UNIVERSITY OF EDUCATION, WINNEBA

EXAMINING FEMALE STUDENTS' ACHIEVEMENT IN GEOMETRY USING INSTRUCTIONAL STRATEGIES: THE DETERMINANTS AND THE WAY FORWARD IN SENIOR HIGH SCHOOLS IN WA MUNICIPALITY

JUSTINE YIRSOR
(202142387)

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

AUGUST, 2022

DECLARATION

CANDIDATE'S DECLARATION

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

Candidate's Signature: ……

Date: ……

SUPERVISOR'S DECLARATION

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

Professor Charles K. Assuah

Signature: ……

Date: ……

ACKNOWLEDGEMENTS

I wish to express my heartfelt appreciation to all the people who contributed in one way or the other, to the successful completion of this thesis. I am most grateful to my supervisor, Professor Charles K. Assuah, who notwithstanding his busy schedules, found time to read through and offered useful input and constructive criticism to the successful completion of my thesis.

I further wish to express my sincerest gratitude to the lecturers in the mathematics department of the University of Education, Winneba, for the unique ways they motivated me to complete my thesis on schedule. My sincere appreciation also goes to all heads of mathematics department, especially, Mr. Adinan Issahaque, the head of mathematics department, Islamic SHS, Wa and the students, who took time out and willingly provided data for the successful completion of this thesis. Thank you all, for your kind support.

DEDICATION

I dedicate this thesis to my parents for their support in my life.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

GES	Ghana Education Service
SHS	Senior High School
SHTS	Senior High Technical School
WAEC	West African Examination Council
WASSCE	West African Senior School Certificate Examination
NMC	National Mathematical Centre

ABSTRACT

Ghana Education Service (2018) report, indicates that, mathematics is the most poorly performed WASSCE core subject since 2006. It also showed that the female students' yearly achievement in geometry and mathematics in general has been very poor. According to Yarkwah (2018), female students' difficulties in geometry influenced their smaller enrolment into Science related programs i.e. medicine, mathematics and engineering and in the field of work and is a matter of concern. The purpose of this study was to examine female students' achievements in geometry using varied instructional strategies and find the determinants that influenced their achievement in geometry in SHS. The theoretical framework, the study adopted was a Self-Concept Theory. The study was an action research. The mixed method approach was used (both quantitative and qualitative). Four research questions were designed for the study. The research instruments used for qualitative data were Questionnaires and analyzed using descriptive statistics. The research instruments used for quantitative data were test and were analyzed using the independent sample t-test and also one sample t-test. The sampling technique used for the study was both purposive and simple random sampling techniques. A sample size of 180 i.e. 90 male and 90 female students. Major findings were that, instructional strategies of teaching improve female students' achievement in geometry when used in teaching. The major determinants that influenced female student's achievements in geometry were: inadequate exercises, lack of attention towards female students in class, lack of variety in teaching methods, laziness in learning, lack of motivation, lack of confidence and interest. The implication of the findings for the study was that more female students would further their education and contribute to national development if they are taught using instructional strategies. In conclusion, the study recommends that mathematics teachers, adopts the instructional strategies in teaching and learning to help improve female student's achievement in geometry and mathematics in general in the WASSCE.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter looked at the background of the study, the statement of the problem, the purpose of the study, the objectives of the study, the research questions, and the significance of the study and the delimitation and limitations of the study.

1.1 Background of the Study

Education is the act of transferring knowledge in the form of experiences, ideas, skills, customs, and values, from one person to another or from one generation to generations (Adu – Gyamfi, Donkor & Addo, 2016). Education therefore can be viewed as a symposium/ platform through which obtained data is processed, knowledge refined, accommodated and human resource developed. Mathematics as an aspect of science education, is studied in every part of the globe. And in pursuit of the application of mathematics knowledge, Eraikhuemen (2003) posited that a discipline and ordered pattern of life can only be achieved through the culture of mathematics.

In Ghana, mathematics is one of the four compulsory subjects incorporated into the Senior high schools' curriculum. The philosophy behind making mathematics a compulsory subject, right from basic to senior high schools' level was to help improve upon Ghanaian students' basic knowledge in numeracy and in effect, enhance critical thinking skills and also to contribute to the socio – economic development of the country (Asante, 2010). It is now evident that, a significant number of Ghanaians who had their basic and secondary education in Ghana have become a little conversant working with numerals. That is, people can easily transact simple buying

and selling transactions among themselves, and with ease and hence improve their income levels. In addition, the Conference Board of the Mathematical Science, CBMS (2012) headquartered in Saint Paul, MN stated that mathematics is both intellectually demanding to learn and widely used, and demand the application of reasoning strategies. Stakeholders in education need to care in developing the mathematical minds of Ghanaians, because it would improve upon the problem-solving skills of people and hence translate into improving the livelihood of people, minimizes societal crimes and uprisings.

However, over 30years now, there have been persistent public outcry about what content of mathematics is been taught and the pedagogy used, that accounts for the weak mathematics achievement in WASSCE and the strives made in mitigating the low scores obtained by students in mathematics in their WASSCE (Bush, 2009).

According to the Ghana Education Service (2018) sector performance report, the WASSCE pass rates (A1 – C6) as an admission requirement for the study of an undergraduate programme in Ghana, for core mathematics from 2006 to 2017 reveals that the proportion of students who obtained these grades, increased from 43.8% in 2011 to 49.4% in 2012. However, the number of students who obtained the same pass rates (A1 – C6) decreased from 36.6% in 2013 to 25.0% in 2015, longer than the period to which it experienced the increase. Notwithstanding the WASSCE pass rate in core mathematics (A1 – C6) that increased from 32.8% in 2016 to 42.2% in 2017, the proportion of students who obtained F9 in mathematics for these years have increased from 18.8%, 28.0% to 45.2% respectively. However, the drop from 38.1% in 2016 to 20.5% in 2017 is worrying and needs urgent solution to student's weak achievement in mathematics. See figure 1 below.

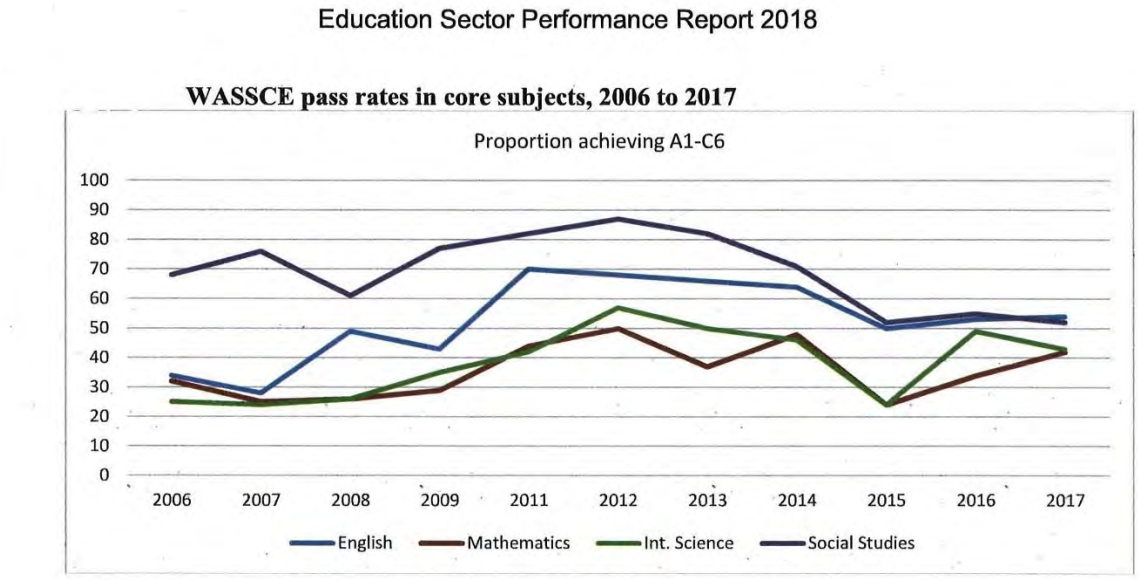


Figure 1: WASSCE pass rates in core subjects, 2006 to 2017

Further, the general regional pass ratings for the 2018 West African Senior Schools Certificate Examination, WAEC (2017; 2018) showed that, Upper West Region came seventh out of the ten regions in Ghana, only ahead of Upper East region and Northern region respectively. In addition, the student's achievement in the Upper West region in core mathematics on regional basis was the third underperformed region out of ten regions in Ghana, with a percentage pass rating below 20.0% while the highest performed region (Brong Ahafo) obtained above 70.0%. See figure 2 below.

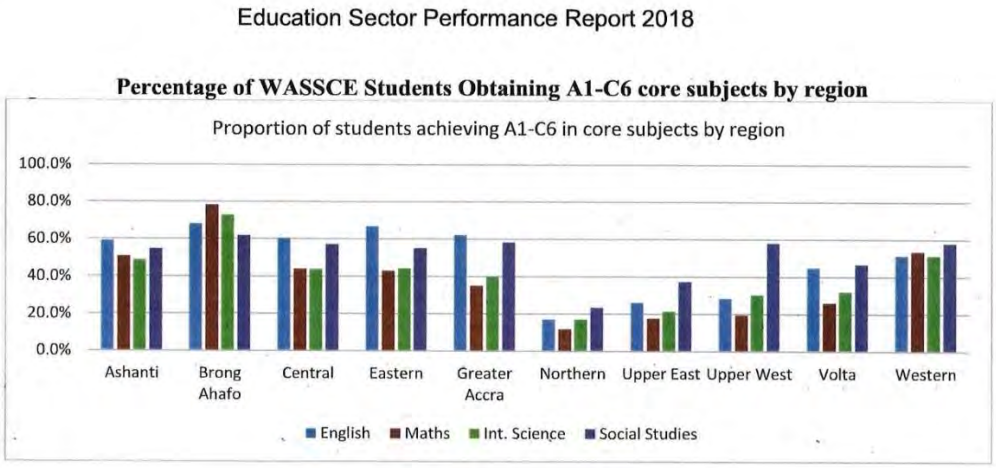


Figure 2: Percentage of WASSCE students obtaining A1-C6 in core subjects by region

Regrettably, student's pass rates in mathematics in the region, became the least (below 20.0%) compared with the same student's achievement in the core subjects (Integrated Science, above 20.0% and below, 40.0%; English Language, above 20.0% and below, 40.0% and Social Studies, above 50.0%) in the region as shown in figure 2.

Further, in figure 3 below, the WASSCE pass rate (A1 – C6) in Ghana for the 2017 academic year in the core subjects showed that apart from English Language, the male students performed better than the female students in Core Mathematics, Science and Social Studies**.** That is; English language, males (53.2%) and female (54.3%); Core Mathematics, males (45.8%) and females (38.4%); Integrated Science, males (46.6%) and female (39.5%) while Social Studies, males (54.7%) and females (49.7%).

Figure 1 showed that Integrated Science and Social studies have also performed better than Core mathematics on the national scale. Figure 3 below revealed that female students did better in both Integrated Science and Social Studies than in Core

mathematics. Hence, the reason, Science and Social Studies did better than core mathematics on the national WASSCE rating.

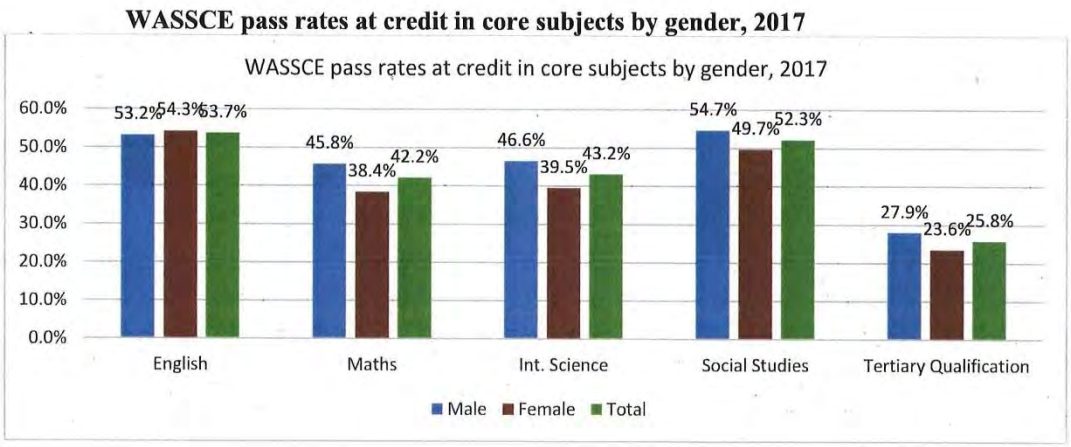


Figure 3: WASSCE pass rate at credit in core subjects by gender, 2017

These findings, revealed that female student's achievements in core mathematics is very poor, and invariably, influenced the poor achievement of core mathematics on the national, core subject achievement or performance ratings in Ghana. As such, the Upper West region need to rapidly, consistently and extensively review and research into student's achievement in core mathematics, if not Ghana as a whole for the socio-economic development of the people.

Notwithstanding, Tetteh, Wilmot and Ashong (2018) study on 'gender difference in performance among pre – service teachers in mathematics', found out that there was no gender difference among the pre – service mathematics teachers in colleges in the Brong – Ahafo region of Ghana, interestingly Asante (2010), study into gender differences in mathematics achievements among senior high school students in the

Greater Accra region, revealed that there exist gender difference among student's achievement in mathematics.

The gaps in these studies, that this present study identified included, the studies failed to agree on one thing, that is, whether there exist gender differences in achievement in mathematics or that there are no gender differences in achievement in mathematics, thereby paving way for further studies like this present study and many other research studies into the same study area. Again, the studies demographics were different and also did not directly relate to students' achievements in mathematics as compared with the present study demographical attributes. According to Alhajraf (2014), demographics and academic characteristics like, the high school a student attended, high school GPA, age and gender, significantly influenced student's academic achievements.

Further, many other studies into students' achievement in mathematics in general, adduced: self – concept, the use of lecture method of instruction, motivation, teacher coverage of mathematics content, weak mathematics admission grades for further studies, weak mathematics concepts acquired by lower grade students impacted student's achievement in mathematics (Peteros & Gamboa 2020; Enu, Agyman & Nkum, 2015; Dennis, Mereku & Alhassan, 2018; Sa'ad, Adamu. & Sadiq, 2014). This implies, there exist countless determinants that influence students' achievements. This formed part of the reasons why further studies into the study area are still relevant.

For these above stated reasons, the researcher further looked into the composition of the topics examined in the WASSCE core mathematics paper from 2013 to 2019. And the field data in table 1 showed that students have been examined in geometry yearly by WAEC in the WASSCE.

Table 1: Number of Years a Particular Core Mathematics Topic Occurred in WASSCE Core Mathematics Paper 2 from 2013 to 2019

Core mathematics topics	Number of years examined in WASSCE paper 2 from 2013 to 2019
Geometry	7
Trigonometry	7
Mensuration	7
Business Mathematics	7
Statistics	7
Change of subject	6
Algebraic expression	5
Probability	5

Source: Field Data (2021)

For the purposes of this study, any other topic not listed implies it occurred 5 years or less in the WASSCE from 2013 to 2019.

As a consequence of the findings in table 1 and other factors that influenced student's achievement in mathematics stated above, the researcher vied into conducting this research in geometry and then examined student's achievement in geometry: the determinants and way forward in senior high schools in Wa municipality. This was done to help ascertain whether student's achievement in geometry significantly accounted for the abysmal achievement in mathematics rating.

In brief, geometry is a branch of mathematics and has an extensive range of applications and repository of historical and cultural background. Again, geometry scope has been widened to include transformations, vectors, matrices and some topology (Baah-Duodu, Osei-Buabeng, Ennin, Hegan & Nabie, 2020). According to Baah-Duodu et al. (2020), the strand geometry and measurement in the Ghanaian

standards-based curriculum is made up of lines and shapes, position transformation, measurements, geometrical reasoning. Again, geometry is an area that is much needed in the field of academic, and career opportunities and in the field of work. Thus, geometry is applied in physics, engineering, and in the technological space, as a result there is the need for students to learn and understand geometry (Anamuah-Mensah, 2007). Geometry is revered in mathematical education and taught in core mathematics in all senior high schools in the country. Therefore, the teaching and learning of geometry must be effective and efficient.

