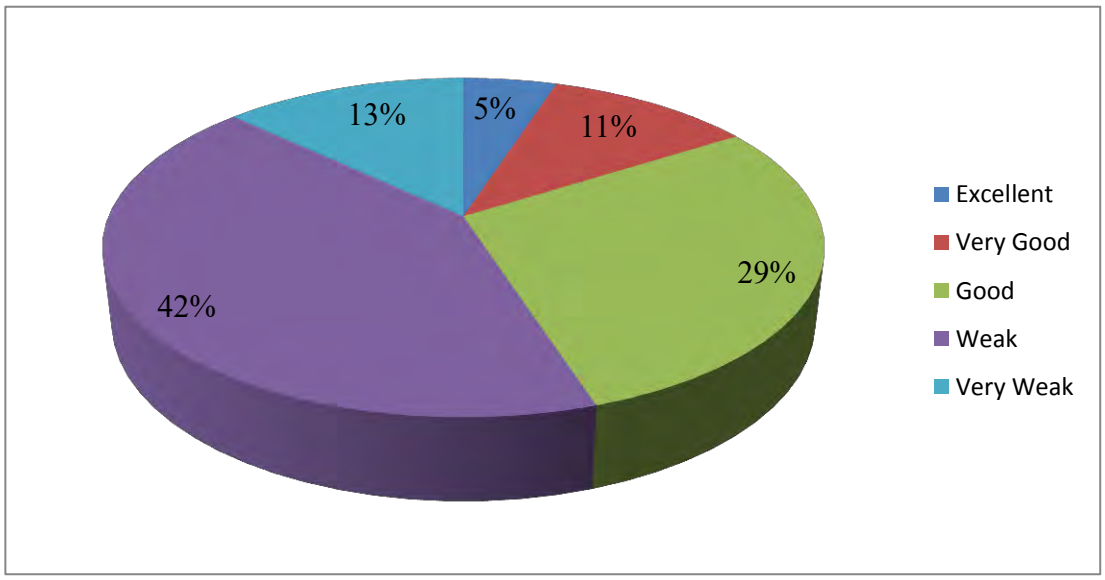

Figure 4.4: Responses of Student Respondents According to their Performance Rankings (n=220)

Source: Field Survey, 2017

From the pie chart, 29% (n=64) of student respondents attested that they are good and 11% (n=24) of them believed they were very good in mathematics with excellent coming from a handful of them. On the contrary, majority of the students indicated they were weak and very weak. On the whole, 55% (n=121) of the respondents indicated that their mathematics performance was below average. This indicates that the students generally were not knowledgeable in mathematics. The students were further made to write a geometric achievement test (GAT) to assess their level of understanding in geometry to confirm if indeed they were knowledgeable in geometric contents. Table 4.4 shows the distribution of students who attempted the test items and the number of them who actually got it correct.

Table 4.4: Distribution of Students Who Attempted the Items and Number of Them Who Got it Correct

Aspects	Items	Attempted Items (N=220)		Correct Items	
		Number	Percent	Number	Percent
Plane Figures	1	220	100.0	99	45.0
	2	220	100.0	140	63.6
	3	220	100.0	100	45.5
	4	220	100.0	110	50.0
	5	218	99.1	111	50.5
	6	219	99.5	92	41.8
	7	200	90.9	82	37.3
	8	220	100.0	92	41.8
	9	215	97.7	112	50.9
	10	218	99.1	98	44.5
	11	218	99.1	87	39.5
	12	220	100.0	102	46.4
Solid Figures	13	220	100.0	90	40.9
	14	211	95.9	67	30.5
	15	215	97.7	77	30.0
	16	212	96.4	70	31.8
	17	216	98.2	62	28.2
	18	215	97.7	52	23.6
	19	210	95.5	41	18.6
	20	210	95.5	39	17.7

Source: Field Survey, 2017

From table 4.4 it could be concluded that majority of the students attempted the questions of which few of them arrived at the correct answer. The most popular questions (item 2 and 4) were attempted by 100% of the students, of which 63.6% and 50.0% respectively of them were able to work it correctly. The most challenging question (item 20) was attempted by 95.5% of the students but only few of them (17.7%) were able to answer it correctly. In the first twelve items of the test, students were expected to demonstrate their content knowledge in the areas of plane figures. Data gathered in Table 4.4 indicated that an average of 46.4% of the students were able to answer questions 1 to 12. In the case of items 12 to 20, which were also to test students' content knowledge and application on solid figures, although majority of the students answered the questions, percentages of students who were able to answer

correctly were 40.9%, 30.5%, 35.0%, 31.8% 28.2, 23.6% 18.6% and 17.7% respectively which were rather on the lower side.

Likewise, statistics in Table 4.4 further showed that apart from questions 2, 4, 5 and 9 where percentages of students who answered them correctly were 63.6%, 50.0%, 50.5% and 50.9% respectively, questions 1, 3, 6, 7, 8, 10 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20 recorded discouraging percentages of right answers. Below in Table 4.5 is the descriptive statistics of students' performance in the achievement test.

Table 4.5 Descriptive Statistics of Students Scores in the Geometric Achievement Test

	N	Min	Max	Mean	S.D	Median	Mode	Skewness	Kurtosis
Score	220	5	85	30.18	15.88	25	25	.675	.408

Source: Field Survey, 2017

Table 4.5 shows the descriptive statistics of the students' scores in the geometric achievement test. From table 4.5, the highest score on all the twenty questions was 85% and the least score was 5% with a mode and median as low as 25% and 25% respectively. The geometric achievement test recorded a mean of 30.18 with a standard deviation of 15.88. The descriptive statistics of students score is an indication that most of the sampled students had very low marks.

Below in figure 4.5 is the overall performance of students in geometric achievement Test (GAT).

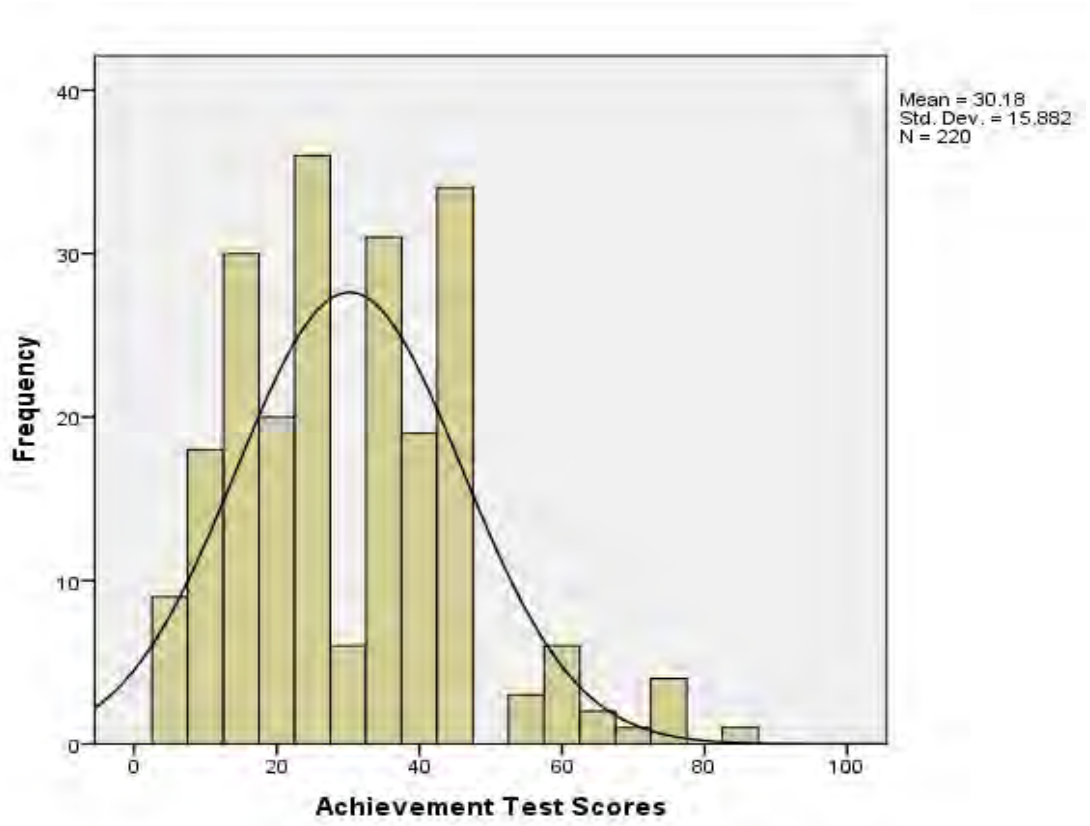

Figure 4.5: Overall Performances of Students in the Geometric Achievement Test

Source: Field Survey, 2017

Figure 4.5 shows the overall performance of students in geometric achievement Test (GAT). The graph shows a positively skewed performance by students with Skewness of *0.675* and kurtosis of *0.408* indicating that the overall performance of students was abysmal with most of students obtaining marks below 50%. The performances were characterized into 5 categories which include: less than 20%, 20-30%, 31-40%, 41-49% and finally 50% and above. Table 4.6 is the summary showing the various percentages of performances that were obtained by students.

Table 4.6: Cumulative Percentage Frequencies of Students' Test Scores (n=220)

Categorized percentage score	No of students Frequency	Students Percentage	Cumulative Percent
Less than 20%	57	25.9%	25.9
20 – 30%	62	28.2%	54.1
31 – 40%	50	22.7%	76.8
41 – 49%	28	12.7%	89.5
50% and above	23	10.5%	100
Total	**220**	**100**	

Source: Field Survey, 2017

Results in Table 4.6 show the cumulative percentage frequencies of students' achievement test scores. From Table 4.6, it could be seen that 25.9% (n=57) students scored less than 20% in the test while 28.2% (n=62) students scored between 20 and 30%. The results further showed that only 10.5% (n=23) students scored an average marks of 50% and above. None of the students who sat for the test had a score less than 5%. Using cut-off marks of 50%, these results depict that over 80% of the students who wrote the test failed. The results imply that the performance of students in geometric contents in the secondary schools of the study area was very low.

4.4 Results from the Descriptive Statistical Analysis

Responses to question items in the respondents' questionnaires were used to answer the research question. The responses were computed using frequency, percentages, means and standard deviations to evaluate them. The five point Likert scale was used.

4.4.1 Research Question One: What are the effects of teachers' teaching strategies on students' level of achievement in geometry at the senior high school (SHS) level?

Research question one sought to examine teaching approaches used in teaching geometric concepts and the extent of achievement by students in secondary schools in Agona District in Central Region of Ghana. According to NCTM (2000), students

understanding of mathematics, their ability to use it to solve problems, their confidence in and disposition towards mathematics are well-shaped by the teaching approaches used in class. Participants' questionnaires were used to elicit information about the teachers' preferred teaching approaches. To achieve this, the study respondents were asked to select from a list of five (5) approaches on an increasing scale of 1 to 5 in that order to express the extent to which these approaches identified in the literature which are often used in Ghanaian schools. The approaches assessed include lecture methods, small group discussion methods, discovery method, demonstration method and finally drawing and modeling method. The teaching methods are limited to these five in the present study as these methods constitute the common teaching practices in Ghanaian schools (Adentunde 2007). The responses from both teachers and students are presented as follow;

Teacher Respondents

In section B of the teachers' questionnaire, the teachers were asked to indicate the extent of use of the five teaching approaches identified in the literature which are often used in Ghanaian schools. The responses were evaluated using mean and standard deviation, and are presented in Table 4.7.