However, the teaching and learning of geometry, according Aboagye, Denke-Ke and Mante (2021), most mathematics teachers, teach geometry without providing the underlying concepts of geometry to the student's level of understanding. This they belief further affirms the perception that geometry is difficult to learn and understand.

Moreover, Tambychik, Subahan, and Meerah (2010) opined that students exhibit weak mathematical skills in visual-spatial, information, shape orientation (geometry), inter-problems relationship establishing, memorizing ability, and interrelated facts memorization affect student's achievement in mathematics (Cited in Aboagye, Denke-Ke & Mante, 2021). For these reasons, the researcher deemed it relevant to research into student's achievements in geometry and it impact on core mathematics. These assertions buttress the WAEC (2017) chief examiners report for core mathematics, that majority of the candidates who wrote May/ June 2013 and 2016 WASSCE did not answer questions 10(a) and 11(b) respectively that involves the application of geometrical reasoning. The report however stated, that candidates who attempted answering the geometry questions failed to demonstrate sound understanding, adequate content knowledge and application in their solutions

(WAEC, 2017; cited by Ntow & Hissan, 2021). This invariably supports the Ghana Education Service Report (2018) on core subjects and that mathematics pass rate was the least among the core subjects. This is because, such candidates were left with few optional questions among the remaining questions to answer, as their opportunity to select from 7 optional questions automatically reduced, due to their inability to answer questions 10 (a) and 11(b) respectively.

Again, studies have shown that the difficulties in the teaching and learning of mathematics especially geometry has resulted in mass failure in examinations (Adegun & Adegun, 2013; cited by NMC, 2009). Other studies by Noraini (2006) and Aysen (2012) cited teacher methods of instruction, geometric language, visualizing abilities as the determinants that influenced student's achievement in geometry. Lastly, other determinants like: non-availability and obsolescence of instructional materials, gender differences, poor reasoning skill, inadequate time, inadequate school curriculum and lack of proof by students among influenced students' achievement in geometry (Mason, 2002; Uduosoro, 2011).

In conclusion, the continues poor WASSCE achievements among students in mathematics, no definite research findings on gender differences in core mathematics, the different determinants, differences in study demographics and fact that WAEC regularly examined students in geometry in their WASSCE, formed the basis for this present study.

1.2 Statement of the problem

The Ghana Education Service (2018) sector performance report of Ghana, reveals that, mathematics is the most poorly performed WASSCE core subject since 2006. It also showed that the female students achieved very poor results on yearly basis.

Further, a number of studies (for instance, Aiken, 2007; Callaham, 2001, cited in Tetteh et al., 2018; Fennema, 1976 & Asante, 2010) support the above assertion, that female students performed poorly in geometry and mathematics in general.

Again, the field of Science especially medicine, mathematics and engineering records fewer female workers as well as lower enrollment in the science and mathematics related programs into the universities (Yarkwah, 2020). According to Anamuah-Mensah (2007), the essence of geometry cannot be over emphasized because geometry is applied in physics, engineering, and in the technological space. As such, female students' inability to understand and achieve strong grades in geometry hinder their chances to purse programmes in such field of studies which are among the global well-paid jobs.

Moreover, the previous studies' demographics were different as well as different causative factors were assigned as the determinants that influenced female students' poor achievement in geometry and core mathematics in general, i.e. the findings could have been situation specific just as the present study. According to Alhajraf (2014) study, demographics and academic characteristics like, high school a student attended, high school GPA, age and gender significantly influence students' academic achievement. This perhaps explained why the three Northern regional senior high schools in the country, averagely on yearly basis, performed poorly against the remaining regional SHS in country, Ghana with the female students dominating in the poor performance (Ghana Education Service, 2018) report.

Again, the WAEC (2016) Chief Examiners report for core mathematics, specifically lamented about why most of the May/June 2013 and 2016 WASSCE candidates did not make any attempt to answer questions 10(a) and 11(b) respectively, which

involved the application of geometrical concepts. In addition, the report further reiterated that the few candidates who attempted these questions showed lack of understanding, inadequate content knowledge and application of geometrical content (WAEC, 2017; cited by Ntow & Hissan, 2021).

Also, the study and application of geometry in our present generation is demanding both in the academic field and career opportunities and at the same time, it partly determines the WASSCE core mathematics pass rate because students are on yearly basis examined in geometry as the field data suggested. For these reasons, is it undeniable that geometry and core mathematics in general, forms part of the subject selection criteria that qualifies a student's enter into the public tertiary institutions in Ghana for further studies. It is also open knowledge that, Upper West region suffers the effects of lack of significant economic activities in Ghana. As such, the students especially females, economics success which largely depends on their success in WASSCE results affects their opportunities to pursue further studies, as it is their only available path to obtaining white color jobs and a substitute for early marriages in the region. These assertions support Yarkwah (2020), findings that fewer female students pursue mathematics related programs, and it influenced their ability obtain high paid jobs and invites the need for many other researches like this, into student's achievement in geometry, and it impact on the WASSCE core mathematics performance. For these reasons, this study was conducted and call on researchers not to relent but continue to research into the existing and emerging causative determinants that influenced student's mathematics achievement in geometry and mathematics at large.

1.3 Purpose of the Study

The purpose of this study was to examine female students' achievements in geometry using a variety of instructional strategies, determine the determinants that influenced their achievement and make recommendations for implementation. According to Anamuah-Mensah (2007), geometry is an area that is much needed in the field of academics, in career opportunities and in the field of work.

1.4 Objectives of the study

The objectives of the study were:

1. to examine the differences between female and male students' achievement in geometry in the senior high schools.
2. to determine students' determinants that influenced female students' achievements in geometry in senior high schools.
3. to determine the factors caused by mathematics teachers that female students, perceive to influence their achievements in geometry in senior high schools.
4. to examine whether there is a significant difference between the mean scores of the post-test of the male control group taught according to traditional method and the female students experimental group taught using varied instructional strategies approach for the intervention.

1.5 Research Questions

The researcher sought to fine answers to the following questions:

1. What is the different in the achievement in geometry between female and male students' in the Senior High Schools?
2. What students' determinants influence female students' achievements in geometry?

3. What mathematics teacher determinants do female students perceive to influence their achievements in geometry?
4. Is there enough evidence to support the claim that female student's achievement in geometry significantly improved after using instructional strategies for teaching and learning in the intervention process?

1.6 Significance of the Study

The relevance of the study is to uncover the loop holes bedeviling student's achievement in geometry in senior high schools. Therefore, findings from the study are significant to:

a. mathematics teachers: They would enable mathematics teachers to be more interested in engaging teaching reflective practices that enables them use teaching strategies that motivate, inspire and captivate female students to want to learn geometry and core mathematics in general.
b. Ghana Education Service (GES): GES in their yearly WASSCE results analysis advocate for the need to increase students' achievement in geometry and core mathematics in general. The findings would help GES know what female students' factors influenced their achievement in geometry and the negative effect it has on the regional and national WASSCE core mathematics achievements.
c. government (Ministry of Education): Prospects for education in Ghana is considered enormous (Ministry of Education, medium term expenditure framework for 2017 -2019 budget estimates) report. Findings from the study, would enable them to identify the right intervention policies that would improve students' achievement in geometry and core mathematics in general.

d. female students: Base on Ghana Education Service Sector performance WASSCE pass rate (A1 – C6), (2018), and other gender studies, male students outperform the female students in core mathematics. Findings from this study, would enable female students overcome geometry/ mathematics phobia anxiety and motivated enough to do well in geometry and core mathematics in general.

1.7 Delimitation of the Study

The researcher limited the scope of the study to cover only three (3) public senior high schools in the study area. It consisted of 180 students. Out of this, 90 of the students represented each gender. The equal sample size for both female and male students primarily was to fairly measure the gender differences in achievement in geometry and for that matter core mathematics. The study was also delimited by inadequate time at the disposal of the researcher at the time of the study. Despite these delimitations, the researcher still belief, findings from the study can be adopted in demographics with similar attributes.

1.8 Limitation of the Study

The major limitation encountered was associated with the student's inability to return the answered questionnaires and the test items on time. One other limitation was that, the study used open ended questions and can be misinterpreted by the researcher and as such, the data needs to be crossed-checked with other sources.

1.9 Organization of the Study

The study is made up of five chapters. Chapter one consists of the background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significant of the study, delimitation, limitation and organization

of the study. Chapter two, discuss the review of related literature which include, the theoretical framework, essence of mathematics education, students' achievement in geometry and mathematics, gender difference in mathematics achievement, influence of mathematics teacher motivation on students achievement in geometry and mathematics, influence of students attitude on mathematics achievement, influence of a mathematics teacher attitude on students achievement in geometry and mathematics, influence of nature of mathematics on students geometry and mathematics, philosophy of teaching mathematics and students achievement in geometry and mathematics, mathematics teachers' content knowledge influence on students geometry and mathematics and ways of improving female students achievement geometry and core mathematics in general.

Chapter three discuss the research designs, population, accessible population, sampling techniques, sample, research instruments, validity and reliability, data collection procedure and data analysis. On the other hand, chapter four focuses on data analyses and the discussions of data while chapter five looks at the summary of the research findings, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

Chapter two discuss the review of related literature relevant to the study. Thematic areas covered included the conceptual framework, theoretical framework, determinants that influence female students' achievements in geometry, instructional strategies and students achievement, essence of mathematics education an students' performance in mathematics, gender difference in mathematics performance, influence of mathematics teacher motivation on female students achievement in mathematics, influence of students (female) attitude on mathematics achievement, influence of a mathematics teacher attitude on students (female) achievement in mathematics, influence of nature of mathematics on students (female) achievement in mathematics, philosophy of teaching mathematics and female students (students) achievement in mathematics, mathematics teachers' content knowledge influence on students (female) achievement in mathematics and ways of improving female students achievement in geometry (mathematics) and a chapter summary.

2.1 Conceptual Framework of the study

The conceptual framework is focused on using a variety of instructional strategies to examine female students' achievement in geometry i.e.

1. adopt teaching and learning materials, TLMs
2. step-by-step instruction
3. guided practice and independent practice
4. monitor and assess learning
5. encourage female students to self-monitor and self-correct

6. Encourage self-reflective practices, workshop and modelling

Hence, the conceptual framework of this study is rooted in the following representation of knowledge:

Visual/ Manipulation of cut-out shapes – students cut-out shapes of angles drawn from a cardboard, compare the similar shapes, measure the cut-out angles, interpret and draw conclusions on the types of angles identified.

Algebraic/ Symbolical – the mathematics teacher guides female students using varied instructional strategies to analyze their conclusions from pictorial illustrations on the marker board and write out equations or expressions from the diagrams drawn the board.

Numerical – female students' interpretations are analysed from calculations from further examples on geometric diagrams illustrated on the board. Based on these premises and also relating to literature, the theoretical framework was chosen.

2.2 Theoretical Framework

The theoretical framework used for the study is Self-concept theory by Sincero (2012). Self-concept is the totality of a complex, organized, and a dynamic system of learned attitudes, beliefs, and evaluative judgements, individuals hold about oneself (Leary & Tangney, 2012). Self-concept theory, according to Dramanu and Balarabe (2013), is multifaceted, hierarchical, organized and structured, descriptive and evaluative, stable, and its situation specific. Moreover, the theory states that students who have high self-concepts in a particular subject perform very well, however, students who have low self-concept avoid such subjects in the absent of motivation and consequently perform poorly (Guay, 2010).

According to Sincero (2012), Self – concept theory includes, Self – concept is learned, Self – concept is organized and Self – concepts is dynamic. First, Self – concept is learned includes those concepts a student develops which the surrounding environment affects and can be changed (Zimmerman, 2013). A student can develop self - identity in school based on interactions with other students. Once a student can identify and organize perceptions about oneself, the student will try to examine if his beliefs are consistent with who he really is. In a broader perspective, societal stereotype shows a significant role in shaping the identity of students like the gender-role stereotype, which can affect the academic self-concept of the students (Cheryan & Meltzoff, 2015). For instance, students tend to develop the concept that male students are better than female students in mathematics from the societal stereotype, based on what society perceived to be true.

Another scenario, is the societal stereotyped perceived perception that mathematics is a difficult subject and therefore a preserve of the males and may as a result cause a student to change from one program to another (Nosek, Banaji & Greenwald, 2002). This societal stereotype effect is felt strongly in senior high schools' courses with more calculations options than less/ non-calculations subject options. These are consequences of individuals interacting through socialization.

Second, the self-concept is organized. One or two student(s), can examine a single situation in different perspectives. However, the students may be able to organize one single belief of thought. When beliefs of students are consistent with their philosophical perspective, there is the likelihood such belief would exist and would be tough to change, though it is possible to adopt to a change (Peteros, Gamboa & Sitoy, 2020). For instance, a student and for that matter a female student, who finds mathematics to be a difficult subject and the achievement in mathematics are

consistently weak (poor), the student is more likely to think that she is not good in the subject and may end up reinforcing such belief of thoughts. However, a student who thinks she is good in mathematics and perform better in the subject is more likely to develop a positive self-concept towards the subject.

Third, self-concept is dynamic. Beliefs and experiences of students (females) may change depending upon the kind of situation encountered and would demonstrate commensurate response. In other words, a student reaction to a situation is dependent on how she sees herself in that situation and may adopt to a new situation though inconsistent with his character traits, if she beliefs, she has come to terms with what he now sees as the truth. As such, individuals hold onto things that reflect oneself and promote personal intellectual development (Peteros et al., 2020). Peteros et al. (2020), further stated, a student experience in school environment is significant in shaping self-concept towards any academic subject, especially in perceived challenging subjects like mathematics.

This finds expression in the students' responsibilities and the task that they engage in, in the various senior high schools across the country Ghana, as they tend to develop their own identity in school and act accordingly on what is expected from them. Further, if students are motivated to develop positive self-concept towards the subject mathematics, they will identify their perceived capabilities in the subject. Hence, the student will re-orientate oneself to perform well in mathematics. Self-concept in mathematics can be defined as student ratings of their skills, ability, enjoyment, and interest in mathematics (Peteros et al., 2020).

The choice of the Self-concept theory for the study was anchored on the fact that the study area is situation specific (female students' performance) and it relates students'

belief, attitude, perception to student's academic achievements. The study topic also associate itself with attributes that include students' attitudes, beliefs, perceptions in examining female students' performance in core mathematics just as Self-concept theory. Moreover, Timmernan (2017) findings revealed that, there existed a significant positive correlation between mathematics self-concept and achievement of students for all domains of mathematics, such as measurement, relations, numbers and scale, hence the reason why self-concept is used as the theoretical framework for this study.

Similarly, Kamoru, Usman, Ramon and Gbolagade (2017) investigated the relationship between self-concept and mathematics achievement of 200 senior secondary school students from Ibadan Metropolis using random sampling. Students were asked to answer the 20-item mathematics self-concept questionnaire and took a 30-item multiple choice mathematics achievement Test. The findings revealed that there was a significant positive correlation between the self-concept and the mathematics achievement of the students. They therefore suggested, teachers should develop student's positive self-concepts towards mathematics and provide a pleasant teaching experience in order to enhance higher self-concept and better performance of the students in mathematics.

To add, in a similar study conducted by Peteros et al. (2020) with a sample size of 183 Junior high students, revealed that there existed a significant relationship between all aspects of self-concept and the respondents' academic performance in mathematics. Peteros et al. (2020), therefore defined academic self-concept as an evaluation of the perception of students based on their experience and interpretation of the events that they experience in school which leads to the formation of specific attitudes, feelings,

and perceptions about one's intellectual and academic abilities based on the academic scenario.

In conclusion, the literature review is based on the above theoretical framework i.e. self – concept theory of the students/ female students' performance, and the below related literature in support. A student self – concept about core mathematics can therefore be explained to consist of his or her belief and feelings about mathematics and is subject to a change.

2.3 Determinants that Influence Female Student's Achievements in Geometry and Core Mathematics in General

According to the Colleges of Education Examinations (2008; 2009) report, Geometry, Trigonometry, Statistics and Probability significantly caused students' achievement in mathematics to decrease over the years. The consequential effect of this continues decrease in achievement by students in geometry greatly affects the female students due to their large numbers in schools. Again, some determinants that influenced female students' achievement in geometry and career choices includes factors such as biological factors, mathematics learning strategies, sex hormones on brain organization, and symbolic gender (Geary, 2000) and that it influences their self - concepts in learning geometry.

According to Tetteh (2018), the determinants that influence female student's achievement in geometry and mathematics in general were: lack of confidence in females and the perception that mathematics is a male domain subject including. Moreover, Mereku (2010), study states inadequate completion of the mathematics syllabus among others as factors that further worsen the plight of the female student's achievement in geometry and mathematics in geometry. Also, according to Aboagye,

Denk-Ke and Mante (2021) study on students perceived difficulties in studying geometry stated: self-confidence, professional teacher training and parent educational level as the factors that influenced students perceived difficulties in studying geometry and it related achievements.

Again, Freeman (2004) states that globally, females achieved two-thirds, representing almost 67% of all degrees awarded at the undergraduate level, however, a few of these degrees are attained in science and technology which requires the application of knowledge in geometry. This supports Jacobs and Simpkins (2005) assertion that, women enrolled into tertiary education, are only able to finish a terminal degree i.e. only 1% attain PhD degrees in science, technology, engineering, and mathematics (STEM) related fields. By 2015, the number of women who earned 42% of the Doctoral degrees were in Physical, Life, Computer, Earth and Social Sciences, Psychology and Engineering (National Science Foundation, 2016). Regardless, only 25% women had PhD degrees in mathematics and computer sciences in 2015 (National Science Foundation, 2016).

In realizing the significance of female education to humanity, the Girls Education Unit (G.E.U.) of the Ministry of Education, on yearly bases organizes Science and Mathematics clinics for female students in the Secondary schools. The aim of the unit is to sensitize female students and make them have interest in Science, Mathematics and Technology, including providing scholarships schemes for the female students and documentaries on what the female students can achievement if given equal opportunities (Tetteh et al., 2018).

2.4 Instructional Strategies and Students Achievement

Instructional strategies are techniques teachers adopt to help students become independent, and strategic learners (Alberta Learning, 2002). Instructional strategies motivate students to focus attention, organize information for understanding and remembering, and monitor and assess learning.

Instructional strategies have been proven to have positively impacted students learning outcomes through use of its features in the teaching and learning process where lessons are presented using: step-by-step strategy instruction, a variety of instructional approaches and learning materials, appropriate support that includes modelling, guided practice and independent practice, opportunities to transfer skills and ideas from one situation to another, meaningful connections between skills and ideas, and real-life situations, opportunities to be independent and show what they know, motivate students to focus attention in class, monitor and assess learning, encouragement to self-monitor and self-correct and tools for reflecting on and assessing own learning (Alberta Learning, 2002).

2.5 Essence of Mathematics Education and Geometry in Mathematics Education

The major significance of mathematics education in Ghana, is to develop critical thinking and reasoning skills among students and promote the application of the knowledge obtained in solving problems. The instructional syllabus adopted by the Ghana Education Service (2011), is designed around content knowledge (CK), the pedagogical content knowledge (PCK) and the application of the content knowledge in the subject matter. The study of mathematics and its application world over, is accepted to be one of the most important ways of turning micro-economics into macro- economics. According to Bush (2009), there have been many changes in both

the content and the style of mathematics teaching for the last thirty years (cited in Darfour, 2016). This saw an emerge advocate for the use of problem-solving strategies in the teaching and learning processes of mathematics than the outdated rote learning approach that is mostly practiced in the Ghanaian classroom.

Lastly, mathematics and its' applications undeniably are the bench rock of material science, engineering and medicine programs especially in Ghana. As such, the importance of mathematics education cannot be underestimated.

2.6 Students' Achievement in Geometry and mathematics

From 2006 to 2017, the general performance of both male and female students in WASSCE pass rate (A1 – C6) has been the worst not excluding the 2018 WASSCE performance in mathematics compared with the remaining three compulsory core subjects; English Language, Integrated science and Social studies (Ghana Education Service, 2018) report. It worth to note how students in general, fare in mathematics because, mathematics forms part of the university's admission requirement for undergraduate programs in Ghana. As such the need to have a critical look into students' performance in mathematics in Ghana.

According to Churcher, Aseidu-Owuba and Adjabui (2015); Ehiametor (1990) stated, to improve the students' achievement, teaching should be accompanied with assignments because assignment provides the teacher, data on the achievement of the student in a learnt concept and where needs to be improved. He further stressed that students seem to understand the solution of a mathematics task better when the teacher is in class teaching but find it very difficult solving a similar task when the student works independently. In furtherance, the National Research Council (2000) opined, that students' beliefs about their competence and expectations for success in

school have been directly linked to their levels of engagement, as well as to emotional states that promote or interfere with their ability to succeed academically (cited in Akey, 2006). This implies, mathematics teachers should endeavor to expose students to varied but challenging mathematics ways of solving diverse geometric and mathematics tasks with the students in the class in order to minimize this effect.

Another way of curbing the aforementioned problem is by peer teaching. According to Tullis and Goldstone (2020) peer teaching supplements the work of the teacher by communicating to the other students those lessons they have been taught by the teacher. As such, students are able to share ideas freely among themselves that enhances achievement in geometry and mathematics.

Unfortunately, in the contemporary Ghanaian mathematics classroom, teaching and for that matter mathematics is taught and learnt, in a manner just to pass the WASSCE to enable them proceed to the next level of education worsens geometric understanding. This situation is further worsened by the over loaded 28 mathematics topics and the numerous sub topic needed to be covered by the mathematics teacher and the student ahead of their final West African Senior School Certification Examination. This indirectly do not offer the mathematics teacher the luxury of time to apply varied methodologies that deepens geometric knowledge. According to Dennis, Mereku and Alhassan (2018), one of the most relevant contributing factors to the poor achievement in geometric and mathematics is due to lack of significant coverage of the mathematics topics in the syllabus. As a consequential effect, lack of significant coverage of mathematics demotivates the already weak students, and also reduces the efficacy of the peer teaching as it limits the extent to which good students can even explore.

Perhaps curriculum differentiation in assessment in the WASSCE core mathematics paper is needed just as it's done in some subjects will reduce the effect of the inadequate coverage of the core mathematics topics in senior high schools in Ghana. According to Konstantinou-Katzia, Tsolakia, Meletiou-Mavrotheris and Koutselini (2013), Tomlinson a curriculum differentiation advocator, defines differentiated instruction as a philosophy of teaching on the premise that, students learn best when their teachers accommodate the differences in their readiness levels, interests and learning profiles. He further stated, differentiation is a well-structured, non-rigid way of ''teaching and learning'' that is tailored to meet students where they are and to help them attain their learning goals. To them teachers and the students learn continuously, and teachers regularly evaluate students' level of readiness, and plan learning activities based on the needs and interests of a student. As such, WASSCE core mathematics paper which seeks to assess the mastering level of the cognitive domains of a student, should be differentiated as it offers the student the opportunity to select questions based on differentiated topics and capabilities that fairly and equally measures student's mastering level. For this takes care of all the heterogeneous group of candidates who write the WASSCE.

A clear instance of curriculum differentiation in assessment is the WASSCE elective mathematics paper. For instance, the elective mathematics WASSCE paper is made up of paper 1 (one) and paper 2 (two). Paper 1 consist of 40 multiple choice questions covering all topics with the following breakdown: questions set on Pure Mathematics – 30, Statistics and Probability – 4 and Vectors and Mechanics – 6.

Paper 2 consist of two sections A and B. Section A is made up of 8 elementary questions in type and compose of 4 – Pure mathematics questions, 2 – Statistics and

Probability questions and 2 – Vectors and Mechanics questions. Section B on the other hand consist of seven questions of greater length and difficulty put into three parts I, II, III. Part I: 3 – Pure mathematics questions, Part II: 2 – Statistics and Probability questions and Part III: 2 – Vectors and Mechanics questions where students are required to answer 4 questions with at least one from each part.

In a study conducted in the United States shows that differentiated curriculum eliminates a student's feel of isolation from the teaching and learning process and thereby improves the academic prospects of the learners (Mastropieri et al. 2006 cited in Marishane, Marishane & Mahlo, 2015). Instructional differentiation, therefore do not imply to discriminate among students the volume of work or number of items a student is supposed to be engaged in but rather vary the tasks and not the content assigned to each group of the students and the pedagogy used. It is very clear the ultimate aim for curriculum differentiation is to be able to meet, measure and improved the learning outcomes of every student in the classroom setup, based on one's ability as a yardstick of a standardized curriculum.

From the above analysis, the researcher outlined the following immersed benefits a student stands to gain should the core mathematics GES, WAEC syllabus and the WASSCE core mathematics paper be differentiated:

1. there will be clear guideline to the specific learning outcome a student is supposed to possess
2. it vividly offers each child the opportunity to master a specific concept based the students' learning abilities. This is because the child has the free will to conceptualize in specific topics deemed sufficient to pass ahead of the examinations.

3. the student do not have necessarily to learn all math topics. This invariably motivates and increase their interest in the learning of core mathematics thereby develop deeper understanding in problem solving.
4. it indirectly offloads the overburdened/ numerous topics in the syllabus meant for the student to learn with equal measure.
5. it will improve pass rating in the subject

Lastly, one other factor that influence students' achievement in geometry and for that matter mathematics is the over populated classroom sizes and the overburdened 20 teaching periods per week. The mathematics teacher barely finds time to do proper reflective practice which forms one major basis for the mathematics teacher, to whether vary the method or even conduct intervention teaching for some sections of the students. As such, class exercises, homework and others assessment tools are in real terms not effectively used and it influenced the achievement of the students in geometry and mathematics in general in WASSCE.

2.7 Gender difference in achievements in geometry and mathematics

In the early 1978, Fennema and Sherman in a study, revealed that male students outperform female students in mathematics especially, from basic school up to the senior high school level of education. However, Mullis, Martin, Gonzales, and Chrostowski (2004) in a study averagely across all countries stated that there was no difference between males and female students' achievements in mathematics (as cited in Tetteh et al., 2018). However, recent report from the Ministry of Education Sector Performance Report, (2018) of Ghana and others like (Eshun, 1999 & Asante, 2010) revealed the contrary, that male students outperformed the female students in mathematics.

In a societal stereotyped environment such as the senior high schools in Ghana, where students tend to develop their own identity in schools and act accordingly on what is expected from them, the females align themselves to the stereotype that, mathematics is the preserve of male students (Nosek et al., 2002). This belief makes females not motivated enough to give their best in the learning of mathematics in the senior high schools in Ghana. It is therefore very important that mathematics teachers re-orientate themselves and do a lot of reflective practices on how best to boost female interest or belief towards the topic geometry and the subject mathematics.

Female Education in Mathematics and Science in Africa (FEMSA, 1997) project findings again exacerbated the situation that females lack role models in mathematics and science areas. This further compound the stereotyped thinking that mathematics is the preserve of males.

As such, Geary (2000) cited in Tetteh et al. (2018) in resolve to solve the gender disparity in mathematics performance, in a study, adduced biological factors, mathematics learning strategies, sex hormones on brain organization and symbolic gender as factors that caused gender differences in geometry and mathematics achievements. It is very clear about the effect of mathematics teachers in contributing to the gap between males and female's achievement in mathematics. Again, Wilmot (2009) in a study, cited mathematics teachers as one of the important determinants that affects female students' achievements in mathematics. Because, according to Ajogbeje (2010) cited in Peteros et al. (2020), female student's self-concepts in mathematics are largely depended on how the mathematics teacher introduces his beliefs in mathematics to the females just like any other subject. As a result, females are the most affected as they form the largest group likely to be stereotyped on the

perception that, mathematics is for males and not females. Hence, mathematics teaching be refocused on more female students centered teaching approach than the already existing child centered approach.

2.8 Motivation/Encouragement and female students' achievement in Mathematics

Motivation connotes performance. According to Farrant (1980) cited Enu, Agyman and Nkum (2015) "today the relationship between teachers and pupils is often up-side down; pupils come because they must and teachers teach because they are paid to. Teachers mourn that their profession is not respected and complain that they are inadequately paid for the duties they are required to do. They look over their shoulders at others professions and conditions of services for a better life'' (pg 125).

Again, recent Ghana education policy in senior high schools that prohibits the use of cane by teachers has demotivated most teachers in Ghana to belief that students are empowered to do whatever they want and get away unpunished. Most of the school environments now are highly indiscipline and a breeding ground for criminals. It is a common concern among senior high school teachers in Ghana about the urgency and swiftness that GES, Ministry of Education and stakeholders exhibit in dealing with a teacher involved in misconduct which most instances recommends' the sacking and prosecution of the teacher involved but a students' is usually suspended for some weeks for the same or similar offense committed even worse case scenarios signed a bond of good behavior. This unfair, biased system kills the spirit of the teacher to effectively engage in a productive reflective practice that produces positive learning outcomes. To add, the teacher is powerless in taking any corrective measure on

student as almost everything done in the school is against the teacher. It is a highly frustrating school environment for teachers nowadays.

2.9 Females/ Students attitude toward geometry and mathematics in general

Generally, students' belief about mathematics determines how they approach the study of mathematics which also influence their way of reasoning and tackling problem solving task in mathematics (Mensah, Okyere & Kuranchie, 2013). According to Zan and Martino (2007), attitude towards mathematics is a mere positive or negative emotional disposition towards mathematics. However, Neale (1969) posited that, attitude towards mathematics are the aggregated measure of "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics and a belief that mathematics is useful or useless" (cited in Churcher, Aseidu-Owuba & Adjabui, 2015).

The above assertion, is further affirmed by another research work done by Enu et al. (2015), that students' attitude towards mathematics influences the efforts they put, in understanding and practicing mathematical concepts and skills. Based on this understanding, and the belief that, female students are emotionally attached than males in controlling their feelings and are the most affected in core mathematics performance.

Further, the above assertions are aggravated by the findings that mathematics teachers are unable to complete about 50% to 70% of the mathematics syllabus before WASSCE, lack of enough qualified teachers and poor teaching methods further feed into the perception and negative attitude that female students have about the subject mathematics (Abreh, Owusu & Amedahe, 2018). Base on the above perspectives, it

can be said that, what females (students) are easily seen engaged in, is directly associated with their interest. If a female's perception towards the study of mathematics is negative, then the desired female core mathematics outcome on the average becomes weak (poor).

2.10 Mathematics teacher's attitude toward achievement in mathematics

According to Maio and Haddock (2009), there are three components of attitudes; the cognitive, affective, and the behavioral components of attitude (adopted by Mensah et. al., 2013). Cognitive component of attitude is what a person thinks about the attitude of the object whereas affective component of attitude, is referred to as the feelings or emotions an individual have about an object. However, behavioral component of an attitude is referred to the tendency to response in a certain way towards an object.

In addition, a math teacher's positive attitude towards math is significantly related to high achievement in students (Mensah et al., 2013). Moreover, Ngeche (2017) study revealed that students who had more devoted teacher interactions were regarded by their peers as helpful not to victims of bullying compared with students who got exposed to less devoted teacher interactions. These dispositions bring to bear that, a student with more devoted interactive teachers were more motivated and determined to face difficulties than the others. Invariable a student who regularly interacts with a teacher stand to have more time to learn, confidence to learn and asked more critical questions and easily sought for answers to questions.

Similarly, a female/ student emulates from her teacher's disposition to form his own attitude which may affect his performance. Teachers' beliefs about mathematics, such as the relevance of mathematics, how mathematics should be learned, the difficulty or

ease of mathematics, affects their attitude towards the subject and impact on the performance (Churcher et al. 2015). As such, a teacher's attitude like any other attitude can be measured by his emotional response (affective) towards mathematics, his belief about mathematics (cognitive) as well as his behavior has the tendency to influence student's achievement in geometry and mathematics in general.

Further, Clark and Vidakovic (2009), reports that attitude and practice of teaching mathematics are complexly affected by beliefs, emotions, social context and content knowledge. This position was further confirmed by (Philippou & Christou, 1998; Brady & Bowd, 2005), that a teacher's attitude towards mathematics include, likes and dislikes of mathematics, anxiety and self-confidence in relation to mathematics.