Table 4.7: Teachers' Responses on Mostly Used Approaches in Teaching of Geometric Concepts (N=12)

	N	Mean	Std. Deviation
Lecture method	12	4.08	.900
Small Group Discussion method	12	3.25	1.055
Discovery method	12	2.33	1.073
Demonstration method	12	4.17	.835
Drawing & modeling method	12	2.25	1.055

Source: Field Survey, 2017

Results in Table 4.7 showed the means and standard deviations for responses regarding the use of selected teaching approaches in the sample senior high schools.

Those approaches recorded to be “heavily used” and/or "frequently used" by teachers were: lecture method (mean = 4.08) and demonstration method (mean = 4.17). The small group discussion (mean = 3.25), discovery method (mean = 2.33), and drawing and modeling (mean = 2.25) were those methods recorded to be "not used" and/or "rarely used". The results showed in Table 4.7 indicated that both teacher-centred and student-centred approaches to teaching were used by teachers; however, the use of teacher-centred approaches was statistically significant, as compared to student-centred approaches. This shows that, the mathematics teachers in the study district frequently use expository approaches rather than interactive teaching methods.

Student Respondents

It was required to find out students’ opinions of their teachers’ approaches to geometric concepts delivery in the mathematics classroom. Their opinions were sought and analysed by type of teaching approaches. The responses were evaluated using mean and standard deviation, and are presented in Table 4.8.

Table 4.8: Students’ Responses on Mostly Used Approaches in Learning of Geometric Concepts (N=220)

Teaching Strategies	N	Mean	Std. Deviation
Lecture method	220	4.53	.737
Small Group Discussion method	220	3.01	1.077
Discovery method	220	2.55	1.128
demonstration method	220	4.52	.561
Drawing & modeling method	220	2.25	1.004

Source: Field Survey, 2017

Results in Table 4.8 show that the consensus proportions of students who indicate that their teachers use teacher-centred approach (lecture and demonstration methods) is higher than the consensus proportions of students who indicate their teachers use student-centred approach (small group discussion, discovery and drawing and modeling methods) to teaching. Section C, items 5, 6, 7, 8 and 9 of students’

questionnaire required to seek the extent to which these teaching approaches influence their achievement in geometry. The first teaching approach considered was the lecture method of teaching geometry.

Extent of Understanding of Geometric Concepts by the Lecture method of teaching Geometry

Responses to item 5 in the students' questionnaire were used to find out whether the lecture method enabled them to excel in geometry examination, whether the lecture method enabled students to grasp geometric concepts, whether lecture methods in teaching geometry enable students to apply the geometric concepts in problem solving among other measure of performance. The responses obtained were summarized and presented in Table 4.9.

Table 4.9: Students' Responses on Extent of Understanding of Geometric Concepts by the Lecture Method of Teaching Mathematics

Items	Responses						
	S.D N(%)	D N(%)	N N(%)	A N(%)	S.A N(%)	Mean	StdDev
Using lecture methods in teaching geometry leads to excellence in mathematics	38 (17.3)	59 (26.8)	46 (20.9)	42 (19.1)	35 (15.9)	2.89	1.33
Using lecture methods in teaching geometry ensures students grasp of geometric concepts	47 (21.4)	41 (18.6)	46 (20.9)	31 (14.1)	55 (25.0)	3.03	1.48
Using lecture methods in teaching geometry enable students to apply the geometry concepts in problem solving	43 (19.5)	40 (18.2)	37 (16.8)	52 (23.6)	48 (21.8)	3.10	1.44
Using lecture methods in teaching geometry enables students to do their assignments with easy	50 (22.7)	39 (17.7)	44 (20.0)	50 (22.7)	37 (16.8)	2.93	1.41
Mean of Means					**2.99**		
Mean od Standard Deviations					**1.42**		

N=220 Scale: 1= Strongly Disagree 2=Disagree 3= Neutral 4= Agree 5= Strongly Agree

Results in Table 4.9 indicate that 35% (n=77) of the students strongly agreed and agreed that lecture method enable them to excel in geometry examinations while 44.1% (n=97) of the students strongly disagreed and disagreed with this statement.

Similarly, 39.1% (n=86) agreed and strongly agreed that lecture methods enabled them to grasp geometry concepts while 40% (n=88) disagreed and strongly disagreed to the assertion. These results imply that majority of the students did not prefer lecture method as an approach to geometric concepts delivery in the mathematics classroom. The mean of means (2.99) in Table 4.9 clearly infer that students disagreed to the assertion that lecture method enhances their achievement in geometry.

Extent of Understanding of Geometric Concepts by the small group discussion method of teaching Geometry

Responses to item 6 in the students' questionnaire were used to access the effects of small group discussion method on students' achievement in geometry. The responses obtained were evaluated using mean and standard deviation, and are presented in Table 4.10.

Table 4.10: Students' Responses on the effects of Small Group Discussion Method of Teaching Geometric Concepts on their Understanding

Item	Responses						
	SD N (%)	D N (%)	N N (%)	A N (%)	SA N (%)	Mean	Std.Dev
Using small group discussion methods in teaching geometry leads to excellence in mathematics	48 (21.8)	39 (17.7)	24 (10.9)	41 (18.6)	68 (30.9)	2.99	1.44
Using small group discussion methods in teaching geometry ensures students grasp geometry concepts	29 (13.2)	37 (16.8)	27 (12.3)	58 (26.4)	69 (31.4)	3.96	1.46
Using small group discussion methods in teaching geometry enable students to apply the geometry concepts in problem solving	41 (18.6)	23 (10.5)	45 (20.5)	69 (31.4)	42 (19.1)	3.82	1.39
Using small group discussion methods in teaching geometry enables students to do their assignments with easy	43 (19.5)	19 (8.6)	40 (18.2)	46 (20.9)	72 (32.7)	3.89	1.45
Mean of Means					**3.67**		
Mean od Standard Deviations					**1.44**		

N=220 Scale: 1= Strongly Disagree 2=Disagree 3= Neutral 4= Agree 5= Strongly Agree

Results in Table 4.10, indicate that students had varying opinions on the small group discussion method. The results show that 39.5% of the students disagreed and strongly disagreed that using small group discussion method in teaching geometry leads to excellence in mathematics. However, 49.5% of the respondents agreed with the small group discussion methods lead to better performance. The results also revealed that over 57% of the students agreed that small group discussion method enabled students to grasp geometric concepts. Majority of the students (50.5%) also agreed that using small group discussion method in teaching geometry enables students to apply the geometry concepts in problem solving. The mean response on Table 4.10 shows that the students accepted the small group discussion as the teaching strategy that could enhance learning of geometry in secondary schools in the study districts if adopted. The mean of means (3.67) which is in line with the criteria for accepting a factor.

Extent of Understanding of Geometric Concepts by the Discovery method of teaching Geometry

The study assessed the effects of using discovery approach on students' achievements. Responses to item 7 on the students' questionnaire were used to answer this question. Table 4.11 shows the various percentages, means and standard deviation of responses given by students on the extent of understanding of geometric concepts by the discovery method of teaching geometry.

Table 4.11: Students' Responses on the Effects of Discovery Method of Teaching Geometric Concepts on their Understanding (N=220)

Item	Responses					Mean	Std Dev
	SD N (%)	D N (%)	N N (%)	A N (%)	SA N (%)		
Using discovery teaching approach methods in teaching geometry leads to excellence in mathematics	36 (16.4)	26 (11.8)	25 (11.4)	72 (32.7)	61 (27.7)	3.04	1.35
Using discovery teaching approach in teaching geometry ensures students grasp geometry concepts	39 (17.7)	33 (15.0)	30 (13.6)	61 (27.7)	57 (25.9)	3.14	1.42
Using discovery teaching approach in teaching geometry enables students to apply the geometry concepts in problem solving	36 (16.4)	43 (19.5)	29 (13.2)	46 (20.9)	66 (30.0)	3.92	1.38
Using discovery teaching approach in teaching geometry enables students to do their assignments with easy	31 (14.0)	39 (17.7)	37 (16.8)	48 (21.8)	67 (30.6)	2.88	1.36
Mean of means						**3.25**	
Mean od Standard Deviations						**1.38**	

N=220 Scale: 1= Strongly Disagree 2=Disagree 3= Neutral 4= Agree 5= Strongly Agree

The study results in Table 4.11 show that 60.4% of the students agreed and strongly agreed that using discovery method in teaching geometry leads to excellence in mathematics while 28.2% of the respondent disagreed with this statement. The results further showed that, majority of the students agreed and strongly agreed that this method enabled them to grasp concept and apply the concepts in problem solving and aided them to do their assignments with the means 3.14 and 3.92 respectively. With a mean of means (3.25) imply that the use of discovery method led to high achievement among students.

Extent of Understanding of Geometric Concepts by the Demonstration method of teaching Geometry

Item 8 on the students' questionnaire required students to express their views on the effects of demonstration method on their understanding of geometric concepts. The

responses obtained were summarized and presented in Table 4.12. Results presented in Table 4.12 shows the various means, standard deviations and percentages of responses that were given by students on the extent of understanding of geometric concepts by the demonstration method of teaching geometry.

Table 4.12: Students' Responses on the Effects of Using Demonstration Method of Teaching Geometric Concepts on Their Understanding

Item	Responses						
	SD N (%)	D N (%)	N N (%)	A N (%)	SA N (%)	Mean	Std Dev.
Using demonstration methods in teaching geometry leads to excellence in mathematics	17 (7.7)	33 (15.0)	39 (17.7)	73 (33.2)	58 (26.4)	3.95	1.36
Using demonstration methods in teaching geometry ensures students grasp geometry concepts	19 (8.6)	30 (13.6)	45 (20.5)	66 (30.0)	60 (27.3)	3.94	1.37
Using demonstration methods in teaching geometry ensures students grasp geometry concepts	42 (19.1)	33 (15.0)	45 (20.5)	46 (20.9)	49 (22.3)	3.15	1.43
Mean of Means							**3.68**
Mean od Standard Deviations							**1.39**

N=220 Scale: 1= Strongly Disagree, 2=Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

Results in Table 4.12 indicate that 59.6% of the students in this study agreed and strongly agreed that demonstration method helped them to excel in mathematics examinations. The result further show that 57.3% of the students in this study agreed and strongly agreed that using demonstration method in learning geometry had great influence in assisting them to grasp geometry concepts. The results imply that students associated the use of demonstration method with better performance in geometry. According to Horn (1995), teachers are advised to give adequate varied worked examples with various complexities; plan a series of worked examples and that students should work out similar examples immediately. This enhances students' achievement and ability to transfer learnt concepts to new mathematical problems. Students can solve new problems by using what they already know from analogous problems.

Extent of Understanding of Geometric Concepts by the Drawing and Modeling Method of Teaching Geometry

Item 9 on the students' questionnaire required students to express their views on the effects of drawing and modeling method on their understanding of geometric concepts. The responses obtained were summarized and presented in Table 4.13. Results presented in Table 4.13 shows the various means, standard deviations and percentages of responses that were given by students on the extent of understanding of geometric concepts by the drawing and modeling method of teaching geometry.