Last but not least, the teachers' belief about mathematics and its usefulness often correlate with either a positive or negative attitude towards mathematics (Philippou & Christou, 1998). Such mathematics avoidance related behavior, teacher belief about geometry and mathematics, self- esteem, and many more all influence students' mathematics achievement.

2.11 Nature of mathematics and student's achievement in mathematics

Mathematics is the study of quantity, structure, space, and change (Ziegler, 2010). In general, the nature of mathematics can be classified under two main schools of thoughts; the absolutist view and the fallibilist philosophical perspective of mathematics. According to the absolutist perspective, mathematical knowledge is certain, objective, pure, and an incorrigible truth that is anchored firmly on deductive reasoning and independent of human affairs and values (Ernest, 2004).

On the contrary, the fallibilist belief that mathematical knowledge is fallible, controvertible, and subject to revision or refutation. According to this school of thought, mathematics has a link with social responsibility, culturally bounded and value laden. It is a dynamic subject which belongs to a continually expanding field of human creation and invention (Ernest, 2004).

According Illeris (2017) in a model designed to classify teaching styles, if a student is in control and the content structured in a manner aligned to a given discipline, the typical situation will be that of a student studying a course material or a book. If the teacher is in control while content still structured according to the discipline, the typical situation will be that of a lecture. If the content is designed around problems, the situations will assume the format of exercises, however if the student is in control in a problem-oriented approach then the situation revolve around a project work. This model designed by Illeris, the researcher belief, simplifies the two schools of thoughts in the aforementioned.

To add, Van-Hiele (1999), belief that effective processes of learning geometry is different from the teaching and learning processes of other topics in mathematics, therefore teachers should teach geometric topics, words problems and mensuration topics base on the proposed model, Van-Hiele Phase – Based Instruction, VHPI (1999), (cited by Armah, Coffie & Okpoti, 2018). Critically scrutinizing these two philosophical perspectives about mathematics and Van-Hiele Phase – Based Instruction model, it is vivid that, the type of mathematics and its methodology, a mathematics teacher teaches/ use in the classroom varies, and is greatly influences by one's philosophical view about the nature of mathematics.

2.12 Philosophy of teaching geometry and students' achievement in mathematics

If the philosophy of teaching geometry is that of the fallibilist, then the teacher is more likely to teach his students to see mathematics as cultural, creative and an empirical activity. These groups of students are more likely to be in the position to construct their own mathematical knowledge irrespective of how different their methodology may vary from the orthodox mathematics classroom. In addition, in an active problem solving, according to the fallibilist perspective of mathematical knowledge, can warrant the teacher to accept the creativity in a child's approach in solving a mathematical task (Ernest, 2004). Such mathematics would motivate students to be active participants and invariably become problem solvers in their diverse ways.

On the other hand, if the mathematics teacher's philosophy of teaching geometry is that of the absolutist, then students are more likely to be trained, to see mathematics as an entity waiting to be discovered, then it will be enough for school teachers to present the curricula instructions as mere gathering of facts, definitions and algorithms (Ernest, 2004). He further opined that, teaching mathematics would be like transmitting an immutable body of knowledge that students have to accept as a perennial fact without reasoning.

But, if the mathematics teacher's philosophy about geometry is a blend of both the falibilist and the absolutist, then the methodology may vary from the teacher, whose belief is either only falibilist or absolutist (Ernest, 2004) and is more likely to produce better achievements in geometry. And this supports Ntwo and Hissan (2021) concept-based instruction principle.

2.13 Mathematics teacher content knowledge (CK) and students' achievement in geometry

Mathematics content (subject) knowledge is referred to as the basic mathematics knowledge possessed by an individual considered mathematically literate. Further, conceptual knowledge is defined as a rich understanding of the relationships among mathematics concepts (cited in Reid & Reid, 2017). To them, this includes solving problems through reasoning, communicating and justification. The study revealed mathematics teachers who possess weak conceptual mathematical knowledge, appear to be rigid during instructional procedures and students' tasks assessment, hence, inhibit achievements.

Researchers hold the view that mathematics content knowledge is an important construct that can either support or hinder success toward exemplary classroom instructions (Thames & Ball, 2010 cited by Reid & Reid, 2017). Although, Ponte (2012) opined that, possession a strong content knowledge in itself does not guarantee that a mathematics teacher would be effective but stated that would be difficult to facilitate a student to acquire deeper mathematical understanding when the math teacher has inadequate content knowledge, Hiebert and Lefevre (1986) belief that, the teaching of geometry and mathematics in general demands the teacher to demonstrate adequate understanding that enables him to situate concepts in a manner that exemplified and make connections between algebra, numerals, symbolic equations and geometric representations, contribute significantly to students' achievements in geometry (Cited in Ntow & Hissan, 2021). This implies, a mathematics teacher needs to possess a conceptual knowledge that enables him/ her select appropriate teaching methods in order to effectively explain the algorithms and concepts as well as describing the connections between concepts.

According to Liakopoulou (2011), pedagogical content knowledge relates to classroom organization, motivation and retention of students' attention, pooling of resources, learning theories and pedagogical theories in order to simplify understanding. She therefore stated, teaching methodology is a schematic presentation of the specific structural elements of instruction and includes: (i) lesson planning i.e. organization of content into thematic units, transformation of teaching material into teachable knowledge, definition of teaching goals, methodological organization of teaching, time planning and selection of evaluation process.

(ii) teaching performance, i.e. implementation of the teaching plan

(iii) Evaluation of teaching i.e. evaluating the results mainly by assessing student performance (e.g. goals, forms, basic principles, assessment techniques). These assertions imply, a mathematics teacher needs adequate content knowledge and pedagogical content knowledge in order to effect effective and efficient lesson that produces the desired understanding in students.

Finally, Ntwo and Hissan (2021) findings, revealed that there was a significant evidence on the impact of concept-based instruction on the achievement of students in circle theorem when the students were exposed to two different teaching methods. The study found that the use of concept-based instruction in teaching circle theorems had a significant influence on students' achievement in geometry as compared to the traditional method and this depends on the knowhow of the mathematics teachers. It is therefore clear, that to teach, learn or answer a question in geometry one needs adequate content and pedagogical content knowledge.

2.14 Ways of improving female students' (students) achievement in geometry and mathematics in general

According to Tetteh et al. (2018) study, there are numerous alternatives on how to improve students' poor achievement in geometry and mathematics. The study findings suggested that students' poor achievement in geometry and mathematics can be improved by:

1. Changing the perception of students that mathematics is a very difficult subject.
2. Introducing distinguished females in mathematics and science fields to students just to let them understand they can even do better.
3. Linking mathematics learning to technological usage
4. Motivating students intrinsically or intrinsically to develop interest in learning geometry and mathematics.
5. Encouraging and rewarding female students who have improved or/ and are doing well in mathematics.

Also, Frimpong (2021) findings in a similar study opined that, students' achievement in mathematics can significantly be improve if mathematics teachers introduce and effectively use the teaching and learning materials during lesson instructions, especially during the early grades of the student development are important determinants that influenced student's achievement in geometry and mathematics. Again, in a related study, the finding indicated that, self – concept, the use of lecture method of instruction, motivation, teacher coverage of mathematics content, weak mathematics admission grades, weak lower grades mathematics female students and

mathematics teachers' concepts, inadequate qualified teachers all contribute to how students perform in mathematics (Peteros et al., 2020**;** Enu et al., 2015; Dennis et al., 2018)

Moreover, Serebour (2013) outlined the following as factors influencing students' achievement in mathematics:

1. Mathematics teachers hardly use interactive approach in teaching, vary their methods of teaching mathematics, and give enough exercises and assignment. These were stated as findings that affect achievement in mathematics. He was of the view, if carefully relooked at would significantly improve student's mathematics achievement.
2. Most mathematics teachers connect mathematics learnt in the classroom to other disciplines, use marking scheme(s) and also cover all mathematics topics in the teaching syllabus. The Findings showed that, these factors are the most adopted strategies that improve students' performance in mathematics and need to be reinforced.
3. A significant number of parents have negative attitude toward mathematics. And was attributed largely to mathematics teacher's methodology used in school coupled with other factors. And that the teaching process does not allow students to reason or explore.
4. Most mathematics teachers were of the conviction that students' achievement in mathematics got better when engaged in smaller groups, whole class in discussion, used of students' relevant previous knowledge (RPK) during lesson planning and finally when students are well motivated.

Furthermore, according to Ndhlela (2012) study, the causes of students' poor performance in mathematics includes:

1. acute shortage of qualified professional mathematics teachers.
2. exhibition of poor knowledge of mathematics content by many mathematics teachers. Overcrowded mathematics classrooms.
3. students' negative attitude toward mathematics.
4. undue emphasis on the coverage of mathematics syllabus at the expense of meaningful learning of mathematics concepts.
5. inadequate facilities and mathematics laboratories.

It is vivid from the above multiple ways that, depending on the demography of the student and the student involved, the determinants that influenced student's achievement in geometry and mathematics in general, vary. This suggest that, researchers need to explore numerous ways in this area of study especially in females' achievement in mathematics education.

2.15 Chapter Summary

In summary, the used of Self-concept theory as the theoretical framework for study was anchored on the fact that, self-concept theory associate itself with academic achievements of students which this study is all about. The study examined students' achievement in geometry and core mathematics, the determinant that influenced students' achievement in geometry and core mathematics. The study adopted Self-concept theory by Sincero (2012) as the theoretical framework. Further, Timmernan (2017) findings revealed that, there existed a significant positive correlation between mathematics self-concept and achievement of students for all domains of mathematics, such as measurement, relations, numbers and scale. According to Leary

and Tangney (2012), Self-concept is a complex, organized, and yet dynamic system of learned attitudes, beliefs, and evaluative judgements, individuals hold about themselves. And that, self-concept is learned, self-concept is organized and self-concept is dynamic further supports the reason why self-concept theory was deemed the most appropriate theoretical framework for the topic.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Overview

This chapter discuss the methods and procedures used in conducting the study. It includes the research design, population, sampling techniques, sample, research instruments, validity and reliability of the instrument, data collection procedure and data analysis.

3.1 Research Design

Research designs are procedures and instructions that the researcher follow, in conducting research (Serebour, 2013). The research design adopted for the study was an action research design and the research approach was the mixed method i.e. both quantitative and qualitative in nature. According to O'Brien (2001), action research is a research that adopts a holistic approach in solving a problem rather than using a single method to collect and analyse data. It uses several research tools as the project is conducted. The research instruments used in an action research usually common to the quantitative includes Test and qualitative data includes, questionnaires, structured and unstructured interviews.

Again, the action research design fits both the theoretical framework and the study topic. The statistical tool used to analyze the quantitative data were the independent sample t-test (Levene's test) and a one sample t-test whiles a descriptive statistic (frequencies and percentages responses of female students on each questionnaire item) were adopted to analyse the qualitative data.

Further, the rationale behind the used of an action research design for this study was that, action research provides immediate solutions for local problems (Awanta &

Aseidu, 2008). The other rational for using an action research design for this study is that, it provided the researcher with the opportunity to use diverse research instruments, such as questionnaires and test items to collect the appropriate data about the students under the study. It helped the researcher designed appropriate questionnaires items and test items for the pre-test and post-test, to help improve the mathematics performance related challengers among students in SHS in the Wa municipality of the Upper West Region. The study demography is a local community and therefore needed local solutions.

In conclusion, an action research design was most preferred for the study design because it solves classroom or local school problems through the application of scientific methods (Awanta & Aseidu, 2008).

3.2. Population

According to Ilker, Sulaiman and Rukayya (2016), population can be referred to as the total quantity of things or cases which are the variables of the study. Further, Serebuor (2013) describes population as a group of elements or cases, whether individuals or objects that fit a particular criterion under which the researcher may wish to generalize the study. The researcher chose to conduct the study into students' achievement in geometry and in effect core mathematics, find the determinant and the way forward from the Upper West Region (Wa municipality) because, the WASSCE pass rate from 2006 to 2018 according to the Ghana Education Service (2018) sector performance report, the region is placed last but third position among all the then ten regions in Ghana.

It is also bounded to Savana region, Upper East region, and Volta region, and then Burkina Faso and Ivory Coast. The students and teachers from these regions

demonstrate similar cultural characteristics especially those from Ghana not forgetting their quest to obtain white color jobs**.**

The population of the senior high schools used in the study demography is shown in table 2 below:

Table 2: Distribution of the participating schools and their population (Form one and two)

Schools	Students Population
BB	723
CC	1200
DD	540
EE	480
FF	956
GG	679
HH	790
Total	5368

Source: Field Data, (2021)

3.3 Accessible population

The accessible population chosen for the study were senior high schools: BB, GG and HH.

Table 3: Distribution of accessible schools and their population

Schools	Females	Males	Students Population
BB	30	30	60
GG	30	30	60
HH	30	30	60
Total	90	90	180

Source: Field Data, (2021)

3.4 Sampling Technique and sample

Sampling is referred to as the act of selecting a part of a population to represent the population under a study (IIker, Sulaiman, Musa & Rukayya, 2016). According to Serebour (2013), ‘‘sampling occurs when a researcher allows each case, usually individuals, to identify their desire to take part in research’’ whereas IIker et al. (2016) defined sample as a portion of a population or universe. Sampling techniques can then be referred to as the method a researcher used in selecting a sample for his/ her study. It was on these grounds; the researcher chose purposive sampling technique and simple random sampling techniques for this study. According to Tongco (2007), purposive sampling is a nonrandom technique that does not need underlying theories. In other words, the researcher decides what needs to be known and set out to find people who can and are willing to provide the information by virtue of knowledge and experience (Bernard 2002, Lewis & Sheppard 2006). Moreover, according to Ilker et al. (2016), purposive sampling technique, also called the judgmental sampling is the deliberate choice of a participant due to the qualities the participant possesses.

Therefore, the justification for selecting the sample (selected schools) was based on similar demographical characteristics, purposive and simple random sampling techniques. The researcher believed; the study sample has represented the entire characteristics of variables under the study. That is, the researcher selected school BB, which is to the East, GG to the North and HH to the South of the upper West region were considered the most appropriate locations capable of measuring the desired attributes of the participants. It is very clear from the sampled population that, data collated is evenly spread and therefore a representation of the population under the study.

The subjects under the study were the male students and female students. According to Serebour (2013), the researcher requires about 30% sample size to provide data significant enough for even simplest kind of analysis. The 30% sample size calculation was selected purposively to consist of three (3) SHS out of the seven (7) SHS for the study to represent 42.9% of the population as required. The sample size comprised of 180 participants (90 male students and 90 female students). For each participating school, thirty (30) students were used (6 students each, from 5 courses). Thirty (30) males and thirty (30) females were selected from each school for the study.

The students from these classes were then randomly chosen to give equal opportunities to possible participants for selection based on Serebour (2013) definition of sampling. During the random sampling of students' data, numbers 'Yes', and 'No' were written on sheets of papers. Students were asked to pick only one of the balloted sheets (from a hat) to determine their chances of been included in the study. If a participant selects 'Yes', balloted sheet, that particular participant qualifies to take part in the study and 'No' to imply, you do not qualify to take part in the study.

3.5 Research Instrument

The researcher adopted questionnaires and test, to collect the female students and the male students' data for the study. According to Roopa and Satya (2012), questionnaires are set of questions used in asking an individual in order to obtain a statistically useful information about a given topic under a study. Questionnaires when properly constructed and administered, become a vital instrument by which a statement can be made about a particular group or people or population. A test on the

other, is a common educational assessment tool, used to systematically measure the quality, ability, skill or knowledge a student possesses against a given standard, whether it is acceptable or not (Adom, Mensah, & Dake, 2020). Hence, the researcher also adopted test items as one of the research instruments for purposes of this study to enable him measure the quality of skill or knowledge a student possesses in geometry.

Further, O'Brien (2001) stated that, action research uses several research tools as the project is conducted. These include, document collection and analysis, participant observation recordings, questionnaires surveys, workshops, focus groups, structured and unstructured interviews and case studies. The researcher, therefore considered the used of questionnaire and test items as the most appropriate research instrument for the study.