Table 4.13: Students' Responses on the Effects of Drawing and Modeling Approach of Teaching Geometric Concepts on Their Understanding

Item	Responses						
	SD N (%)	D N (%)	N N (%)	A N (%)	SA N (%)	Mean	Std Dev.
Using drawing and modeling in teaching geometry leads to excellence in mathematics	17 (7.7)	34 (15.5)	49 (22.3)	56 (25.5)	64 (29.1)	3.23	1.46
Using drawing and modeling in teaching geometry ensures students grasp geometry concepts	22 (10.0)	32 (14.5)	36 (16.4)	65 (29.5)	65 (29.5)	3.88	1.39
Using drawing and modeling in teaching geometry enables students to apply the geometry concepts in problem solving	13 (5.9)	25 (11.4)	41 (18.6)	65 (29.5)	76 (34.5)	3.89	1.42
Using drawing and modeling in teaching geometry enables students to do their assignments with easy	21 (9.5)	23 (10.5)	46 (20.9)	55 (25.0)	75 (34.1)	3.04	1.45
Mean of Means					**3.51**		
Mean od Standard Deviations					**1.43**		

N=220 Scale: 1= Strongly Disagree 2=Disagree 3= Neutral 4= Agree 5= Strongly Agree

Geometry learning requires the use of drawing and modeling for illustration purposes. Therefore, the study sought to find out if students that are taught using drawing and modeling method performed better than those that don't use this method. The results in the Table 4.13 indicate that, 55% of the respondents agreed and strong agreed with the statements "drawing and modeling in teaching geometry leads to excellence in

mathematics". The results show that 54.6% of the respondents agreed and strong agreed that drawing ad modeling in geometry learning led to better performance. The results further, show that 59% of the students agreed and strongly agreed that use of drawing and modeling significantly improved the grasping of geometry concepts among students. The results also show that 64% of the students indicated that using drawing and modeling in geometry enabled them to apply the concepts acquired in problem solving.

Table 4.14 depicts the summary of the mean of means and mean of standard deviations of students' responses to the various teaching approaches used in the classroom. The mean of means rating in the study refers to the average of the mean scores of the number of items under each core factor which indicates the overall acceptance or rejection by the study respondents while standard deviation suggests a divergence of opinion among the respondents to an issue under discussion.

Table 4.14: Summary of Mean of Means and Mean of Standard Deviations of Students' Responses Regarding the Effects of Teaching Approaches on Students' Achievement in Geometry

	Lecture Method	Small Group Discussion Method	Discovery Method	Demonstration Method	Drawing and Modeling method
Mean of Means	2.99	3.67	3.25	3.68	3.51
Standard Deviation	1.42	1.44	1.38	1.38	1.43

Source: Field Survey, 2017

The mean of means as presented in Table 4.14 shows that the students accepted the small group discussion method, discovery method, demonstration method, and drawing and modeling method as the strategies that influence their learning of geometry. The mean of means values ranges from 3.25 to 3.68 which is in line with the criteria for accepting a factor. The results in Table 4.14 again show that the lecture method had non-favourable responses with a mean of means value of 2.99 which is

below the speculated mean of 3.0. this indicates that students generally did not like lecture method used by their teachers in learning geometry and that it affected them negatively in their achievement.

4.4.2 Research Question Two: How do students' study habits influence their level of achievement in geometry at the senior high school (SHS) level?

Research question two sought to find out some of their study habits in learning geometric concepts and the extent of achievement by students in the sample schools. Section D, item 10 of students' questionnaire was used to elicit information regarding which learning behaviours the students prefer most in their learning of geometric concepts. The responses of students' study habits are summarized and presented on Table 4.15.

Table 4.15: Students' Responses on mostly used study habits in learning geometric Concepts

Study Habit	Frequency (F)	Percentage (%)
Discussion Amongst students	48	21.8
Discussion between students and teachers	40	18.2
Study privately using textbooks	58	26.4
Doing assignment/practices	34	15.5
Consultations	40	18.2
Total	**220**	**100**

Source: Field Survey, 2017

Results in Table 4.15 revealed that privately studying using textbooks was the common study habits used by majority 26.6% (58) of the students. The results also showed that the second most common learning behaviour adopted by the students were discussion among themselves which was indicated by 21.8% (48) of the students. Discussion with teachers and consultation was indicated by 18.2% (40) students each and finally least students indicated they preferred doing

assignment/practice on their own. Table 4.16 shows the summary of responses on the extent of achievement in geometry by students regarding the selected learning behaviours.

Table 4.16: Students' Responses on Extent of Understanding of Geometric Concepts by their Study Habits in Learning Geometry

Item	Responses						
	SD(%)	D(%)	N(%)	A(%)	SA(%)	Mean	StdDev.
Discussion among students lead to grasp of geometric concepts, good performance and concept application.	21.4%	18.6%	11.8%	23.2%	25.0%	3.12	1.48
Discussion between students and teachers lead to grasp of geometric concepts, good performance and concept application	19.5%	18.2%	12.3%	23.6%	26.4%	3.19	1.44
Studying privately using textbooks lead to grasp of geometric concepts, good performance and concept application	26.4%	26.8%	11.8%	19.1%	15.9%	2.71	1.33
Doing assignment/practice lead to grasp of geometric concepts, good performance and concept application	14.0%	17.7%	16.8%	21.8%	30.6%	2.78	1.36
Consulting parents and guardians lead to grasp of geometric concepts, good performance and concept application	22.7%	17.7%	20.0%	22.7%	16.8%	2.83	1.41
Mean of Means				**2.90**			
Mean of Standard Deviation				**1.40**			

N=220 Scale: 1= Strongly Disagree 2=Disagree 3= Neutral 4= Agree 5= Strongly Agree

Results in Table 4.16 reveals that 48.2% (n=106) of the students agreed and strongly agreed to the assertion that discussion among themselves lead to grasp of geometric concepts, good performance and concept application whilst 40.0% (n=88) of the students disagreed and strongly disagreed to the statement. Similarly, 50.0% or more agreed and strongly agreed that discussion between students and teachers and doing assignment/practice enabled them to grasp geometric concepts, perform better. These results imply that majority of the students believed being engaged in an interactive environment enhances their understanding of geometry.

4.4.3 Research Question Three: What are the effects curriculum implementation on students' level of achievement in geometry at the senior high school (SHS) level?

Mathematics curriculum in Ghana requires that students and teachers should have materials necessary in learning geometry. The study sought to find out whether students adhered to the curriculum requirements when learning geometry. Response to item 9 on the teachers' questionnaire was used to answer the research question above. The responses were evaluated using mean and are presented in Table 4.17.

Table 4.17: Students' Responses on the Effects of Curriculum Implementation On their Achievement in Geometry

Item	Responses						
	SD(%)	D(%)	N(%)	A(%)	SA(%)	Mean	StdDev.
There are enough textbooks for students in the ratio 1:1	20.5%	27.3%	20.9%	22.7%	8.6%	3.02	1.40
Each students has a geometrical set	32.3%	17.7%	21.4%	18.6%	10.0%	2.96	1.44
The school has mathematical lab/library	29.5%	30.9%	19.5%	13.6%	6.4%	2.96	1.37
The school has enough computers to aid teaching and learning of geometric concepts	25.5%	25.9%	23.6%	10.9%	14.1%	3.12	1.39
The school provides programmable calculators	23.2%	24.5%	22.3%	19.1%	10.9%	2.97	1.35
The school organizes remedial lessons for weak students in geometrical concepts	30.9%	24.1%	16.4%	10.5%	18.2%	2.91	1.42
Mathematics teachers give a lot of assignments in geometry and mark frequently	20.5%	22.7%	22.3%	24.5%	10.0%	3.11	1.41
Mathematics teachers always motivate students	20.5%	22.7%	14.5%	19.5%	22.7%	3.01	1.47
Mean of Means					**3.01**		
Mean of Standard Deviation					**1.41**		

N=220 Scale: 1= Strongly Disagree 2=Disagree 3= Neutral 4= Agree 5= Strongly Agree

The results in Table 4.17 showed that, 47.7%, 60.4% and 47.7% of students in the schools surveyed disagreed and strongly disagreed to the statement "there are enough textbooks for students in the ratio 1:1", "each students has a geometrical set" and "the

school provides programmable calculators" respectively for learning geometric concepts while 31.3%, 28.6% and 30% of the respondents agreed and strongly agreed with the statements that such materials among others were available to them. Majority of the respondents had varying opinions on teachers organizing remedial lessons for weak students. The results showed that 55% of the respondents disagreed that remedial classes are organised for weak students. However, 28.7% of the respondents agreed that remedial classes were organised for weak students on geometry. The results also revealed that 43.2% of the respondents disagreed that enough assignment are given and marked frequently on geometric concepts by their mathematics teachers while 34.5% agreed with this statement. The results indicated majority of the respondents did not have the required materials for learning mathematical concepts. Geometry requires a lot of demonstration therefore lack of necessary materials could lead to poor performance. Chepkurui (2004) argues that availability and use of such materials have a positive effect on students' achievement in Mathematics, particularly in geometry, since the students can use it as a guide in geometric skill development and offers exercise for further practice of learnt concept.

4.4.4 Research Question Four: How does evaluation influence students' level of achievement in geometry at senior high school (SHS) level?

According to Eshun and Effrim (2008), Evaluation is the pivot of educational system which gives an exact idea of what has actually been achieved at the end of a particular period or stage as a result of the teaching-learning experiences, provided in the classroom. Students need to be assessed in order to discover knowledge gaps between what is learnt and what is known for an intervention (Mzokwana, 2008). The study sought to establish the effects of evaluation on students' achievement in geometry. Students were requested to indicate whether their teachers assess them on geometric

concepts. This was necessary because evaluation by teachers was a key element in influencing student's academic performance. The responses are summarized and presented in Figure 4.7

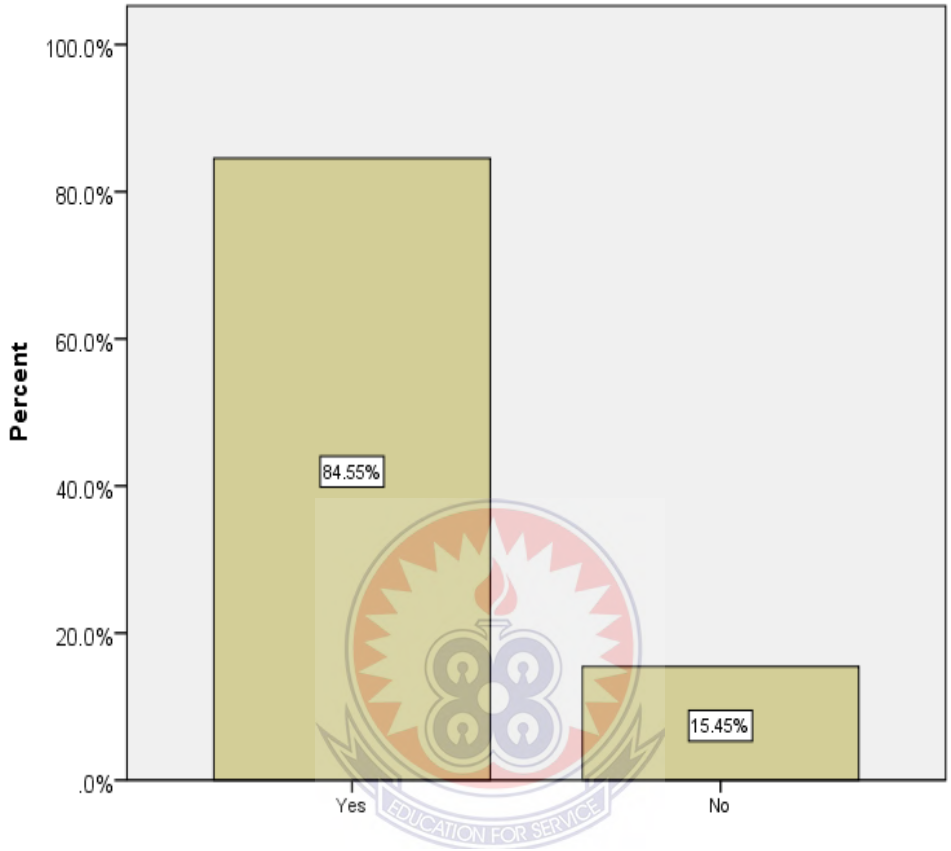

Figure 4.6: Students' Response on Whether Teachers Evaluate their Learning of Geometry

Source: Field Survey, 2017

Figure 4.7 indicated 84.55% (n=186) out of the 220 student respondents indicated that their learning of geometry is assessed whilst 15.45% (n=34) of the students indicated they are not assessed. The study further asked students to indicate the assessment techniques commonly adopted by the mathematics teachers in assessing them. The results of students' responses are summarised and presented in Table 4.18

Table 4.18: Students' Responses to the Main Assessment Techniques Used

Technique	Frequency (F)	Percentage (%)
Teacher-made test	114	51.82
Assignment/Homework	58	26.36
End-of-term exams	39	17.73
Other	9	4.09
Total	**220**	**100**

Source: Field Survey, 2017

When asked about the main assessment techniques adopted by mathematics teachers, 51.82% (n=114) responded that the teacher-made test are used, while 26.36% (n=58) agreed that assignments/homework are used as assessment techniques. Another 17.73% (n=39) of the students responded that the end-of-term examination technique was used while 4.09% (n=9) of the students cited that other forms of assessment such as quizzes are normally adopted. The study concludes that teacher-made test is most frequently used to assess students. The results also showed that the teachers used different methods of assessment to monitor their students' learning.

The study further sought to find out whether assessment of geometrical concept is a continuous process, whether after assessment feedback should be given immediately to the student, whether feedback given to the learner after assessment is motivating to the student among other measures of evaluation. Response to item 10 on the respondents' questionnaire was used to answer the research question. The responses were measured using mean and are presented in Table 4.19.

Table 4.19: Students' Responses on the Effects of Evaluation on their Achievement in Geometry

Item	Responses						
	SD(%)	D(%)	N(%)	A(%)	SA(%)	Mean	StdDev.
Assessment of geometrical concept is a continuous process	2.3%	5.0%	8.2%	46.4%	38.2%	4.13	0.92
After assessment feedback should be given immediately to the student	5.5%	7.7%	4.1%	42.3%	40.5%	4.05	1.12
Feedback given to the learner after assessment is motivating to the student	7.3%	5.5%	4.1%	42.3%	40.9%	4.04	1.15
Assessment is an important process of teaching and learning of geometry	4.5%	4.1%	8.6%	42.3%	40.5%	4.10	1.03
When setting a test a table of specification is important for evaluation	5.9%	6.8%	4.1%	45.0%	38.2%	4.03	1.11
Geometrical concepts are always tested in assignments	4.5%	6.8%	6.8%	38.6%	43.2%	4.09	1.09
Geometrical concepts are always tested in continuous assessment tests(C.A.T`s)	6.8%	5.5%	2.7%	45.9%	39.1%	4.05	1.12
Geometrical concepts are always tested in main exams.	4.5%	7.3%	5.9%	40.0%	42.3%	4.08	1.09
Mean of Means							**4.07**
Mean of standard Deviation							**1.08**

Source: Field Survey, 2017

The results in Table 4.19 showed that 46.4% and 38.2% of the respondents agreed and strongly agreed that assessment of geometrical concept was a continuous process among. The results also show that 82.8% of the respondents agreed that after assessment feedback should be given immediately to the students. Majority of the respondents also agreed that geometry concepts are tested in both continuous assessment and main examinations. These results imply that there was continuous evaluation on geometric concepts. The study established that evaluation was conducted in terms of continuous assessment of geometric concept, giving feedback immediately after assessment and testing geometrical concepts in continuous assessment tests main end of term examinations. The above information is significant

to the study because evaluating lessons helps in knowing to what extent instructional objectives had been achieved and to know the strengths and weaknesses of individual students. This will enhance students' academic performance.

However, in order for the researcher to make inferences of the responses presented by the study respondents on the effects of the factors (teaching strategies, students' study habits, curriculum implementation and evaluation) on students' achievement in geometry. The responses were computed using mean to evaluate them. The five point Likert scale was used. the mean of means values and their respective mean of standard deviations were computed, summarised and presented in Table 4.20. The mean of means value for acceptance is $X \geq 3.0$ otherwise reject.

Table 4.20 presents the summary of the mean of means and mean of standard deviations of the factors influencing students' achievement in geometry

Table 4.20: Mean of Means and Mean of Standard Deviations of Factors Affecting the Learning of Geometry

	Teaching Strategies	Students Study Habits	Curriculum Implementation	Evaluation
Mean of Means	3.42	2.90	3.01	4.07
Mean of Standard Deviations	1.41	1.39	1.41	1.08

Source: Field Survey, 2017

Results in Table 4.20 revealed that teachers' teaching strategies, curriculum implementation and evaluation with mean values of 3.42, 3.01 and 4.07 respectively influenced students' achievement in geometry in secondary schools in Agona District. This implies that students' response to the items in the question were between agreed and strongly agreed columns. These revelations go to confirm that the approaches used by teachers, curriculum materials in teaching geometric concepts and evaluations of students' work contributed to students' achievement in geometric concepts. Again Table 4.20 showed the mean of means for students' study habits to be 2.90 which is less than the criteria for accepting a factor, hence affected them negatively. However,

Table 4.20 indicated that the standard deviations for the underlying factors were greater than 1.0. this implies that there was divergence of opinions by the study respondents hence their responses could not generally be used to represent the views of the population. The researcher further conducted a correlation and regression analysis to establish the nature of relationship that exist between students' achievement and the underlying factors.

4.5 Results from the Inferential Statistical Analysis

4.5.1 Results of Correlation Analysis

The initial analysis involved establishing a relationship between students' achievements in geometric concepts and the indices of teachers' teaching strategies, students' study habits, school curriculum implementation and evaluation. Pearson product-moment correlation was utilized in the correlation analyses. Students' achievement test scores were used while the responses to the factors (teaching strategies, students' study habits, school curriculum implementation and evaluation) were quantified using Likert scale as shown in the questionnaire (appendix A and B). The correlation result being significant at $p<0.5$ means that the probability of obtaining the correlation by chance is less than five out of 100 (5%). The correlation result being significant at $p<0.01$ means that the probability of obtaining the correlation by chance is less than one out of 100 (1%).

Correlation Between Students' Achievement and the Combined Indices of Teachers' Teaching Strategies, Students' Study Habits, Curriculum Implementation and Evaluation

The variables defining each of teachers' teaching strategies, students' study habits, school curriculum implementation and evaluation were combined and correlated with students' achievement in geometry. Table 4.21 shows the Pearson product-moment

correlation coefficient of combined variables and students' achievement in geometry. The table shows that teachers' teaching strategies had negative significant relationship with students' achievement in geometry test *(r = -0.366, P=0.000<.01) at N=220*. while students' study habits, school curriculum implementation and evaluation had positive significant relationships with students' achievement in geometry test *(r=0.402, p=0.000<.01), (r=0.194, p=0.004<.01)* and *(r=0.242, p=0.000<.01)* respectively at *N=220*.

Table 4.21: Pearson Product-Moment Correlation Between Students' Achievement in Geometry and Combined Indices of Teachers' Teaching Strategies, Students' Study Habits Curriculum Implementation and Evaluation.

		Study habits	Teaching strategies	Curriculum implementation	Evaluation	Level of achievement
Study habits	Pearson Correlation	1	-0.07	.312**	.176**	.194**
	Sig.(2-tailed)		0.301	0	0.009	0.004
	N	220	220	220	220	220
Teaching strategies	Pearson Correlation	-0.07	1	-.253**	-0.122	-.366**
	Sig.(2-tailed)	0.301		0	0.072	0
	N	220	220	220	220	220
Curriculum implementation	Pearson Correlation	.312**	-.253**	1	.490**	.402**
	Sig.(2-tailed)	0	0		0	0
	N	220	220	220	220	220
Evaluation	Pearson Correlation	.176**	-0.122	.490**	1	.242**
	Sig.(2-tailed)	0.009	0.072	0		0
	N	220	220	220	220	220
Level achievement	Pearson Correlation	.194**	-.366**	.402**	.242**	1
	Sig.(2-tailed)	0.004	0	0	0	
	N	220	220	220	220	220

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

To further confirm the results of the combined indices of teachers' teaching strategies, students' study habits, curriculum implementation and evaluation respectively, multiple regression analysis of the combined variables with students' achievement

using SPSS was carried out. Table 4.22 shows the result of multiple regression analysis displaying the observed F-Statistic and probability (sig.) value of the combined effects of the indices of teachers' teaching strategies, students' study habits, curriculum implementation and evaluation. The results of the model summary revealed that the four statistically significant predictors variables in this study accounted for 24.5% of the variation in the level of achievement of students in geometry. From the ANOVA (Table 4.21), *F=17.399* and *P=0.00(< .01)* which indicates that the test was statistically significant.

Table 4.22 ANOVA Summary of Regression Analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.034	4	5.758	17.399	.000[b]
	Residual	71.157	215	.331		
	Total	**94.191**	**219**			

a. Predictors: (Constant), Teachers' teaching strategies, Students' study habits, Curriculum implementation, Evaluation
b. Dependent Variable: Level of achievement

4.5.2 Results from Regression Analysis

Regression analysis was used to examine the contributions of each of the independent variables defining teachers' teaching strategies, students' study habits, curriculum implementation and evaluation to the dependent variable (students' achievement). It allows for the determination of the variance between the dependent variable and the independent variables. It also helped the research to determine the independent variables that are statistically significant predictors of students' achievement in geometry. Tables 4.23 and 4.24 show the SPSS Regression analysis results involving students' achievement in geometry as the criterion variable (dependent) and the four independent variables defining teachers' teaching strategies, students' study habit, curriculum implementation and evaluation.

Table 4.23 Relationship between the criterion variable (achievement) and the four independent variables (Regression analysis) (N = 220)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.495[a]	.245	.23	0.5753

a. Predictors: (Constant), Teaching strategies, Students' study habits, Curriculum implementation, Evaluation
b. Dependent Variable: Level of achievement

Table 4.24 Coefficients of predictors indicated by the regression analysis

	Unstandardized Coefficients			
	B	Std. Error	t	Sig.
(Constant)	2.648	0.276	9.591	0.
study habits	0.057	0.046	1.237	0.217
Teaching strategies	0.231	0.05	4.621	0
Curriculum implementation	0.254	0.066	3.845	0
Evaluation	0.045	0.053	0.857	0.393

a. Dependent Variable: Level of achievement

Table 4.22 indicates that the four statistically significant predictors accounted for 24.5% percent of the students' achievement in geometry ($R^2=0.245$), F = 17.399, p < 0.01. Teachers' teaching strategies *(B=0.231, p=0.000) and* curriculum implementation *(B=0.254, p=0.000)* demonstrated significant effects on students' achievement in mathematics (geometry). However, students' study habits *(B=0.057, p=0.217)* and evaluation *(B=0.045, p=0.393*) showed insignificant effects on students' achievement in mathematics (geometry)

The coefficients of the model indicate that the four regresses can be ranked in order to quantify their influence on the dependent variable by starting with school curriculum implementation (0.254), teachers' teaching strategies (0.231), students' study habits (0.057) and evaluation (0.045). In other words, school curriculum implementation and teachers' teaching strategies accounted for 25.4% and 23.1% variation on students' achievement in geometry respectively, while 5.7% and 4.5% can be attributed to students' study habits and evaluation respectively. It can therefore be concluded that curriculum aids and strategies used in teaching geometry could go a long way in

improving students' achievement in mathematics particularly geometry. That is not to say that the benefit of learning behaviours and evaluation of students' work should be ignored as its effects on students' achievement in geometry amount to 5.7% and 4.5% respectively. The regression analysis highlights the importance of teachers' teaching strategies and curriculum implementation in explaining how students' achievement in geometry can be improved.