Again, a five (5) – point likert scale was adopted (Strongly Disagree= 1, Disagree = 2, Never = 3, Agree = 4, and Strongly Agree =5). The questionnaire was made up of 17 items. It consisted of Appendix A while Appendix B consisted of the Test items. The test item also consisted of five questions items, numbered 1 to 5 all intended to help gather students' data for the study.

To answer research question one (1): Test items in Appendix B, numbered 1 to 5 in the pre-test were used to measure students' gender difference in achievement in geometry. The research instrument adopted in research question 1 was test. The students test scores were analyses using the independent sample t-test (Levene's test) to determine the significance of the difference in achievement in geometry between the female and the male students.

Furthermore, the research instrument for research question two (2) was questionnaires from Appendix A. Questionnaire items, numbered from 1 to 7 were used to determine the student's determinants that influenced the female student's achievement in geometry and core mathematics in general in Wa municipal senior high schools. As such, a five-point likert scale was used to rank the responses. The statistical tool adopted was descriptive statistics. The questionnaires were analyzed using the frequencies and percentages (descriptive statistics) to answer research question two (2).

For research question three (3), a set of questionnaire items, numbered from 8 to 17 were adopted to determine what factors caused by their mathematics teachers influenced the female students' achievement in geometry. A five (5) point performance likert scale was used for research question three (3). Questionnaires according to Roopa et al (2012), makes survey worthwhile, as it may accurately reflect the views and opinions of the participants. The questionnaires were analyzed using the frequencies and percentages (descriptive statistics) to answer research question three (3).

Also, the research instrument used to collect data for research question four (4) was a test. The scores of the female students for both the experimental group and the control group were analyzed using the one sample t-test.

Appendix B contained five (5) pre-test, test items, numbered, 1 to 5, Appendix C contained the post-test items, numbered 1 to 5. However, Appendix D and E contained the marking schemes for the pre-test and the post-test questions respectively.

3.6 Pilot – Testing of Research Instruments

The researcher pilot – tested the research instrument to ascertain the reliability and face to face validity of the questionnaire's relevance of the research questions. The participants for the pilot – testing were male and female students from Wa – TSHS. The reason has been that the pilot - tested schools possessed similar futures (age, home town, academic qualification and gender) as the schools under the study. A total of thirty (30) students were engaged during the pilot testing of the questionnaires. The pilot – test used fifteen (15) female and fifteen (15) male students. Questionnaires were pilot tested because, the useful method for checking questionnaires and ensuring it accurately captures the intended information about the respondent is to pretest among a smaller group of the targeted population (Roopa et al., 2012).

3.7 Testing validity and reliability

According to Gay and Airasian (2003) cited in Assuah (2016) states, reliability is the extent to which an experiment, test or any measuring procedure yields the same result on repeated trials. Validity on the other hand is the degree to which an assessment measures what it is supposed to measure (Kaplan & Saccuzzo, 2012 cited in Assuah, 2016). The researcher solicited some mathematics teachers' views and that of the supervisors to help examine the questionnaires, and the test items content validity, and reliability. This was done to authenticated the questionnaire items, and the test items content validity, and reliability. The purpose was to examine whether the questionnaire items were good enough to answer the research questions before they were administered to the students under the study.

3. 8 Data Collection Procedure

Prior to the collection of the data, the researcher made formal contact with the schools considered for the study. Head of Mathematics departments (HOD) were officially given written letters. Mathematics teachers were delegated by their respective school HOD's to help randomly administer the students' questionnaires to the students' respondents and in some cases, in the presence of the researcher. It was done in manner that minimized the degree of committing errors. The researcher later collected the answered questionnaires from the participated schools.

To collect data for research question 4, the research implemented the intervention strategies suggested by the female students' and then an organized extra class on the topic geometry in the form of a workshop for a focus group for the experimental group. The pre-test and post-test results, before and after the intervention program were analyzed using a t-test.

3.8.1 Pre – Test

The purpose of the pre-test was to have a fair idea of the students basic understanding and ability to solve questions in the topic geometry. The researcher chose the core mathematics topic, geometry, for the pre-test and for the implementation of the intervention program because, it is one of the most examined topics in WASSCE as contained in table 3 below. The test comprised of five (5) questions in geometry with varying degree of difficulty for 20 marks which are listed in Appendix B. Data was collected for further analyzes and actions taken. Appendix D contained the suggested solutions to the pre-test questions.

3.8.2 Intervention Design

The intervention design was solely based on the instructional strategies for teaching and learning. It was used to teach the female student's experimental group with the help of TLMs. The choice of using TLMs during the intervention program was intended to vary the method and engage the students which also gave more opportunities for students to explore and interact. According to Frimpong (2021), the use of TLMs in an instruction enhances understanding and improve performance. Some of the instructional strategies tools use in teaching the female experimental group were:

1. motivating students to focus attention in class
2. monitor and assess learning
3. step-by-step strategy instruction
4. adopted a variety of instructional approaches and learning materials, TLMs
5. Modelling, guided practice and independent practice
6. Given opportunities to be independent and show what they know
7. encourage to self-monitor and self-correct
8. Engage students in reflective practices and workshop.

Whereas the control group female students were taught using the usual traditional method of teaching and learning process.

For systematic presentation and understanding, the topic for the intervention (plane geometry) was divided into three headings:

1. Concept of properties of parallel lines.
2. Identification of parallel lines and transversal lines using the diagram – TLMs projection approach.

3. Application of the diagram-TLMs.

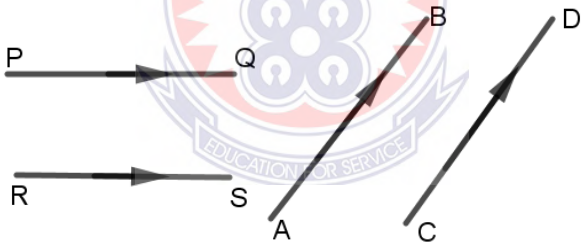
A total of 180 minutes was used to address the problem for the entire intervention implementation period.

3.8.3 Implementation

First Day: The participants were introduced to the concept of parallel lines just for basic understanding of the plane geometry after a brainstorm as follows:

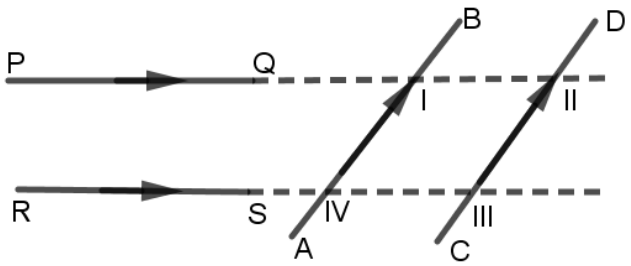
Definition: Parallel lines are lines that keep the same perpendicular distance apart no matter how far they are projected and are directed by the use of an arrow. Transversal lines on the other hand, are straight lines which two or more parallel lines intersect to form an angle as I the diagram below:

- Parallel lines



Activity 1

Guide student to project lines PQ, RS to intersect lines AB and CD respectively at points I and II, IV and III, and determine the parallel lines and nonparallel lines as follows:



Students then proceeded to measure the distance between I and IV, and also II and III. Evidence showed that the distances measured between lines PQ and RS along lines AB and CD were equal regardless of how far they are extended. As such, concluded, Lines PQ and RS are parallel lines. Similarly, distance measured between I and II, and also IV and III along lines PQ and RS were equal. The class also concluded that lines AB and CD were parallel lines however, lines PQ and AB, PQ and CD, RS and AB, and RS and CD were non parallel lines. They also concluded, lines AB and CD were transversal lines to lines PQ and RS respectively and vice versa.

3.8.4 Application of Parallel lines in angles (Plane geometry I)

- **Angles (Relevant previous knowledge)**
- **Types of Angles**

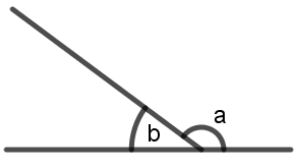
a. **Right Angles:** Right angle is a 90° angles formed when two lines intersect at a point.

b. **Supplementary angles:** Supplementary angles are angles formed by any two adjacent angles whose sum is 180°.

Activity 2

Guide students to:

i. Mark and cut cardboard as in diagram below:

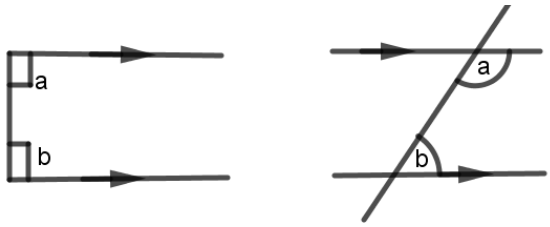


ii. Measure angle a and b with the aid of a protractor

iii. Add angle a and b i.e. $a + b$

iv. Write result down

Activity 3



Guide students to:

i. Repeat steps (i) and (iv) as in activity 2 for activity 3

ii. If in each case measure of $a + b = 180°$ then $a + b$ are supplementary angles. The class also concluded that, the sum of opposite co-interior angles are supplementary. Lecture method changed to Exploratory approach.

Exercise 3.8.4.1

Calculate the angles marked x and y in figures (a), (b) below;

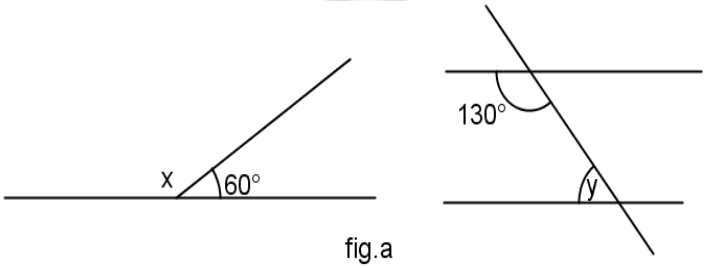


fig.a

Suggested solutions

$< a + < b = 180°$

$\therefore < a + 60° = 180°$ (supplementary angles)

$< x = 180° - 60° = 120°$

Also, $< y + 130° = 180°$ (supplementary angles)

<y = $180° - 130° = 50°$

Students work exercise after every subtopic

Second day:

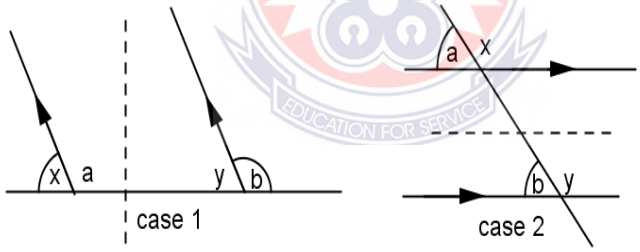
The second day was aimed at helping students to identify parallel lines and apply the properties of angles formed when a transversal line crosses pairs of parallel lines with the aid of the concept(s) learnt previously.

c. Corresponding angles

Definition: Corresponding angles are any two relatively equal angles formed when a transversal line cults at – least two parallel lines.

Activity 4

Consider case 1 and case 2 respectively illustrated below;



Steps

Guide students to:

Case 1

i. Mark and cut cardboard as shown in case 1 and 2

ii. Cut out <a in case 1 and compare it with $< b$ in case 1

iii. Deduce that if angle a = angle b, then $< x =< y$. Hence $< a$ and $< b$ are corresponding angles and $< x$ and $< y$ are also corresponding angles.

Case 2

i. Repeat steps in case 1 for case 2

ii. Students were able to deduced that if $< x =< y$ and $< a =< b$ then $< a$ and$< b$, $< x$ and $< y$ are also corresponding angles.

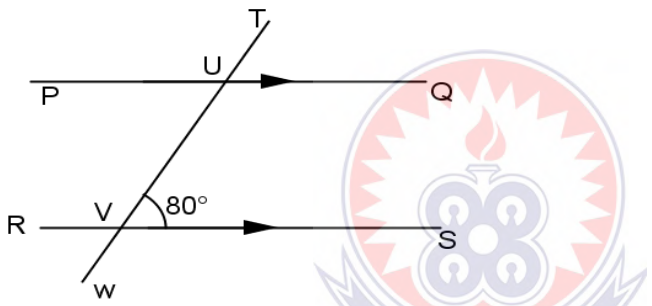
Exploratory approach rather than teacher centred approach

Example 3.8.4.2

Find angle (a) TUQ

(b) QUV

(c) SVW in the diagram below, given that $\overline{PQ}$ // $\overline{RS}$ and angle UVS = 80°



Suggested Solutions

(a) < TUQ $=<$ UVS $=$ 80° (corresponding angles)

(b) $< QUV +< UVS$ = 180° (supplementary <s)

$< QUV$ = 180°$-< UVS$

$< QUV$ = 180° − 80° = 100°

(c) $< SVW + < UVS$ = 180° (supplementary <s)

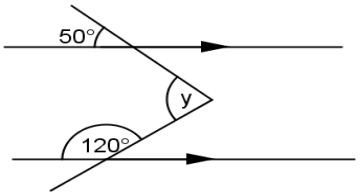
<SVW = 180° − <UVS

$< SVW = 180° - 80° = 100°$ or

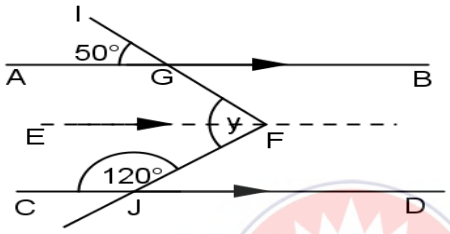
$< SVW =< QUV = 100°$ (corresponding angles)

Exercise 3.8.4.3

Calculate the value y in the diagram below;



Suggested Solution



$< EFJ + < CFE = 180°$ (Supplementary <s)

$< EFJ + 120° = 180°$

$< EFJ = 180° - 120° = 60°$

Also, $< EFG = < AGI = 50°$ (corresponding angles)

But $< EFJ + < EFG = < y$

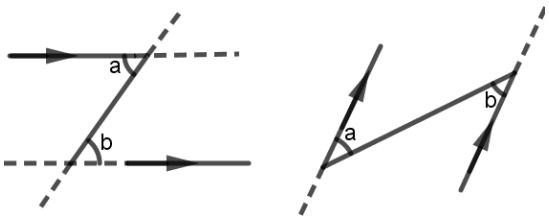
$< y = 50° + 60° = 110°$

Activity 5

d. Alternate angles

Definition: Alternate angles are any two equal angles formed in a Z form.

Let us consider diagram b and c respectively below;



Steps

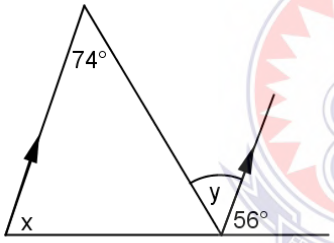
Guide students to:

i. Mark out a card board as shown above

ii. Cut out angle marked a and compare it angle marked b

iii. Deduce that if $< a =< b$ in each of the figures, then $< a$ and $< b$ are alternate angles.

Example 3.8.4.4



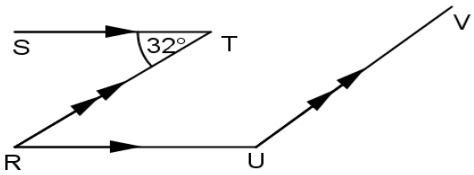
Calculate the values of x and y in the diagram above.

Suggested Solution

$< x = 56°$ (corresponding <s)

$< y = 74°$ (alternate <s)

Exercise 3.8.4.5



In the diagram above $\overline{ST}$// $\overline{RU}$ and $\overline{RT}$// $\overline{UV}$ and $< STR = 32°$, find angle RUV.

Suggested Solution

$< TRU = 32°$ (alternate <s)

$< TRU + < RUV = 180°$ (supplementary <s)

$< RUV = 180° - 32° = 148°$

Third Day:

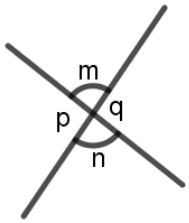
When students become conversant with the approach, the third day was jeered toward the used of concepts learnt in the past days, such as supplementary angles, corresponding angles, alternate angles to facilitate students develop a much more complex concept known as, vertically opposite angles and the sum of interior angles in triangle is 180° and further apply all these concepts in solving more challenging questions involving plane geometry.

e. **Vertically opposite angles**

Definition: Vertically opposite angles are any two opposite equal angles that are directly opposite to each other caused by a cut of a transversal line on one line or more parallel lines.

Activity 6

Consider the diagram below;



Steps

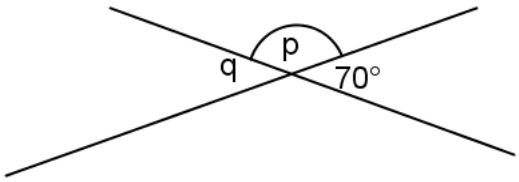
Guide students to:

i. Mark out the diagram on a piece of cardboard as shown above.

ii. Cut out the angle marked m and compare it with$< n$, and then deduced that if $< m =< n$, then$< m$ and $< n$ are vertically opposite angles. Hence$< p =< q$

Example 3.8.4.6

Given the diagram below, calculate the values of (a) $< q$ (b) $< p$



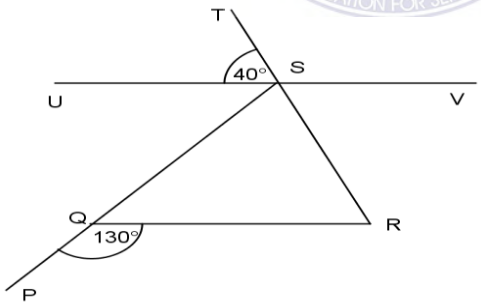
Suggested Solution

(a) $< q = 70°$ (vertically opposite <s)

(b) $< p + 70° = 180°$ (supplementary <s)

$< p = 180° - 70° = 110°$

Exercise 3.8.4.7



In the diagram above $\overline{UV}$// $\overline{QR}$, <PQR = 130° and $< UST$ = 40°.

Find anlge (a) QSR (b) QRS

Suggested Solution

(a) $< PSV = 130°$ (corresponding <s)

$< RSV$ = 40° (vertically opposite <s)

But $< PSV =< QSR+< RSV$

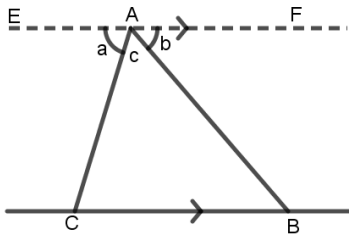
$130° =< QSR + 40°$

$< QSR = 130° - 40° = 90°$

f. Sumof interior angles in quadrilateral triangle is 180°

Actuvity 7

Let us consider diagram below;



From the theorem: $< BAC+< ABC+< ACB = 180°$

Guide students to:

i. identify by applying concepts learnt so far that

(a) $< a + < b + < c = 180°$ (straight angles)

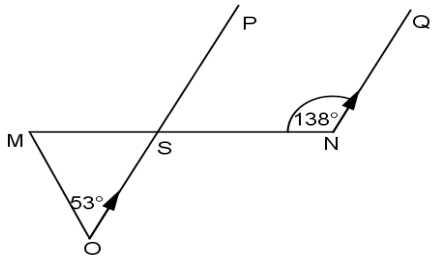
(b) $< ABC = b$ (alternate <s)

(c) $< ACB = a$ (alternate <s) and $< BAC = c$

$< a + < b + < c =< BAC + < ABC + < ACB = 180°$

Hence students concluded that $< BAC + < ABC + < ACB = 180°$

Example 3.8.4.8



In the diagram above $\overline{OP}$// $\overline{NQ}$, MSN is a straight line, $< MOP = 53°$ and $< SNQ = 138°$. Find $< OMS$.

Suggested solution

$< MSP = 138°$ (corresponding <s)

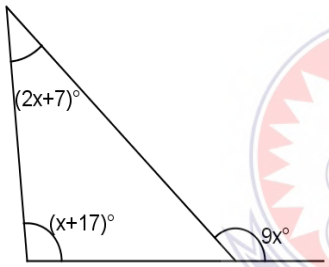
$< OSM = 180° - 138° = 42°$

But $< OMS + < OSM + < MOS = 180°$ (sum of interior <s in a Δ)

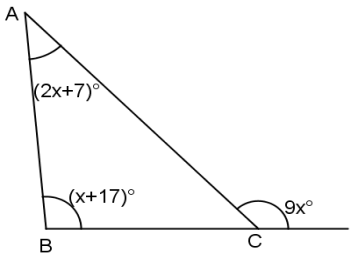
$\therefore < OMS = 180° - (42° + 53°) = 85°$

Exercise 3.8.4.9

Find the value of $9x°$ in the diagram below;



Suggested Solution



$< ACB + 9x° = 180°$ (supplementary <s)

$< ACB = 180° - 9x°$

But $< ABC + < BAC + < ACB = 180°$ (Sum of interior <s in a Δ)

$(2x + 7)° + (x + 17)° + (180° - 9x°) = 180°$

$9x° = (2x + 7)° + (x + 17)°$

$9x° = 3x° + 24°$

$x^{\circ} = 4$

3.8.5 Post – Test intervention

After the three-day implementation process, a post- test was administered to the experimental group to determine whether the intervention has improved female students' performance in core mathematics. Another set of five questions, were given to both the control group and the experimental group to solve within an hour (see appendix C). Suggested solutions are in Appendix E.

3.8.6 Description of Test Items

Question 1

Question 1 objective was to find an angle in a simple diagram. The diagram could easily be identified to consist of parallel lines and transversal lines.

Question 2

The only difference between question 2 and question 1 was that, question 2 involves finding more than two angles.

Question 3

In question 3, the parallel lines and transversal lines were slightly hidden in the diagram that required the student to project some of the lines in the diagram to facilitate the chances of solving the problem.

Question 4

Question 4 shows a blend of techniques in question 3 and other concepts like corresponding angles.

Question 5

Finally, question 5 demands that a student should have been able to solve question 1 to 4 correctly before attempting it. See Appendix B and C.

3.9 Data analysis Procedure

After carefully sorting out the questionnaire items, the field data was categorized, organized, themes formed. Positive Likert rating scale statements were ranked in the following descending order:

Table 4: Coded Positive Likert statements of female students

SA	A	N	D	SD
5	4	3	2	1

The Abbreviations used in the Likert Scale are:

SA – Strongly Agree, A – Agree, N – Neutral, D – Disagree, SD – Strongly Disagree

The field data was analyzed using Statistical Package of Social Science (SPSS) version 16.0 SPSS. The statistical analysis such as frequencies and percentages were used to answer the research questions. The Statistical tool used for the analysis during the study was the descriptive statistics (using frequencies and percentages), and independent sample t-test (Levene's test) and the one sample t-test at alpha value $\alpha = 0.05$ significant level. The Means represented the average value of the distribution. Standard deviation, according to Fields (2005), measures how far the data values deviates away from the mean. The smaller the standard deviation relative to mean value, implied that the data points were closer to the mean value. This meant the instrument was more efficient and effective.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Overview

This chapter is divided into two parts. The first part delved into data presentation, the second part involved data analysis and discussion of the findings. This chapter used the data analyzed to answer, the four research questions designed in chapter 1.

4.1 Data Presentation

4.1.2 Demographic Attributes of Respondents

Table 5 below shows the regional distribution of the participated students. The table indicated which regions most of the students in the senior high schools in Upper West region especially the municipality under the study come from.

Table 5: Regional Distribution of Students

Regions	Frequency	Percentage (%)
Upper West	124	68.9
Savannah	32	17.8
Bono	8	4.4
Upper East	10	5.6
Others	6	3.3
Total	180	100

Source: Field Data, (2021)

In Table 5, the sample size used for the study of students was 180. It also, revealed that most of the students were admitted from the Upper West region. The communities, the students came from included: Wa Zongo, Charia, Duccie, Jirapa, Kambale, Hamile, Zingu, Kunturo, Kaleo, Bichemboi, Tumu, GA, Gurungu,

Maakoteng, Charingu, Wa, Dondoli, Salimaana, Kambali, Kokoligu and Gadi representing 68.9% (n = 124) more than the students who came from the Savannah Region, 17.8% (n = 32). The study also revealed that, the Savannah region which came second, had most of its students were from a community called Sawla, and it shares boundary with the Upper West region.

The table further showed that, Upper East region contributes about 5.6% (n =10) of the students to placed third highest in the regional distribution of students while Bono region came forth representing 4.4% (n = 8) and 3.3% (n = 6) representing the other regions.

Table 6: Age Distribution of Students

Age groups	Frequency	Percentage (%)
10 – 13	43	23.9
14 – 17	98	54.4
18 – above	39	21.7
Total	180	100

Source: Field Data, (2021)

Table 6 above represents the age distribution of the respondent students. It showed a clear view of the ages of the respondents under the study.

From the table, the populous age group of students under the study was the age group, 14 – 17 to represent about 54.4% (n = 98) of the students under the study. Age group, 10 – 13 came second and represented about 23.9% (n = 43) while the least populated age group was the 18 and above to represent 21.7% (n = 39) of the total students 100% (n = 150) who took part in the study.

Table 7: Gender Distribution of Students

Gender	Frequency	Percentage (%)
Males	90	50
Females	90	50
Total	180	100

Source: Field Data, (2021)

The gender distribution shown in Table 7 shows that, there were equal representation of males and female students under the study. The gender distribution of females was 90 (50%) and 90 (50%) representing males. Based on females to males' ratio been 1: 1, data from the study gives the researcher the appropriate opportunity to measure the gender differences in mathematics performance as well as the girls' performance in mathematics within the study area.

4.2 Analysis and Discussion of Results

Part two of this chapter is focused on the data presentation, the analysis and discussions. The researcher in this part, provided answers to the four research questions under the research topic, 'Examining female students achievement in geometry using instructional strategies approach: the determinants and the way-forward in SHS.

Research Question One: What is the difference in the achievement in geometry between the female and male students' in Senior High Schools?

The aim of this research questions is to examine exactly, whether there existed any significant difference in achievement in geometry between the female students and the male students. The male students' achievement was used in research question one just for purposes of helping the researcher to examine the female student's

achievement in geometry. The independent sample t-test was used to analyzed the data.

H_0: Equal variance assumed,

H_1: Equal variance not assumed

Decision Rule: Reject H_0, if t-value < 0.05 or P-value < 0.05

Therefore, the hypothesis for testing the differences in achievement in geometry between the female and male students is stated below and concluded using the results of Levene's test and the t-test.

H_0: There is no difference differences in the achievement in geometry between the female and male students.

H_1: There is a difference differences in the achievement in geometry between the female and male students.

Table 8: Frequency table for the scores of male and female students for School BB

Scores	Number of female students	Number of male students
1 – 5	28	26
6 – 10	2	3
11 – 15	0	1
16 – 20	0	0

Source: Field Data, (2021)

Table 9: Group Statistics of the test scores of male and female students for School BB

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
School BB Test Scores	Female	6	1.00	.000	.000
	Male	9	1.11	.333	.111

Table 9 shows the number of male and female students, means and standard deviations of scores obtained. The male students (M = 1.11, SD = 0.333) had mean slightly higher than their female students (M = 1.00, 0.000). According to Fields (2005), standard deviations only measure how far the data values deviate away from the mean.

Table 10: Descriptive Statistics of the independent sample t-test scores of male and female students for School BB

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tail)	Mean Difference	Std. Error Difference	Lower	Upper
School BB Test Scores	Equal variances assumed	3.396.	.088	-.806	13	.435	-.111	.138	-.409	.187
	Equal variances not assumed			-1.00	8.00	.347	-.111	.111	-.367	.145

From Table 10, the significant value is 0.088 and the alpha level is 0.05 which means that the significant value is greater than the alpha level. This means that the column labelled equal variances assumed's t-value is chosen. Also, the significant (2-tailed) value is 0.435 which implies that it is greater than the alpha level of 0.05; hence there is no statistically significant difference in achievement in geometry between male and female students as such we failed to reject the null hypothesis though the t-test conducted revealed males (M = 1.11, SD = 0.333) achieved higher means in geometry than the females (M =1.00, SD = 0.00); t(13) = 0.806, P = 0.435 (two-tailed) because

that does not necessarily indicates that the male students did better than the male students. This result showed both male and female students have no difference in achievement in geometry for t(13) = 0.806, P = 0.435 at alpha level 0.05 and that is in accordance with Tetteh et al. (2018) revelation that there is no difference among male and female's in mathematics achievement. However, it contradicts Mullis' (2004) study that male advantage in mathematics performance is a universal phenomenon. The results in this work therefore indicated that there was no statistically significant difference in achievement in geometry between the male and the female students.

Table 11: Frequency table for the male and female students text scores for School GG

Scores	Number of female students	Number of male students
1 – 5	27	23
6 – 10	3	6
11 – 15	1	1
16 – 20	0	0

Source: Field Data, (2021)

Table 12: Group Statistics of the male and female students text scores for School GG

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
School GG Test Scores	Female	6	1.83	2.041	.833
	Male	6	1.17	.408	.167

Table 12 shows the number of male and female students, means and standard deviations of scores obtained. The male students (M = 1.17, SD = 0.408) had mean slightly lower than the female students (M = 1.83, 2.041).

Table 13: Descriptive Statistics of the independent sample t-test scores of male and female students for School GG

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					
								95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
School GG Test Scores	Equal variances assumed	3.846	.078	.784	10	.451	.667	.850	-1.227	2.560
	Equal variances not assumed			.784	5.399	.466	.667	.850	-1.470	2.804

From Table 13, the significant value is 0.078 and the alpha level is 0.05 which means that the significant value is greater than the alpha level. This means that the column labelled equal variances assumed's t-value is chosen. Also, the significant (2-tailed) value is 0.451 which implies that it is greater than the alpha level of 0.05; hence there is no statistically significant difference in achievement in geometry between male and female students as a result we fail to reject the null hypothesis though the t-test

conducted revealed males (M = 1.17, SD = 0.408) do not have higher level of achievement in geometry than the females (M = 1.83, 2.041); t(10) = 0.784, P = 0.451 (two-tailed). This result showed both male and female students have no difference in achievement in mathematics and that is in accordance with Tetteh et al. (2018) study findings that there was no gender difference among the pre – service mathematics teachers in colleges in the Brong – Ahafo region of Ghana. Therefore, the results showed that there was no statistically significant difference in achievement in geometry between the male and the female counterparts.

Table 14: Frequency table for the male and female students text scores for School HH

Scores	Number of female students	Number of male students
1 – 5	27	26
6 – 10	3	2
11 – 15	0	2
16 – 20	0	0

Source: Field Data, (2021)

Table 15: Group Statistics of the male and female students text scores for School HH

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Students Test scores	Female	6	1.00	.000	.000
	Male	8	1.12	.354	.125

Table 15 shows the number of male and female students, means and standard deviations of scores obtained. The male students (M = 1.12, SD = 0.354) had mean slightly higher than the female students (M = 1.00, 0.00).

Table 16: Descriptive Statistics of the independent sample test scores of male and female students for School HH

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					
								95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
School HH Test Scores	Equal variances assumed	4.00	.069	-.857	12	.408	-.125	.146	-.443	.193
	Equal variances not assumed			-1.000	7.00	.351	-.125	.125	-.421	.171

From Table 16, the significant value is 0.069 and the alpha level is 0.05 which means that the significant value is greater than the alpha level. This implies the column labelled equal variances assumed's t-value is chosen. Also, the significant (2-tailed) value is 0.408 and it is greater than the alpha level of 0.05; hence there is no statistically significant difference in achievement in geometry between male and female students as a result we failed to reject the null hypothesis though t-test

conducted revealed males (M = 1.12, SD = 0.354) have higher level of performance in mathematics than females (M =1.00, SD = 0.00) t(12) = 0.857, P = 0.408 (two-tailed), however does not necessarily imply that the males did better than the female students.