4.6 Testing of Hypotheses

The results of the data analysis on Table 4.21 was used to test the hypotheses advanced in this study. The hypotheses were tested one by one.

4.6.1 Hypothesis One

The first hypothesis stated that there is a statistically significant relationship between students' achievement in geometry and teachers' teaching strategies. In testing this hypothesis, the data was analysed using correlation analysis while statistical inference was taken at 0.01 alpha levels. The result is displayed in Table 4.21. From the table the result ($r = -0.366$; $p < 0.01$) indicated that a statistically significant relationship existed between students' achievement in geometry and teachers' teaching strategies. To confirm the finding further, another statistical method-multiple regression analysis using SPSS was used to analyse the data. The result of the combined significance of the variables of teaching strategies is displayed in Table 4.24. The result shows that the probability value for teaching strategies is $p=0.000$. This is less than 0.01 implying that there is statistically significant relationship found. On the basis of this finding therefore, the first hypothesis was accepted.

4.6.2 Hypothesis Two

The second hypothesis stated that there is a statistically significant relationship between students' achievement in geometry and students' study habits. To test this

hypothesis, the data was analysed using correlation analysis while statistical inference was taken at 0.01 alpha levels. The result is displayed in Table 4.21. From the table 4.21 the result ($r = 0.194$; $p=0.004 < 0.01$) indicated that a statistically significant relationship existed between students' achievement in geometry and students' study habits. On the basis of this finding therefore, the second hypothesis was accepted.

4.6.3 Hypothesis Three

The second hypothesis stated that there is a statistically significant relationship between students' achievement in geometry and school curriculum implementation. To test this hypothesis, the data was analysed using correlation analysis while statistical inference was taken at 0.01 alpha levels. The result is displayed in Table 4.21. From the table the result ($r = 0.402$; $p < 0.01$) indicated that a statistically significant relationship existed between students' achievement in geometry and curriculum implementation. To confirm the finding further, another statistical method-multiple regression analysis using SPSS was used to analyse the data. The result of the combined significance of the variables of curriculum implementation is displayed in Table 4.24. The result showed that the probability value for curriculum implementation is $p=0.000$. This is less than 0.01 implying that there is statistically significant relationship found. On the basis of this finding therefore, the third hypothesis was accepted.

4.6.4 Hypothesis Four

The fourth hypothesis stated that there is a statistically significant relationship between students' achievement in geometry and evaluation. The hypothesis was tested by using correlation analysis to analyse the data at 0.01 alpha levels. The result is displayed in Table 4.21. From the table the result ($r = 0.242$; $p < 0.01$) indicated that there is a statistically significant relationship between students' achievement in

geometry and evaluation. On the basis of these findings the fourth hypothesis was accepted.

4.6.5 Research Question Five: What are the Challenges teachers and students face in their teaching and learning of geometric concepts at the secondary school level?

Research question 5 was to seek the views of the teachers and students about their challenges in teaching/learning geometric concepts. Section E, item 11 on both students' and teachers' questionnaires sought the views of the respondents on their challenges in teaching and learning of geometry. The researcher analysed individual views separately and later made cross examinations and inferences.

Responses of Teachers

Teachers were asked to give their responses *on problems they encounter in teaching geometry***.** A total of 44 responses were received from 12 respondents. This was possible because the question was an open-ended type and respondents had the right to give more than one response. These responses were grouped under four main themes after careful considerations. The researcher deemed the grouping necessary because similar ideas had been expressed in different language forms by individual participants and also because Miles and Huberman (1994) have indicated grouping to be feasible. Table 4.25 below shows the group response analysis of teachers.

Table 4.25: Group Response of Teachers

Challenges faced in T/L of Geometric Concepts	Responses N	Percent
Lack of adequate curriculum materials	12	27.3%
lack of teacher motivation	9	20.5%
Lack of in-service training and experience teachers	8	18.1%
Poor attitude towards geometry among students	15	34.1%
Total	**44**	**100.0%**

From Table 4.25, it could be observed that 15 out of the 44 collated responses suggested poor attitude toward geometry among students was the major problem. This represents 34.1% of total responses while 27.3% indicated lack of adequate curriculum materials, 20.5% indicated lack of teacher motivation. Only 18.1% of the respondents indicated lack of enough trained and experienced teacher.

Responses of Students

Students were asked to give their responses on *challenges they faced in learning geometry.* A total of 211 responses came from respondents and their responses, upon careful considerations, were grouped under six (6) main themes. The researcher deemed the grouping necessary because the researcher realised that similar ideas had been expressed in different language forms by individual respondent. Table 4.26 shows the summary of open-ended responses from students.

Table 4.26: Summary of open-ended responses from students

ITEMS	Frequency	Percent
Poor assessment methods	37	16.8%
Lack of learning materials	64	29.1%
Inadequate instructional period duration	46	20.9%
Poor learning Strategies used by teachers	28	12.7%
Lack of motivation by teachers	19	8.6%
Lack of enough trained and experienced teacher	17	7.7%
Total	**211**	**95.9**

The results show that 29.1% of the students in this study indicated lack of curriculum materials for teaching and learning geometric concepts among students was the major problem whilst 20.9% indicated lack of adequate instructional period, 16.8% indicated poor assessment methods, 12.7% of the respondents indicated poor learning strategies used by teachers. Only 8.6% and 7.7% of the respondents indicated poor motivation and lack of enough trained and experienced teachers respectively.

A cross examination of the results from the two sets of respondents exhibited some similarities in ideas. For instance, all the two sets of respondent groups hinted on teaching and learning materials (curriculum materials) with geometrical sets and textbooks being marked as essential ingredients that hinder the teaching and learning of mathematics (geometry). This result is obvious because Ghana Mathematics Series, which is a product of Mathematics Association of Ghana (MAG), is the only Government recommended textbook for both teachers and students. This is not adequate for a country that wants to move mathematics performance to a highest level. Additional textbooks are needed for teachers to read and prepare adequately for mathematics lessons in order to vary their ideas and presentations. This might be the reason why Anamuah-Mensah Committee (2002) recommended that teachers should be encouraged and supported to write textbooks, which should be assessed and recommended by CRDD for use in schools.

Other educational researchers have found curriculum materials to be an indispensable factor that is influential to students' Mathematics learning. Thompson and Senk (2006) found, particularly, both curriculum materials and teachers' implementation of the materials to be influential to students' opportunity to learn Mathematics. Teaching and learning materials represented a greater part of the contributions that came from students and teachers. It is therefore obvious for educational stakeholders and policy

makers to ensure that schools are resourced with all the needed curricular materials if they really mean business in achieving higher mathematics outcomes in SHS. Furthermore, motivation of mathematics teachers was jointly mentioned as a factor which needs consideration from schools. In Ghana, teachers are always agitating for increment in salaries which means that teachers are not extrinsically motivated to teach. This has affected the teaching of mathematics in schools because teachers show very little commitment. Among several lacking factors that were found and reported by Anamuah-Mensah Committee (2002) as factors that have accounted for the low performance was non-availability of qualified and well-motivated teachers. Moreover, 18.1% of teachers' responses indicated that school authorities need to organise in-service training to update teachers on new developments in the teaching and learning of mathematics. However, about 70.0% of teachers who participated in this research had already indicated they had never participated in any in-service training in mathematics. This is not good news because mathematics is now moving with the pace of technology and if mathematics teacher should keep to this pace then they need regular professional development. It should be noted that, for teachers, education does not end with obtaining a degree or diploma.

Assessment was another factor that was addressed by both students and teachers. 16.8% (n=37) of students' respondents believed that the school has to do more for them in terms of assessment so as to build their confidence and to identify their shortfalls. This is consistent with one of the teachers' responses which says;

> *the schools lack the mechanisms that would enforce mathematics teachers to assess students regularly so that teachers will become informed of their students' performances.*

Therefore, school authorities have to institute various assessment strategies; be it summative or formative assessment to improve students' mathematics (geometry)

assessment in schools. Generally, international research on school effectiveness has demonstrated that inputs such as teaching strategies, in-service training, the provision of teaching and learning materials, and students' assessment increase students' learning outcomes, particularly in developing countries where schools are deprived of the most rudimentary resources (Hanushek, 1995; Lockheed & Verspoor, 1991; Pennycuick, 1998; Fuller & Clarke, 1994).

4.7 Discussion of Research Results

The sample for the study consisted of 240 form three students and 12 mathematics teachers from four Senior High Schools, which happen to be Swedru Senior High School (SWESCO), Swedru School of Business (SWESBUS), Nsaba Presbyterian Senior High School and Nyakrom Senior High School. While the results of this study are limited to the population from which sample was drawn, several important conclusions can be made. Considering the students from the secondary schools, it was observed that 55.5% of the sampled students were males as against 44.5% who were females. The low percentage of females in the sample could be attributed to the assertion by Auguele (2007) that gender differentials in enrolment and achievement in higher education is invariably rooted in inequality at the basic and secondary levels where the real sorting out of University bound students take place.

Statistics obtained in the study indicates that all sampled teachers had the minimum requirements for a secondary school teacher. In practice, some schools employ teachers with varied qualifications, due to shortage of qualified mathematics teachers. The study sought to find out the professional qualifications of the mathematics teachers in Agona district and was established that more than half of the teachers (58.33%) were professionally qualified to teach mathematics. This suggest that students in the study district were taught by qualified teachers as in Ghana, the

requirement to recruit a mathematics teacher at the secondary level is that one has to have a bachelors' degree in mathematics with education. According to Alexander and Fuller (2005) possessing a major or minor in mathematics is related to increased students' achievement in the subject. From the findings of the study, one would expect students' achievement in the study district to be reasonable. Yet the results were still poor. This is an indication that for an enhanced achievement in mathematics, teachers need more than just a qualification. It is for such a reason that the study sought to establish the teaching methods used by mathematics teachers in Agona District, where the results are discussed in the next section. In terms of teaching experience, majority of teachers at the SHS level have five (5) years or below of teaching experience. This could have adverse effect on teachers' performance because literature evidence has shown that number of years of teaching improves teachers' classroom effectiveness and students' mathematics achievement. A research conducted by Murnane & Phillips (1981) and Klitgaard & Hall (1974) found a relationship between teachers' effectiveness and their years of experience. Teacher quality is normally proxied by such variables as experience in the profession. According to Tremblay, Ross and Berthelot (2001), students perform better at school when taught by teachers who have more than 10 years' experience in the secondary school grades.

Another issue of concern was professional development and in-service training. Professionalism is a stronger feature when it comes to teaching because teaching is not an activity that can be effectively performed by anybody at all as perceived by some people. Teaching is a skill that needs to be developed to enhance proficiency in persons who have the desire to impart knowledge at all educational levels. It is for this reason that two tertiary institutions namely, University of Cape Coast (UCC) and

University of Education (UEW) have been entrusted to train teachers for Ghanaian SHS classrooms. Therefore, the 40.63% of respondents who indicated not being professionals in this study should be provided with professional development opportunities to enhance their proficiency in teaching. According to Bolam *et al.* (1993), in-service trainings are those education and training activities engaged in by Primary and Secondary school teachers and heads, following their initial professional certification, and intended exclusively to improve their professional knowledge in order to educate students more effectively. In-service training is a necessary part of any profession, particularly for teaching, because of the increasing demand on teachers for better performance. It provides opportunities for individuals to develop themselves to the highest level of professional competencies. It also updates teachers' knowledge about current developments, encourages exchange of ideas and experiences with other colleagues, and enables teachers to constantly review their own teaching strategies, assessment and evaluation skills. Therefore, the teacher's education should not end with obtaining a diploma or degree. No wonder 32.1% of mathematics teachers who participated in this study called on the school to organise in-service for them to improve teaching and learning of mathematics. Although the importance of in-service training has been recognized by the Ghana Education Service (GES), its implementation has been difficult due to lack of effective plan as well as inadequate logistics (Anamuah-Mensah Committee 2002).