In conclusion, the findings from the study in all the three schools under the study, showed that there was no statistically significant difference in achievement in geometry between the male and the female students as such researcher concluded there was no statistically significant difference in achievement in geometry between the male and the female students i.e. that is $p > 0.05$ i.e. for school BB: $0.435 > 0.05$, $t(13) = 0.806$; School GG: $0.451 > 0.05$, $t(10) = 0.784$; and for school HH: $0.408 > 0.05$, $t(12) = 0.857$. And this study findings support a Tetteh et al. (2018) study, that there is no difference among male and female's in mathematics achievement though it contradicts Habtamu (2016) study on grade 10 students' achievement in mathematics that revealed, male students to have achieved better scores than the female students in mathematics.

Research Question Two: What student determinants influence female students' achievements in geometry than the male students?

The objective of research question two was to determine the determinants (student's causative factors) that significantly influenced female students' achievement in geometry. The researcher therefore used the questionnaire items in Table 17 and its summary in Table 18 below to enable him measure female student's responses on each item using the likert scale. The sample size used for both Table 17 and Table 18 was 90 each. Their responses were recorded in Table 17 as follows:

Table 17: Responses of Student Determinants that Influenced Female students Achievement in Geometry and Core Mathematics in General Using the Likert Performance Ranking Scale

Factors	SA	A	N	D	SD
1. Geometry is difficult for me to understand	77(85.5%)	7(7.8%)	5(5.6%)	0(0.0%)	1(1.1%)
2. I hardly practice questions in geometry on my own	85(94.4%)	3(3.3%)	0(0.0%)	1(1.1%)	1(1.1%)
3. Weak fundamentals in geometry and in mathematics	79(87.8%)	10(11.1%)	1(1.1%)	0(0.0%)	0(0.0%)
4. lack confidence in learning geometry	86(95.6%)	2(2.2%)	0(0.0%)	1(1.1%)	1(1.1%)
5. Geometry/ mathematics is for male and not both male and female students	88(97.8%)	1(1.1%)	0(0.0%)	0(0.0%)	1(1.1%)
6. feel lazy and lack interest to learn geometry/ mathematics	89(98.9%)	0(0.0%)	0(0.0%)	0(0.0%)	1(1.1%)
7. I will marry after completing SHS as such I am not motivated enough to pass mathematics	25(27.8%)	30(33.3%)	17(18.9%)	13(14.4%)	5(5.6)

Source: Field Data, (2021)

Findings in table 17 above, show the female students' responses on the determinants perceived to have influenced their achievement in geometry and as consequence mathematics in general. Therefore, the researcher intended to determine those similar characteristics, female students considered to have greatly affected their achievement in geometry and for that matter mathematics in general compared with the male students.

With this in mind, the number of female students who strongly agreed that geometry is difficult to understand was 77 representing 85.5%, 7(7.8%) agreed, 5(5.6%) remain neutral while no female students disagreed. However, one female representing 1.1% strongly disagreed that geometry is difficult to understand. This implies, most of the female students in the study strongly held the view that geometry and to extend geometry is difficult to understand 77(85.5%) and hence negatively affected their achievements. This goes to concur on Munn (2009), findings that a lot of people hold the perception that mathematics is a dry and a difficult subject full of abstract things. The findings further reiterated; a students' attitude determines the amount of efforts likely to put in learning a subject. For instance, a student who likes geometry is more likely to learn geometry and increase the opportunities of performing well in the geometry than a student who dislikes the very subject (Munn, 2009). Noraini, 2006 and Aysen (2012), findings affirmed the present study findings that, the learning of geometry concepts in mathematics is difficult for the female students. Hence, the findings that geometry and that matter mathematics is difficult to understand demotivates the female students and do not enable them grasp the concepts in geometry (Telima, 2011; cited in Fabiri, 2017).

Furthermore, while 85(94.4%) of the female students strongly agreed that they hardly learn geometry on their own, 3(3.3%) agreed, no female student took a neutral position on the questionnaire item, one female student disagreed to represent 1.1%, just as one (1) other colleague female students who strongly disagreed that she hardly learns geometric questions on her own. Findings from this item also revealed that, majority of the female students strongly agreed that they hardly practice geometry on their own. This, contributed significantly to their nonperformance in geometry and

mathematics in general. These evidence goes to affirm the findings that students who hardly practice mathematics, do not do well in mathematics (Serebour, 2013).

Again, the researcher wanted to know whether female students hold the feeling that, they had weak foundations in geometry, and whether it affects their achievement in mathematics. Based on this, 79 of the female students representing 87.8% strongly agreed that they had weak fundamentals in geometry, 10(11.1%) agreed, only 1 stayed neutral to represent 1.1% while no female student neither disagreed nor strongly disagreed that they had weak fundamentals in geometry. The findings have shown that, female students' poor achievement in geometry was significantly affected by their weak fundamentals. According to Colleges of Education Examinations (2008; 2009) report, majority of the students who underperformed in mathematics in their basic education department end of semesters' examination were students who were admitted to the university with very weak mathematics grades. This concur with the findings and that a student who have weak fundamentals in geometry is highly likely to score weak grades or perform poorly in the subject core mathematics. Hence, also explained why female students hardly practiced geometry and core mathematics in general.

Moreover, on questionnaire item 4 in table 17, 86(95.6%) of female students strongly agreed that, female students lack confidence in learning geometry, 2(2.2%) agreed, no female students stayed neutral whereas 1 (1.1%) disagreed and 1(1.1%) also strongly disagreed that they lack confidence in learning geometry. This implies, majority of the female students strongly held the view that, female students lack confidence to learn geometry and invariably affects their achievement in geometry and core mathematics in general. Confidence in teaching connotes positive learning outcomes.

According to Acer and Gözen (2019), the most pressing problem of the classroom teacher is how to build confidence. In examining the effect, confidence has on students' achievements proposed the following suggestions: mathematics teachers should encourage the student gently, adopt picture referral and that teachers teach teacher made examples. This, only affirmed the impact, lack of confidence in a student has on academic achievements.

Findings from questionnaire item 5 in table 13 revealed, that 88 female students representing about (97.8%) of the female students strongly agreed that geometry is the preserve of males and not both males and females. Also, only one (1) female student representing 1.1% agreed on the item and 1 (1.1%) strongly disagreed while the no female student held a neutral view nor disagreed that geometry and that matter mathematics is for the male students and not meant for both genders. With these findings, the researcher therefore stated that, female students hold the believed that geometry (mathematics) is for males and not female students. This goes to support strongly held students' existing perception that, geometry (mathematics) is the preserve of male students. The study finding therefore supports Cheryan et al. (2015) study about gender identity, mathematics gender-stereotypes, mathematics self-concepts, and mathematics achievement of Singaporean elementary students, showed that mathematics self-concepts were positively related to mathematics achievement and that mathematics-gender stereotypes were significantly related to mathematics achievement (cited in Peteros et al. 2020).

Also, in reference to Table 17 item number 6, findings showed that aside one (1) female students who strong disagreed that female students feel lazy and lack interest to learn geometry, the remaining 89 representing about 98.9% of the female students

strongly agreed, that female students feel lazy and lack interest to learn geometry (mathematics). The results have shown, on the average that majority of the female students feel lazy and are not motivated to learn geometry and it supports Wilmot (2009) findings that female students are not encouraged enough to develop interest in the learning of geometry and that it affects achievements.

Lastly, the researcher also wanted to know whether harboring the idea that, a female student will marry after completing SHS affects her motivation towards learning geometry. Responses revealed that, 25(27.8%) females strongly agreed that they will marry after completing SHS and are not motivated to learn mathematics, 30(33.3%) agreed, 17(18.9%) remained neutral, 13(14.4%) disagreed while 5(5.6%) strongly disagreed that they will marry after completing SHS and hence it does not demotivate them to learn. This implies, most female students do believe they will marry after completing SHS as a consequence affected their motivation to learn geometry and mathematics as a subject.

To further make the analysis very clear and meaningful, the researcher interpreted each questionnaire item in Table 9, by grouping likert items into agreed responses and disagreed responses. Agreed responses consisted of the percentage sum of Strongly Agreed, Agreed and Neutral while disagreed responses comprised of the percentage sum of neutral, disagreed and strongly disagreed. The main objective is to determine the exact perspective of the female students in each item in Table 17 whether on the average they agreed or disagreed with the questionnaire item. See Table 18 below:

Table 18: Summary of Responses from Table 17 on Student's Determinants that Influenced Female students Achievement in Geometry and Core Mathematics in General into Agreed and Disagreed Responses

Factors	Agreed Responses	Disagreed Responses
1. Geometry is difficult for me to understand	89(98.9%)	6(6.7%)
2. I hardly practice geometry on my own	88(97.8%)	2(2.2%)
3. Weak fundamentals in geometry	90(100%)	0(0.0%)
4. lack confidence in learning geometry	88(97.8%)	2(2.2%)
5. Geometry/ core mathematics is for males	89(98.9%)	1(1.1%)
6. feel lazy and lack interest to learn geometry	89(98.9%)	1(1.1%)
7. I will marry after completing SHS as such I am not motivated enough to pass core mathematics	72(80%)	35(38.9%)

Source: Field Data, (2021)

From table 18, evidence have shown, the clear intention of all the female students who participated in the study on the average, agreed that their achievement in geometry is influenced by the aforementioned perceived factors. In conclusion, from item 1 to 7 in table 18 findings from the female students' responses indicate all female students agreed on all questionnaire items. Hence, the factors female students agreed on to have influenced their achievement in geometry were: geometry (mathematics) is difficult to understand, they hardly practice geometry on my own, weak fundamentals in geometry/ core mathematics, lack confidence in learning geometry, geometry (core mathematics) is for males and not both males and females (mathematics is a preserve of males), they feel lazy and lack interest to learn geometry and that the idea that they will marry after completing SHS do not motivated them to learn. These findings

confirmed other research findings such as Peteros et al. (2020), Frimpong (2021), Churcher et al. (2015) and Bandura (2001).

Table 19: Responses of Student Determinants that Influenced Male students Achievement in Geometry and Core Mathematics in General

Factors	SA	A	N	D	SD
1. I find geometry difficult to understand	10(11.1%)	19(21.1%)	0(0.0%)	41(45.6%)	20(22.2)
2. I hardly practice geometry on my own	12(13.3%)	17(18.9%)	0(0.0%)	33(36.7%)	28(31.1%)
3. I have weak fundamentals in geometry	34(37.8%)	44(48.9%)	0(0.0%)	8(8.9%)	4(4.4%)
4. I lack confidence in learning geometry	7(7.8%)	15(16.7%)	0(0.0%)	38(42.2%)	30(33.3%)
5. Geometry/ mathematics is for males not females	37(41.1%)	45(50.0%)	0(0.0%)	5(5.6%)	3(3.3%)
6. I feel lazy and lack interest to learn geometry	0(0.0%)	9(10.0%)	0(0.0%)	35(38.9%)	46(51.1%)
7. I will marry after completing SHS and not motivated enough to learn	6(6.7%)	11(12.2%)	1(1.1%)	30(33.3%)	42(46.7%)

Source: Field Data, (2021)

The researcher in Table 19 intended to find out the male's perspective on each questionnaire items, whether the male students also hold the same view point and measures equal effect just as the female students at the same magnitude. The researcher therefore used the same questionnaire items as in table 17 to measure the male students' responses to each likert scale ranking.

Findings from item 1 showed that, out of the 90 male students, 10 male students representing about 11.1% strongly agreed that geometry (mathematics) is difficult to

understand, 19(21.1%) agreed, no male student stayed neutral, 41(45.6%) disagreed while 20(22.2%) strongly disagreed that geometry (mathematics) is difficult to understand. All male students were very clear in their responses because there existed no neutral participant deviates the research findings by Munn (2009) that students in general, belief that geometry (mathematics) is difficult. Perhaps this contrary male student's specific findings that geometry (mathematics) on the average, is not difficult supports the study that students who strongly hold positive attitude towards geometry and mathematics related achievements, perform better than students who had negative perception about mathematics and explained why the male students perform better than the female students (Peteros et al., 2020).

Again, item 2 was designed to measure male students' attitude on how often they learn geometry. The findings revealed that, 12 male students representing about 13.3% strongly agreed that they hardly practice geometry, 17 male students representing 21.0% agreed, no male was undecided, 33(36.7%) disagreed while 28 male students representing 31.1% strongly disagreed on the questionnaire item, that male students hardly practice geometry (mathematics). The findings showed that, male students on the averagely disagreed they hardly practice geometry (mathematics). According to Churcher et al. (2015) study, constant engagement in doing more mathematics exercises improves students' achievements. It is therefore evident why the male students continue to perform better than the female students.

Similarly, out of the 90 male students used in the study, 34 males representing about 37.8% strongly agreed that they have weak fundamentals in geometry, 44(48.9%) agreed, no male student stayed neutral, 8(8.9%) disagreed whereas 4(4.4%) male students strongly disagreed that male students have weak fundamentals in geometry.

Evidence is that male students are of the view that they have weak fundamentals in geometry (mathematics). This support the WAEC (2017; 2018) chief examiners' report that a significant number of students demonstrated weak understanding in answering mathematics questions. This result also explained why students' achievement in geometry (mathematics) within the study demographics is poor apart from the Northern and Upper East regions and it does not in any way deviate from the findings that, male students perform better than the female students and that the demographics of the student influence the fundamental mathematical content knowledge acquisition and performance (Alhajraf, 2014). Further, evidence from this study affirms Dennis et al. (2018) findings, that student's geometric achievements in the SHS is influenced by weak mathematics admission grades and weak mathematics foundations.

In addition, the researcher also used questionnaire item 4 to determine the confidence level of male students toward their achievement in geometry. The finding indicated, only 7 out of 90 male students representing 7.8% strongly agreed that they lacked confidence in learning geometry, whereas 15 male students representing about 16.7% agreed and no student stayed neutral. However, a significant number of male students representing 38(42.2%) disagreed while 30(33.3%) strongly disagreed that they lacked confidence to learn geometry. A study by Baah-Korang et al. (2015), cited lack of confidence in female students in the study or participation of mathematics related programmes as compared to the males, is affirmed by this study findings that, male students are more confident in learning geometry (mathematics) than the females.

Moreover, 37 male students representing about 41.1% strongly agreed on item 5 that geometry (mathematics) is for male students and not female students, 45 (50.1%)

agreed, 5(5.6%) disagreed, and 3(3.3%) strongly disagreed on the questionnaire item that geometry (mathematics) is for males and not female students. Interestingly, all the 90 male students were very resolute in their responses as no male student stayed neutral or undecided. Many findings, according to Asante (2010) support the findings that male students appear to perform better than female students in mathematics achievements, contrary to Yarkwah (2020) findings, which stated that female students who took part in that study did not hold the view that mathematics is the for male students' and not female students.

Further, male students' response on whether they feel lazy and lack the interest to learn mathematics, the study revealed that, no male students strongly agreed, 9(10.0%) agreed on it, no male students remain undecided, 35(38.9%) disagreed while 46 male students representing 51.1% strongly disagreed with the statement that male students feel lazy and do not have the interest to learn mathematics. The perspective of male students in this questionnaire item, was that males averagely disagreed that they lacked interest to learn geometry, perhaps explained why the male student's achievement in geometry is better than the female students in achievement and it also affirms Lockheed (1991) study cited in Etsey (2005) that, the lack of interest and motivation results into poor attendance and lack of commitment by students affect the academic achievements.

Finally, the researcher also wanted to find out the impact of harboring the idea they will marry after completing SHS has on male students' motivation towards learning. Responses revealed that, 6(6.7%) strongly agreed that they will marry after completing SHS and are not motivated to learn mathematics, 11(12.2%) agreed, 1(1.1%) remained neutral, 30(33.3%) disagreed while 42(46.7%) strongly disagreed

that they will marry after completing SHS and hence it does not demotivate them to learn. This implies, most male students do not believe they will marry after completing SHS as such it does not influence their motivation to learn mathematics.

Further, the researcher interpreted each questionnaire item in Table 19 by grouping likert items into two groups to further give a clear picture of the responses. Agreed responses to consist of the percentage sum of Strongly agreed, Agreed and Neutral while Disagreed responses comprised of the percentage sum of Neutral, Disagreed and Strongly disagreed. The main objective is to determine in a larger scale, the exact perception (thought) of the male students in each item in Table 19 whether on the average they agreed or disagreed with the questionnaire items. See Table 20 below.