Statistics gathered in the study from the responses in Figure 4.4 revealed that, students in the study district were not knowledgeable in geometric contents of which the geometric achievement test on level of understanding also confirmed. These findings concur with Charles and Lynwood (1990), who argued that poor performance in high school geometry has traditionally been high and this has been ascribed to various

causes such as the difficulty of the subject, others have to blame it to ineptitude or laziness on part of the student. While others have held that students lose interest in geometry because of its abstract nature which they regard as having no practical value. They argue that demonstrative geometry is not the easiest subject to learn. Similarly, Rukangu (2000) conducted a study on students' development of spatial ability on Mathematics and found out that 67% did not enjoy learning spatial concepts because they are confusing, abstractly demanding a lot of thinking and difficult to understand.

However, analysis of respondents' responses on the approaches that were employed in teaching geometric concepts, expository approaches of teaching mathematics which limits students' classroom activities to just listening to teacher's words and copying notes from the board was the major strategies of instruction by most tutors. The results indicated that 72.3% of the mathematics teachers employed lecture method in lesson delivery while the interactive methods of teaching such as small group discussion, discovery and, drawing and modeling methods, which are strongly believed to enhance students' understanding of geometric concepts, were least used. This finding was in line with Fletcher (2003) and Osafo-Affum (2001), who reiterated that indeed, irrespective of the level at which mathematics was, taught the role of the Ghanaian mathematics teacher has almost always been that of a lecturer and explainer, communicating the structure of mathematics methodically. This also brings to light about the observation made by Anamuah-Mensah, Mereku and Ghartey-Ampiah (2008) with regard to the general performance of Ghanaian students' in mathematics from the Trends in International Mathematics and Science studies (TIMSS) 2007 report which also revealed teachers' delivery approach. According to Anamuah-Mensah et al. (2008), they were of the view that in Ghana, there seem to be

rapid movement from one topic to another suggesting that the level of the subject taught was rather superficial, with students often failing to acquire deeper understanding of any particular topic which often leads to their poor performance.

The results also revealed that teaching strategies significantly affected students' academic achievement in geometry (*B=0.231, p=0.000*) which imply that teaching strategies accounted for 0.231 (23.2%) units variation in the level of achievement in geometry. Zakaria, Chin and Daud (2010) specified that teaching should not merely focus on dispensing rules, definitions and procedures for learners to memorize, but should also actively engage learners as primary participants. The methods used in teaching Mathematics are instrumental in determining ones' performance Keith (1999). This finding concurs with Kiminza et al (1999) who found out that Mathematics teachers mainly use participatory teaching approach. In their analysis of mostly frequently used methods, assignment method scored 50.6% followed by a class discussion 48.6%, demonstration 38.9%, drawing and modeling 34.4%.

The study analysed the effects of selected students' study habits on their academic achievement in geometrical concepts in secondary schools in Agona District. The study found that students' study habits *(B=0.057, p=0.217)* had no significant effect on students' level of achievement in geometry test. These findings imply that the use of students' study habits will lead to an increase in the level of achievement by 0.057 (5.7%) units. These findings concur with Charles and Lynwood (1990), who argued that poor performance in high school geometry has traditionally been high and this has been ascribed to various causes such as the difficulty of the subject, others have to blame it to ineptitude or laziness on part of the student. While others have held that students lose interest in geometry because of its abstract nature which they regard as having no practical value. They argue that demonstrative geometry is not easiest

subject to learn. Similarly, Rukangu (2000) conducted a study on students' development of spatial ability on Mathematics and found out that 67% did not enjoy learning spatial concepts because they are confusing, abstractly demanding a lot of thinking and difficultly to understand.

In terms of school curriculum implementation, the results of the regression model revealed that curriculum implementation had a positive and significant relationship *(B=0.254, p=0.000)* with the students' level of achievement in geometry. The result implies that curriculum implementation accounted for 0.254 (25.4%) units variation in students' level of achievement in geometry. The findings concur with those of Orodho (2003) who revealed that students and teachers' perception towards remedial was positive with many indicating that it assisted both the weak and bright students especially in preparation of National Examinations. He also noted that regular teachers within the school premises and mainly in Mathematics and sciences carried out remedial lessons.

Finally, this study sought to find out the effect of evaluation on the students' level of achievement in geometry. Evidence from the correlation analysis indicated evaluation had significantly relationship ($r = 0.242$, $p < 0.000$) with students' academic achievement in geometry. These findings concur with Black and Williams cited in Kapambwe (2010) who concluded that use of formative assessment had a powerful impact on students' academic achievement. Continuous Assessment Tests (CATs) is a powerful diagnostic tool that enables students to understand the areas in which they are having difficulty and to concentrate their efforts in those areas. Assessment also allow teachers to monitor the impact of their lessons on students' understanding. The results of the regression model also revealed that evaluation had insignificant effect *(B=0.045, p=0.393)* with the students' level of achievement in geometry. The result

implies that evaluation accounted for 0.045 (4.5%) units variation in students' level of achievement in geometry. According to Kinyua et al (2003) in the class, assessment that takes place is diagnostic. It reveals how much learners have understood various concepts for instance geometrical skills such as construction and therefore plan for remedial work accordingly. This assessment can be done by observation of students as they solve given problems. The teachers assess the students as well as themselves in the light of students' work.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview of the Study

This chapter gives a brief account of what was carried out in the study and discusses the findings in relation to the research questions or hypotheses and some literature reviewed. It also presents the implications of the findings and lists some recommendations. Finally, it gives some suggestions for future study.

5.1 Summary of the Study

The purpose of the study was to gain insight into the influence of teachers' teaching strategies, students' study habits, curriculum implementation and evaluation on students' achievement in geometry. The population for this study constituted all form three students and their mathematics teachers in all the secondary schools in Agona District in Central Region of Ghana. The sample for the study consisted of 240 SHS students and 12 of their mathematics teachers from the four selected Senior High Schools, which happen to be Swedru Senior High School (SWESCO), Swedru School of Business (SWESBUS), Nsaba Presbyterian Senior High School and Nyakrom Senior High School. The study was guided by five research questions and four hypotheses. Data collection instruments used were basically, questionnaires and achievement test. Analysis of data was based on descriptive and inferential statistics.

The data was analysed first by frequencies of the variables on scales, the correlations of the variable with students' achievement was explored. Then, the variables that predicted students' achievement were further investigated using simple linear regression. The hypotheses were tested using the result of the correlation analysis and multiple linear regressions. The results showed that there was a statistically significant

positive relationship between students' achievement in geometry and the variables of students' study habits, curriculum implementation and evaluation. However, the teaching strategies showed a statistically significant negative relationship with students' achievement in geometry. Regression analysis showed that students' achievement in geometry is predicted by the variables of teachers' teaching strategies and curriculum implementation.

5.2 Summary of key Findings

Several findings evolved from this study. Below is a summary of the findings with their respective research questions.

5.2.1 Research Question One: What are the effects of teachers' teaching strategies on students' level of achievement in geometry at the senior high school (SHS) level?

The first hypothesis stated that there is a statistically significant relationship between students' achievement in geometry and teachers' teaching strategies. The findings of the study as shown by the results of correlation analysis in Tables 4.20 supported this hypothesis. Further analysis (Table 4.20) revealed that among the indices of factors, teachers' strategies was found to have a significant-negative correlation with students' achievement (r = - 0.366). This could be caused by the inability of the teachers to carry the students along in their presentations. For example, when a teacher fails to relate their teaching to the students' environment, this makes it impossible for the teacher to effectively help the students to construct knowledge. In such a classroom the students might feel left out and perhaps develop a negative attitude towards the subject. The summary of the regression analysis results revealed that mathematics teachers teaching strategies had positive and significant effect on students' achievement in geometry *(B=0.231, p=0.000)*. These findings imply that teaching strategies accounted for 0.231 units variation in the level of achievement in geometry.

Zakaria, Chin and Daud (2010) specified that teaching should not merely focus on dispensing rules, definitions and procedures for learners to memorize, but should also actively engage learners as primary participants.

5.2.2 Research Question Two: How do students' study habits influence their academic achievement in geometry at the senior high school (SHS) level?

The second hypothesis stated that there is a statistically significant relationship between students' achievement in geometry and their study habits. The findings of the study as shown by the results of correlation analysis in Tables 4.20 supported this hypothesis. Further analysis (Table 4.20) revealed that among the indices of factors, students' study habits was found to have a significant-positive correlation with students' achievement (r = - 0.194). The regression analysis identified students' study habits to have a positive and insignificant effect *(B=0.057, p=0.217)* with the level of achievement in geometry test. These imply that the use of students' study habits will lead to minimal increase in the level of achievement by 5.7%. These findings concur with Charles and Lynwood (1990), who argued that poor performance in high school geometry has traditionally been high and this has been ascribed to various causes such as the difficulty of the subject, others have to blame it to ineptitude or laziness on part of the student.

5.2.3 Research Question Three: What are the effects of curriculum implementation on students' level of achievement in geometry at senior high school (SHS) level?

The third hypothesis stated that there is a statistically significant relationship between students' achievement in geometry and school curriculum implementation. This was supported by the findings of the study according to the correlation analysis results in Tables 4.20. The results of the regression model revealed that curriculum implementation had a positive and significant relationship *(B=0.254, p=0.000)* with

the students' level of achievement in geometry. The result implies that curriculum implementation accounted for 25.4% variation in students' level of achievement in geometry. The findings concur with those of Orodho (2003) who revealed that students and teachers' perception towards remedial was positive with many indicating that it assisted both the weak and bright students especially in preparation of National Examinations.

5.2.4 Research Question Four: How does evaluation influence students' achievement in geometry at senior high school (SHS) level?

This section sought to find out the effect of evaluation on the students' level of achievement in geometry. The fourth hypothesis stated that there is a statistically significant relationship between students' achievement in geometry and evaluation. This was supported by the findings of the study according to the correlation analysis results in Tables 4.20. The results of the regression model revealed that evaluation had a positive and insignificant relationship *(B=0.045, p=0.393)* with the students' level of achievement in geometry. The result implies that evaluation accounted for 0.045units variation in students' level of achievement in geometry. According to Kinyua et al (2003) in the class, assessment that takes place is diagnostic. It reveals how much learners have understood various concepts for instance geometrical skills such as construction and therefore plan for remedial work accordingly. This assessment can be done by observation of students as they solve given problems. The teachers assess the students as well as themselves in the light of students' work.

5.2.5 Research Question Five: What are some the challenges teachers and students face in teaching and learning geometry at senior high school (SHS) level?

The study revealed the following factors as the challenges teachers and students face in their teaching/learning of geometric concepts:

1. Approaches adopted by mathematics teachers in the teaching of geometric concepts were not effective to aid students' understanding of geometric concepts.
2. Exercises given by mathematics teachers were not enough for students to practice on all aspects of geometry to consolidate concepts taught.
3. Lack of effective use of teaching and learning materials.
4. The nature of assessment on geometric concepts taught by mathematics teachers did not promote further research on the part of students to enhance their understanding of these concepts.
5. Lack of enough trained and experienced teachers.
6. Poor attitude toward geometry among students
7. lack of practical sessions

5.3 Educational implication of the study for mathematics teaching

- For effective geometry instruction, the method of teaching should not be the same as in teaching number, algebra or probability. Instead instruction should emphasize hands-on explorations, developing geometric thinking and reasoning, making conjectures and even carrying out geometry projects (Strutchens et al., 2001).
- Mathematics educators should make it as part of their priority in teaching, the use of teaching learning materials in their lesson delivery. This is in line with the view of Akkoyunlu (2002) that, the use of teaching-learning materials is significant element in raising the quality of education. The effective usage of teaching learning materials in teaching mathematical concepts would help learners develop understanding of such mathematical concepts better.

- Assessing learners understanding of concept learnt should focus on approaches of assessment that promote further research on the part of learners. Many educational reforms had heralded new classroom assessment approaches that go beyond traditional paper-and-pencil techniques to include strategies such as performance and portfolio-based assessment (Stiggins, 1997). Such alternative assessments are often intended to motivate students to take more responsibility for their own learning and to make assessment an integral part of the learning experience.
- Professional development such as workshops or seminars on mathematics content and understanding students thinking in mathematics will likely help the teachers to perform better in their teaching.
- Furthermore, teaching practices that would engage students in communication with peers and with teachers would likely help the students perform better in mathematics

5.4 Conclusions

The study tried to examine the three objectives which looked at factors influencing achievement in geometry among Senior High School students. The factors were: Teachers teaching strategies, students' study habits, curriculum implementation and evaluation. Finally, the study sought to determine the problems teachers and students encounter in teaching and learning of geometry in Agona District of central region. From the findings of the study the researcher makes the following conclusions;

1. The study found that the interactive methods of teaching geometry, which are core to improving students' holistic understanding of geometrical concepts and eventually enhance their performance in the subject, were less used in the mathematics classes in the study area. While most of the mathematics teachers

were qualified, they did not use any teaching aids other the illustrations on the blackboard.

2. This study concludes that the performance of students within the study area in geometry was still very poor. This can be attributed to poor attitude among students, lack of adequate learning resources and poor teaching strategies used by teachers, poor study habits, and lack of practical sessions. Lack of enough trained and experienced teacher was the least problem that affected the learning/teaching of geometry. The study region was found not to have experienced and well trained teachers. For this reason, the following recommendations are made
3. Students' study habits, curriculum implementation and evaluation indicated positive association with students' achievement in mathematics (geometry). Regression analysis revealed that teachers' teaching strategies and curriculum implementation are predictors of students' achievement in mathematics (geometry). Based on this finding, it was concluded here that if the teachers' teaching strategies and curriculum implementation are exploited students' achievement in mathematics particularly in geometry would be greatly improved.

5.5 Recommendations

It is not only important to assess what factors influence students' achievement in mathematics, specifically geometry but also imperative for all and sundry to appreciate that there are more things to be done as a nation to help develop mathematics. Based on the findings of this study, the study posited the following recommendations as essential issues for consideration:

- Since 82.8% of respondents views suggested that assessment feedback should be given immediately to support them in the learning of geometry, the

researcher wishes to recommend that a variety of mathematics assessment procedures, including paper and pen test, multiple choices, inter class mathematics quizzes competition, small groups discussion, systematic observation of students' performance and information gathering should be employed in SHS. This will help to ensure that all levels and domains of learning are given the needed attention

- Teachers need to encourage students to form small discussion groups so that each individual student can have a platform to express their ideas and learn from each other. This will encourage consultations among students and with the teachers and eventually boost mastery of the geometry concepts.
- Teachers should demonstrate enough geometry examples from different texts to the students before giving them assignments.
- Teachers should also guide students to practice more on items on the comprehension and application levels of the cognitive domains.
- Teachers should revisit the strategies they use in teaching/learning of geometry
- The ministry of education through the relevant department should carry out regular inspections to schools and organize regular in-service trainings, workshops and seminar for all mathematics teachers to revisit the strategies they use in teaching/learning of geometry in order to alleviate some of the probable causes of poor achievement in geometry content. In addition, mathematics teachers must be encouraged to join subject's Associations such as Mathematics Association of Ghana (MAG). These subject Associations should also be strengthened so that they can organise short courses for their members from time to time in order to improve members' teaching strategies/methods which was one of the issues of concern in this research.

- Very serious efforts should be made by the Government and other stakeholders to provide adequate mathematics resources in all SHS in the country so that no school will be handicapped. This will ensure equal opportunity to all students to learn mathematics. Geometrical set, calculators, Mathematics textbooks among others for example, should be provided for all students and mathematics teachers as well to be used as additional source of information just as this study has revealed. Finding of this study shows that textbooks have immense contribution to the teaching and learning of geometry. In order to improve the availability of mathematics textbooks, mathematics teachers should be encouraged to write textbooks out of their own research and experience. In this regard, subject Associations and publishers should explore the possibilities of having such textbooks published.
- The two premier universities (UCC & UEW) which have been charged to train professional teachers in Ghana should be well resourced to increase enrolment so as to produce enough mathematics teachers for Ghanaian classrooms since this research found limited professional mathematics teachers at the SHS level. Only 59.4% (n=7) of the respondents (teachers) used in this study were professionals.

5.6 Recommendations for Further Studies

Owing to the findings and conclusions reached, the study suggests that a similar study should be conducted in a different geographical region for comparison purposes. In addition, the teaching strategies identified by the learners as the mostly used by teachers and the most effective in enhancing achievement in geometry are not in agreement with the conventional methods of learning and teaching geometry. It is therefore prudent that a study be carried out to identify effective methods involving

the emerging technologies that can be used to improve achievement in geometry. Further studies should also focus on the effects of mathematical language on students' performance in geometry. Likewise, a research could be conducted to find parents' educational level and its relationship with their contribution towards assisting their wards in completing mathematics homework.

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APPENDIXES

APPENDIX A: Mathematics Teachers' Questionnaire (M.T.Q.)

Students' achievement in mathematics is a serious problem for mathematics educators and mathematics teachers. This questionnaire aims at getting your opinion pertaining to the teaching and learning of Mathematics geometrical concepts.

Please answer each question to the best of your knowledge. Your thoughtful and truthful responses will be greatly appreciated. **Your individual name or identification number is <u>not required</u> and will not at any time be associated with your responses.** Your responses will be kept completely **<u>confidential.</u>**

SECTION A: General Information

1. **Teachers' Sex /Gender**:
   Male [ ]
   Female [ ]

2. **What is your highest educational qualification?**
   Diploma-HND [ ] Bachelor's degree [ ]
   Master's degree [ ] Doctorate degree [ ]

3. **Teachers' Professional Qualification**
   Trained Graduate Mathematics Teacher [ ]
   Trained Graduate Non-Mathematics Teacher [ ]
   Untrained Graduate Teacher [ ]
   Others (specify) ----------

4. **Teachers' Age (years)**
   Below 35 years [ ]
   Between 34 and 46 [ ]
   Between 45 and 51 [ ]
   Above 50 years [ ]

5. **Teachers' Teaching Experience (years)**
   1 – 5 years [ ]
   6 – 10 years [ ]
   11 – 15 years [ ]
   16 and above [ ]

6. **Have you ever attended any in-service training (INSET) or workshop on mathematics?**
   Yes [ ] No [ ]

7. **If your answer above is yes, how has it improve on your mathematics teaching?**

……

……

……

……

……

……

SECTION B: Teaching Strategies

Instruction: The answer to this part is done by ticking [√] in the appropriate box or filling in the space provided. Show your extent of agreement using the words; **NU**-Not Used**, RU**- Rarely Used, **SU** – Sometimes Used**, FU** – Frequently Used, **HU** – Heavily Used.

8. To what extents is/are the teaching method used in the mathematics classroom?

Strategy	NU	RU	SU	FU	HU
Lecture Methods					
Discussion Methods					
Participatory Teaching Approach					
Assignment Method					
Drawing and Modeling (Use of games and puzzles)					
Other(s) specify					

SECTION C: Curriculum Implementation

Instruction: Consider each of the following statements and Indicate by putting a tick [√] in the box what you feel about curriculum implementation that can enhance Mathematics geometrical concept interpretation. Show your extent of agreement using the words; **SA**-Strongly Agree**, A**- Agree, **U** – Uncertain**, D** – Disagree, **SD** – Strongly Disagree

Statement	S A	A	U	D	SD
There are enough textbooks for students in the ratio 1:1					
Each students has a geometrical set					
The school should have mathematical lab/library					
The school should provide computers					
The school should provide programmable calculators					
The school should organize for remedial lessons for weak students in geometrical concepts					
Mathematics teachers should give a lot of assignments in geometry and mark frequently					
Mathematics teachers should always motivate students					

SECTION D: Evaluation

Instruction: The answer to this part is done by ticking [√] in the appropriate box or filling in the space provided.

a. Do you teachers assess your classroom work? Yes{ } No { }

b. What do the teachers use to assess you?

Technique	
Teacher-made test	
Home assignment	
Overall exam	
Other(s) specify	

Please indicate by ticking in the appropriate box to show the extent of agreement using the words;

Strongly agree ---------- SA Agree ---------- A

Uncertain ---------- U Disagree ---------- D

Strongly Disagree ----------SD

Teacher's opinion on assessment	**S A**	**A**	**U**	**D**	**SD**
Assessment of geometrical concept is a continuous process					
After assessment feedback should be given immediately to the student					
Feedback given to the learner after assessment is motivating to the student					
Assessment is an important process of teaching and learning of geometry					
When setting a test a table of specification is important for evaluation					
Geometrical concepts are always tested in assessments					
Geometrical concepts are always tested in continuous assessment tests (C.A.T's)					
Geometrical concepts are always tested in main exams.					

SECTION E: Challenges Encountered in teaching geometry

11. Give the most important challenges faced in teaching geometric concepts?

a)……

……

b)……

……

c)……

……

APPENDIX B: Mathematics Students Questionnaire (M.S.Q)

This questionnaire aims at getting your opinion pertaining to the teaching and learning of Mathematics geometrical concepts. The information you give is for research purpose only and will be treated with **confidentiality**. **Your individual name is <u>not required</u> and will not at any time be associated with your responses.**

SECTION A: STUDENTS' BACKGROUND INFORMATION

Instruction: Please tick (√) against the information most applicable to you and fill in the blank spaces as appropriate.

1. State your gender: Male [ ] Female [ ]

2. Age ……..

SECTION B: Level of Understanding of Geometry Concepts Covered in Syllabus among Secondary Schools

Tick one options below which describes your level of understanding in geometric contents after you were taught by your tutor?

3. How would grade your own performance in mathematics?

Excellent ☐ Very Good ☐ Good ☐ Weak ☐ Very Weak ☐

SECTION C: Strategies Used by Teachers in Teaching and Learning of Geometry

Part C4: Teaching Strategies

How are the teaching methods mostly used in teaching geometry? Tick all that apply

Strategy	NU	RU	SU	FU	HU
Lecture Methods					
Small Group Discussion Methods					
Discovery Method					
Demonstration Method					
Drawing and Modeling (Use of games and puzzles)					
Other(s) specify					

Effects of the Strategies Used in Teaching and Learning on Performance in Geometry among Secondary Schools

Part C5: Instructional Methods

Statement	SD	D	U	A	SA
Using lecture methods in teaching geometry leads to excellence in mathematics (geometry)					
Using lecture methods in teaching geometry ensures students grasp geometry concepts					
Using lecture methods in teaching geometry enables students to apply the geometry concepts in problem solving					
Using lecture methods in teaching geometry enables students to do their assignments with easy					

Part C6: Discussion Methods

[For each question, mark one option with a cross(x)]

Statement	SD	D	U	A	SA
Using small group discussion methods in teaching geometry leads to excellence in mathematics					
Using small group discussion methods in teaching geometry ensures students grasp geometry concepts					
Using small group discussion methods in teaching geometry enables students to apply the geometry concepts in problem solving					
Using small group discussion methods in teaching geometry enables students to do their assignments with easy					

Part C7: Discovery Teaching Approach

[For each question, mark one option with a cross(x)]

Statement	SD	D	U	A	SA
Using discovery methods in teaching geometry leads to excellence in mathematics					
Using discovery methods in teaching geometry ensures students grasp geometry concepts					
Using discovery method in teaching geometry enables students to apply the geometry concepts in problem solving					
Using discovery method in teaching geometry enables students to do their assignments with easy					

Part C8: Demonstration Method

[For each question, mark one option with a cross(x)]

Statement	SD	D	U	A	SA
Using demonstration methods in teaching geometry leads to excellence in mathematics					
Using demonstration methods in teaching geometry ensures students grasp geometry concepts					
Using demonstration method in teaching geometry enables students to apply the geometry concepts in problem solving					
Using demonstration method in teaching geometry enables students to do their assignments with easy					

Part C9: Drawing and Modeling (Use of games and puzzles)

[For each question, mark one option with a cross(x)]

Statement	SD	D	U	A	SA
Using drawing and modeling in teaching geometry leads to excellence in mathematics					
Using drawing and modeling in teaching geometry ensures students grasp geometry concepts					
Using drawing and modeling in teaching geometry enables students to apply the geometry concepts in problem solving					
Using drawing and modeling in teaching geometry enables students to do their assignments with easy					

SECCTION D: Students Study Habits/Styles

10. What frequent study habits are often used by students in studying geometry? (Tick the appropriate option)
    A. Discussion between student and other student [ ]
    B. Discussion between students and teachers [ ]
    C. Studying privately using textbooks [ ]
    D. Doing assignments /practice [ ]
    E. Consultation [ ]

SECTION E: Evaluation

Instruction: The answer to this part is done by ticking [√] in the appropriate box or filling in the space provided.

a. Do your mathematics teachers assess students' academic work?

Yes…….. No……...

b. What do the teachers use to assess you? Select from the table below

Technique	Tick
Teacher-made test	
Homework/assignment	
End of term exam	
Other(s) specify	

c. Please indicate by ticking in the appropriate box to show the extent of agreement using the words;
Strongly agree ---------- SA Agree ---------- A
Uncertain ---------- U Disagree ---------- D
Strongly Disagree ----------SD

Teacher's opinion on assessment	**S A**	**A**	**U**	**D**	**SD**
Assessment of geometrical concept is a continuous process					
After assessment feedback should be given immediately to the student					
Feedback given to the learner after assessment is motivating to the student					
Assessment is an important process of teaching and learning of geometry					
When setting a test a table of specification is important for evaluation					
Geometrical concepts are always tested in assessments					
Geometrical concepts are always tested in continuous assessment tests (C.A.T's)					
Geometrical concepts are always tested in main exams.					

SECTION F: Problems Encountered in Learning Geometry among Secondary Schools Students

11. indicate some of the challenges students encounter in learning of geometry in secondary school. (Tick as many as possible)

a) Lack of enough trained and experienced teacher ( )

b) lack of adequate learning resources ( )

c) Poor attitude toward geometry among students ( )

d) Poor learning Strategies used by teachers ( )

e) Lack of adequate practical sessions ( )

Any Other(s)……

……

……

APPENDIX C: Geometry Achievement Test (GAT)

TIME: 1HOUR

THE TEST IS FOR THE PURPOSE OF RESEARCH AND THE MARKS OBTAINED WILL BE CONFIDENTIAL.

Instructions

Answer all the questions in this section by providing only the answer in the blank spaces. Question 1 to 15 carry equal marks.

1. A circle of radius 14cm is divided into 8 equal sectors; find the area of each sector. Ans……

2. A sector of a circle of radius 14cm subtends an angle of 54^0 at the Centre. Find the length of the arc. Ans……

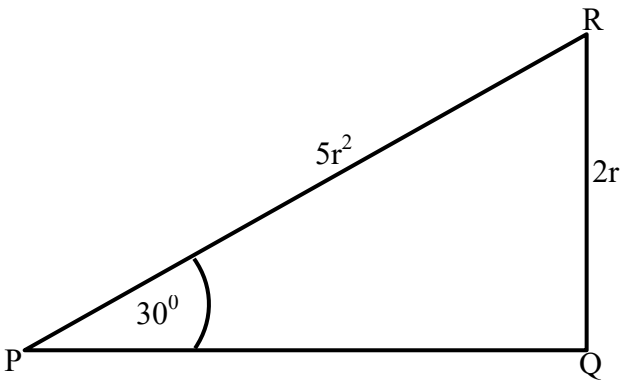
3. A circle has a radius of 9cm. the expression 18πcm represents?

   Ans……

4. The area of a rectangle is 60sq.units. If the length is $(x+4)$ units and the breadth is 5 units. Find the value of x. Ans……

5. A chord of a circle is 10cm long. If the chord is 5cm away from the Centre of the circle, find the radius of the circle. Ans……

6. In the diagram below $|QR| = 2r$, $|PR| = 5r^2$ and $\angle \frac{1}{2} RPQ = 30^0$, find the value of r



Ans……

7. If two supplementary angles are in the ratio 7:8, find the complement of the smaller angle. Ans……

8. If $(3x+11)$, $(2x+4)$ are supplementary angles, find x.

   Ans…….....

9. The sum of the interior angles of a regular polygon of n sides is 4140^0. Find the value of n. Ans……

10. Calculate the sum of the interior angles of a regular polygon with 8 sides

    Ans……

11. How many degrees does the hour hand of a clock makes through the time interval 12 to 8 o'clock? Ans……..

12. How many lines of symmetry are there in an equilateral triangle?

    Ans……

A cylindrical tin with base diameter 14cm and height 20cm is open at the top. Use this information to answer question 13 and 14

13. Find the total surface area of the tin. Ans……...

14. Calculate the volume of water in the tin when it is full. Ans……

15. A cylinder has diameter 14cm and height 11cm. calculate the curved surface area of the cylinder. Ans……

16. The volume of a cone of height 10.5cm is $396cm^3$. find the radius of the cone.

    Ans……

17. The base of a pyramid is a rectangle measuring 4.5m by 2.5m. If the height of the pyramid is 4m, calculate in m^3 its volume. Ans……

18. The volume of a cube is $27cm^3$. Find the total area of its faces.

    Ans……

19. Calculate the surface area of a sphere of radius 7cm. Ans……

20. A sphere of radius *r cm* has the same volume as a cylinder of radius 3cm and height 4cm. find the value of *r*. Ans……

[Take $\pi = \frac{22}{7}$]

APPENDIX D: GAT Marking Scheme

Students Geometric Achievement Test

3 Marks For Each Answer in Question 1 to 15

Total Score: 20 x 5 = 100 marks

1. $77cm^2$
2. 13.2cm
3. Circumference
4. 8cm
5. $\sqrt{50}$ cm or $5\sqrt{2}$ cm
6. 0.80
7. 6^0
8. 13
9. 21
10. 1080
11. 240^0
12. 3
13. $1034cm^2$
14. $3080cm^2$
15. $484cm^2$
16. 6cm
17. $15cm^3$
18. $54cm^2$
19. $616cm^2$
20. 3cm

APPENDIX E: Consent Form for Teacher and Heads (Academic Affairs)

UNIVERSITY OF EDUCATION, WINNEBA

Faculty of Science Education

Department of Mathematics Education

RESEARCH DESCRIPTION AND RIGHTS OF SUBJECTS CONSENT FORM FOR TEACHERS AND HEADS (ACADEMIC AFFAIRS)

For questions about the study, contact: SAM STEPHEN EBO researcher at samstephenebo@yahoo.com or 0240647047 **OR** Dr C.K. Assuah, the research supervisor.

Description: You are invited to participate in a research study that aims at identifying factors that influence students' mathematics achievement at the SHS level.

The research design requires a use of questionnaire in collecting data. Therefore, if you decide to participate in this research, you will be required to complete a questionnaire.

Risk and benefits: The study involves no potential risks. The benefits are that you will have opportunity to express your views on what has to be done to improve mathematics achievement. Consequently, you become part of the course that generated a change should this research result meet educational policy requirement.

Data storage to protect confidentiality: All the information to be gathered from you will be treated in strict confidence. The information you provide will be kept completely confidential and will not require your identity in the report of this study either in writing or speaking.

How will results be used? The data collected from this study will be used for thesis report.

Subject's rights: If you read this form and have decided to participate in this study, please understand that your participation is voluntary and you have the right to withdraw your consent or discontinue participation at any time without penalty. You have the right to refuse to answer some particular questions in the questionnaire. Your privacy will be maintained in all published and written data resulting from the study.

Signature statement: All of my questions have been answered to my satisfaction by the researcher. I consent to participate in the study described.

Signature:……

Date:…….....

The extra copy of this form is for you to keep

APPENDIX F: Permission to Conduct a Pilot Study

Department of Maths. Education

University of Education,Winneba

P. O. Box 25, Winneba
Date ……

The Headmaster/mistress
…….
…….
Dear Sir/Madam,

REQUEST FOR PERMISSION TO CONDUCT PILOT STUDY AT YOUR SCHOOL

I am currently a student at university education winneba (UEW) registered for a master's degree in mathematics education.

As part of the condition for my studies, I am conducting an investigation titled "factors influencing achievement in mathematics geometry of senior high school students in Agona Swedru of central region".

As part of the research I need to administer questionnaires and written test with your form three students and their respective mathematics teachers. The investigation will not in any way distract the normal teaching and learning at the school as the investigation will only be done immediately after normal school hours. I assure you that all information obtained during the investigation will be treated confidentially and only be used for academic purposes only.

Yours faithfully,

APPENDIX G: Permission to Conduct Research Study at Your School

Department of Maths. Education

University of Education,Winneba

P. O. Box 25, Winneba

Date ……

The Headmaster/mistress

…….

…….

Dear Sir/Madam,

REQUEST FOR PERMISSION TO CONDUCT RESEARCH STUDY AT YOUR SCHOOL

I am currently a student at University Education Winneba (UEW) registered for a master's degree in mathematics education.

As part of the condition for my studies, I am conducting an investigation titled "Factors influencing achievement in mathematics geometry of Senior High School Students in Agona Swedru of central region".

To complete the requirement for this degree I need to conduct a research on the above mention topic. I hereby ask for permission from the Head teacher's office to conduct my research at your noble school. I assure you that all information obtained during the investigation will be treated confidentially and only be used for academic purposes only.

Yours faithfully,

APPENDIX H: Letter of Appreciation

Department of Maths. Education

University of Education, Winneba

P. O. Box 25, Winneba
Date ……

The Headmaster/mistress

…….

…….

Dear Sir/Madam,

LETTER OF APPRECIATION

I am glad to reach you through this letter. The intention of this letter is to show my appreciation to you for accepting me in your school to carry out my research with your students.

Throughout the period of my research I received maximum cooperation from you and all your staff. In fact, I am very grateful to you and everybody who contributed in one way or the other towards the success of this program.

Yours faithfully,