Table 20: Summary of Responses on Students Determinants that Influenced Male students Achievement in Geometry and Core Mathematics in General into agreed responses and disagreed responses

Factors	Agreed	Disagreed
1. Geometry is difficult for me to understand	29(32.2%)	61(67.8%)
2. I hardly practice geometry on my own	29(32.2%)	61(67.8%)
3. I weak fundamentals in geometry	78(86.7%)	12(13.3%)
4. Lack confidence in learning geometry	37(24.5%)	68(75.5%)
5. Geometry (mathematics) is for boys and not both male and female	82(91.1%)	8(8.9%)
6. I feel lazy and lack interest to learn geometry	9(10.0%)	81(90.0%)
7. I will Marry after completing SHS as such I am not motivated enough to learn	18(19.0%)	72(81.0%)

Source: Field Data, (2021)

Results from table 20 shows that except for question item 3 and 5, all the male students who took part in the study on the average, disagreed with all the questionnaire items.

In effect, evidence from the study have shown that the determinants that influenced female students in achievement in geometry are largely determinants attributable to the female student's self-concept theory about themselves toward the topic geometry. These determinants support Peteros et al. (2020) findings that, the differences in gender and it associated attributes significantly influenced student's achievement in mathematics and that matter geometry.

In conclusion, according the present study findings, the student's determinants that influenced the female student's achievement in geometry were:

i. Female student's do not frequently practice geometry
ii. Female student's lack confidence in learning geometry and that matter mathematics
iii. Female students feel lazy and lack interest to learn geometry
iv. Female student's desire to marry after completing SHS impact on their achievement in geometry and mathematics.
v. geometry and core mathematics in general, is the preserve of male students and not female students.
vi. they have weak fundamentals in geometry
vii. geometry is difficult to learn.

Research Question Three: What mathematics teacher determinants do female students perceive to influence their achievements in geometry?

The objective of research question three (3) is to find what mathematics teacher determinants (factors caused by mathematics teachers), the female students perceived influence their achievement in geometry in SHS. Table 21 below is a five-point likert used to obtain female students' response to help answer the research question three Female student's responses were revealed in Table 21 below:

Table 21: Responses of Determinants Caused by Mathematics Teachers that Female Students Perceive to Influence Their Achievements in Geometry

Factors	SA	A	N	D	SD
8. Mathematics teachers should vary teaching methods	70(77.8%)	20(11.1%)	0(0.0%)	0(0.0%)	0(0.0%)
9. Mathematics teachers should regularly give exercises	90(100%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
10. Mathematics teachers should revise on the topic before coming to teach	90(100%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
11. Mathematics teachers should motivate female 12. students to learn geometry (mathematics)	60(66.7%)	28(31.1%)	2(2.2%)	0(0.0%)	0(0.0%)
13. Mathematics teachers should pay attention to female students achievement in a class	47(52.2%)	30(33.3%)	11(12.2%)	2(2.2%)	0(0.0%)
14. Mathematics teachers 15. should organized extra classes for students	70(77.8%)	19(21.1%)	1(1.1%)	0(0.0%)	0(0.0%)
16. Mathematics teachers should ask females questions during lessons	20(22.2%)	39(43.3%)	23(25.6%)	6(6.7%)	2(2.2%)
17. Female students should be given role models or mentorship	31(34.4%)	44(48.9%)	4(4.4%)	7(7.8%)	4(4.4%)
18. Should organized mathematics workshops regularly for females	80(88.9%)	10(11.1%)	0(0.0%)	0(0.0%)	0(0.0)
19. Mathematics teacher should adequately complete mathematics syllabus before end of terms/ WASSCE	49(54.4%)	37(41.1%)	0(0.0%)	4(4.4%)	0(0.0%)

Source: Field Data, (2021)

Table 22: Summary of the Response from Table 21 on Determinants Caused by Mathematics Teacher that Female Students Perceive to Influence their Achievements in Geometry into agreed responses and disagreed responses

Factors	Agreed Responses	Disagreed Responses
1. Mathematics teachers Should vary teaching methods	90(100%)	0(0.0%)
2. Mathematics teachers should regularly give exercises	90(100%)	0(0.0%)
3. Mathematics teachers should revise on the topic before coming to teach	90(100%)	0(0.0%)
4. Mathematics teachers should motivate female students to learn geometry (mathematics)	88(97.8%)	0(0.0%)
5. Mathematics teachers should pay attention to female student's achievement in a class	77(85.5%)	2(2.2%)
6. Mathematics teachers should organize extra classes for students	89(98.9%)	0(0.0%)
7. Mathematics teachers should ask females questions during lessons	59(65.5%)	8(8.9%)
8. Female students should be given role models or mentorship	75(83.3%)	11(12.2%)
9. Organized mathematics workshops regularly for female students	90(100%)	0(0.0%)
10. Mathematics teachers should adequately complete the core mathematics syllabus or geometry topic before the end of term/ WASSCE	86(95.5%)	4(4.4%)

Source: Field Data, (2021)

In table 21 item 8 responses showed, 70 female students representing about 77.8% strongly agreed that, mathematics teachers should vary their teaching methods, 20(11.1%) agreed while no other female students held a contrary view. From the summary responses in Table 22, all 90 female students agreed that mathematics teachers should vary their teaching method. This implies that, the female students were of the view that mathematics teachers should vary their teaching methods in order to improve upon their achievement in geometry. According to Bush (2009), the content of mathematics for the past thirsty years has changed and that mathematics teachers should vary their teaching methods especially to a more interactive approach that enhanced mathematics achievement (problem -solving skills) than the traditional lecture method mostly practiced in the classrooms and it supports the female students view that mathematics teachers should vary teaching methodologies. Further, Thompson and Chappell (2007) findings opined that mathematics teachers should engage students through varied teaching and learning methodologies and that it enables the student to understand and communicate mathematical ideas effectively (cited in Assuah, 2011).

Again, findings have shown that all 90 (100%) respondent female students strongly agreed that mathematics teachers should regularly give exercises in order to help improve their achievement in geometry. From the summary responses in Table 22, all 90 female students agreed that mathematics teachers should regularly give exercises. This study findings, supports Serebour (2013) study findings, that mathematics teachers should regularly give exercises and then recommended that mathematics teachers should regularly give exercises to students to help improve students core mathematics achievement and that of Churcher et al. (2015) study findings that,

constant engagement in doing more mathematics exercises improves students' achievements.

Also, evidence in item 9 in Table 21 shows that all the 90 female students held the view that mathematics teachers should always research or revise on the subject matter they are to teacher before they teach. According to Ponte (2008), although possession a strong content knowledge does not in itself guarantee that a mathematics teacher would be effective, however it is difficult to state that a mathematics teacher can facilitate a student to acquire deeper understanding when he, the mathematics has inadequate content knowledge. This assertion by Ponte supports the study findings that mathematics teachers need to revise on the topic they want to teach in order to improve upon their content knowledge and instructional skills to enhance teaching and learning processes. Again, Thames et al. (2010), stated that poor mathematics instruction is a consequence of lack of adequate content knowledge is consequence of inadequate prepare and hence impact negatively on students understanding in geometry and mathematics in general.

Further, from Table 21, 60(66.7%) of female students strongly agreed that mathematics teacher should encouraged/ motivated them to learn geometry. Whereas 28(31.1%) agreed, 2(2.2%) stayed neutral while no one disagreed that mathematics teachers do not encouraged/ motivated female students to learn geometry (mathematics). From the summary responses in Table 22, 88(97.8%) female students agreed that mathematics teachers should encourage and motivate them to learn geometry whereas 0(0.0%) disagreed. This implies, female students were of the view that their achievement in geometry could be improved if their mathematics teachers encourage them. According to Tetteh et al. (2018), stated that motivation is a

significant determinant that influence a student's achievement and that students and teachers be motivated in order to enhance student's mathematics achievement. This assertion supports the female students view that, the inability of a mathematics teacher to motivate female students influence their achievements in geometry.

Further, the findings have shown that, 47 female students representing about 52.2% female students strongly agreed that mathematics teachers should pay attention to female students' achievement in a mathematics class, 30(33.3%) agreed, 11(12.2%) stayed neutral, 2(2.2%) disagreed while no female strongly disagreed that mathematics teachers should pay attention to female students' achievement. However, from the summary responses in Table 20, 77(85.5%) female students agreed that mathematics teachers should pay attention to female student's achievement in class whereas about 2(2.2%) disagreed. It was evident that on the average all female students wanted mathematics teachers to pay attention to female students' achievement. This finding affirms Ngeche et al. (2013) study, that female students who had a core mathematics teacher that pays more attention to them were not bullied, but were more motivated and psychologically prepared to improve academic achievements.

From Table 21, 80(88.9%) female students strongly agreed that mathematics teachers should organized mathematics extra classes for them. 10 female students representing 11.1% agreed while no female student disagreed that mathematics teachers should organized mathematics extra classes for female students. On the average, from the summary responses in Table 22, 89(98.9%) female students were of the view that mathematics teachers should organized extra classes for them in order to help improve upon their achievement whereas 0(0.0%) disagreed. This assertion supports Serebour

(2013) finding that workshops and role model field trips be organized to enhance female related mathematics achievements.

Again, evidence in questionnaire item 14 shows that 20(22.2%) female students strongly agreed that mathematics teachers should ask female students questions during lessons, 39(43.3%) agreed, 23(23.6%) neutral while 6(6.7%) disagreed and 2(2.2%) strongly disagreed that mathematics teachers should ask female students questions in a mathematics class. The summary responses in Table 22 showed, 59(65.5%) female students agreed that mathematics teachers should ask female students questions to help their achievement in geometry, 8(8.9%%) disagreed. As a result, findings have showed that majority of the female students' belief that mathematics teachers should ask female students questions in a mathematics class.

Further, the findings from Table 21 also revealed that 31 female students representing about 34.4% strongly agreed that they should be given role models or mentorship, while 44 female students representing 48.9% agreed, 4(4.4%) females were undecided, 7(7.8%) disagreed and 4 female students representing 4.4% strongly disagreed on the questionnaire item that female students be given role models or mentorship. In the summary responses in Table 22, 75(83.3%) female students agreed that they should be given role models or mentorship whiles 11(12.2%) disagreed. It was then clear that the female students on the average agreed that they need role models and mentorship.

Evidence from the study in Table 21 shows that 80(88.9%) strongly agreed that mathematics workshops and role model engagement be regularly organized to inspire them in learning geometry in mathematics. 10(11.1%) agreed while no other student chose any other remaining likert item. From the summary responses in Table 22,

90(100%) female students agreed that mathematics workshops and role model engagement be regularly organized to inspire them in learning geometry whiles 0(0.0%) disagreed. This study findings supports Serebour (2013) study that mathematics teachers should engage students in mathematics clinics, seminars and workshops to encourage more students into mathematics and related jobs. It is therefore well noting that stakeholder in Ghana Education Service should regularly organize clinics/ workshops or role model engagement for female students to facilitate their achievement in geometry (mathematics).

Findings from table 21 item 12, showed that about 49(54.4%) of the female students disagreed that mathematics teacher should adequately complete of the geometry topic or core mathematics syllabus before end of term exams or the WASSCE. Whereas 37(41.1%) strongly disagreed, no female student agreed nor stayed neutral that mathematics teachers indeed do adequately complete the geometry or mathematics syllabus before they sit for the end of terms or the WASSCE. Summary responses in Table 22 showed that about 86(95.5%) female students agreed that that mathematics teacher should adequately complete of the geometry topic or core mathematics syllabus before end of term exams or the WASSCE but 4(4.4%) disagreed. According to Darfour (2016), the inability of a mathematics teacher to adequately complete the topic geometry or the mathematics syllabus impact negatively on student's achievement and also supports Darfour (2016), findings.

In conclusion, evidence from research question 3, supports Ababio (2013) study findings that the task of a teacher is no more being an agent of knowledge but a communicator and a manager with the responsibility of creating the enabling environment for learning to occur. Moreover, these findings support Sa'ad, Adamu

and Sadiq (2014) findings and that the ways of improving achievements of students in mathematics and for that matter geometry include creation of positive attitude towards mathematics, administering of more examinations and quizzes, provision of adequate teaching and learning materials, motivation, completion of the syllabus in time, provision of adequately trained mathematics teachers, using varied teaching methods as well as monitoring of lesson by the school administration.

Hence, the factors caused by mathematics teachers (mathematics teacher determinants) that female students perceived to have influenced their achievements in geometry in the study findings were:

1. inadequate completion of the geometry topic or the core mathematics syllabus before they sit for end of term exams or the WASSCE.
2. non varying teaching of methodologies
3. inadequate exercises
4. inadequately preparation before coming to teach
5. lack of motivation of female students to learn geometry (core mathematics)
6. lack of sufficient attention towards female student's participation during classroom instructions
7. should organize extra classes for female students
8. lack of asking female students questions during instructions
9. lack of role model or mentorship for female students
10. lack of mathematics workshop for female students.

Research Question Four: Is there enough evidence to support the claim that female student's achievement in geometry significantly improved after using instructional strategies for teaching and learning approach in the intervention?

In research question four (4), the goal of the researcher was to determine whether female students' achievement in geometry under the study has significantly improved after adopting varied instructional strategies into the teaching and learning aimed to address the gaps outlined or the determinants that influence female students' achievements in geometry in research question two (2) and three (3). Pre-test and post-test were used during the intervention process.

The researcher immediately organized a mathematics extra class as the findings in research question two and three revealed in order to fully ascertain whether indeed adopting varied instructional strategies in the teaching and process would address the gaps caused by the determinants mentioned in research question two and three and improve upon the female student's achievement in geometry. A one sample t-test was adopted for the data analysis. As such, researcher selected only school BB as the study school for the purposes of only this research question. School BB was chosen because, its students obtained one of the least mean test scores among the three schools who participated in the study as in research question one (1). The thirty (30) participants in school BB, were divided randomly into the two groups (fifteen each, male and female students). The two groups were named the control group (male) and the experimental group (female).

The two groups were taking through three days internal extra classes period within two weeks (2) on the topic (plane geometry i.e. angles) anchored used of instructional strategies and that of the test items used in Appendix B. The topic geometry was

chosen over other core mathematics topics because it was one of the most occurred topics based on field information shown in table 3 above. The control group was taught using the traditional method while the experimental group taught using the instructional strategies approach.

A resting period of one (1) hour, was allowed after closing before the start of the extra classes. During the extra classes, only 1 hour 30 minutes was used per session. The extra classes were held three days within two weeks during intervention period.

Both Control group and the experimental group were retested with a similar test items of varying difficulty level as compared with the pre – test questions are contained in Appendix C. Note, the initial test results were labeled pre-test, and the test results after the intervention program for both groups were labelled post-test. The tests result after the intervention program is shown in table 23 below:

Table 23: Pre-Test Descriptive Statistics of Students for School BB

One-Samples Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Control group (Male)	15	7.67	4.701	1.214
Experimental group (Female)	15	4.67	2.820	.728

Source: Field Data, (2021)

Evidence from Table 23 have shown that, the average mean score achievement in geometry in the pre-test results for the experimental group (M=4.67, SD= 2.820) was lower as compared to control group results (M=7.67, SD= 4.701) for the respective sample size, 15.

Table 24: One-Samples Test for Pre-Test

	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Control Group (Male)	6.317	14	.000	7.667	5.06	10.27
Experimental Group (Female)	6.409	14	.000	4.667	3.11	6.23

From Table 24, the significant value (t) for the experimental group is 6.409 and the significant value (t) for the control group is 6.317 at alpha level 0.05, P = 0.000. The t-test conducted showed that the average mean score achievement in geometry for the female student's experimental group (M = 4.667, SD= 2.820) was smaller than control group (M =7.667, SD= 4.701) in the pre-test.

Hypothesis Testing for the implementation of the instructional strategies

H_0: $\mu \leq 7.67$ (Claim)

H_1: $\mu > 7.67$

Conditions:

Null hypothesis H_0: $\mu \leq 7.67$ or the post-test control group mean: there is no significant difference in the mean scores of the post-test achievement between control group and the post-test achievement experimental group in geometry after the interventions at significant alpha level 0.05.

Alternate hypothesis H_1: $\mu > 7.67$ or the post-test control group mean: there is a significant difference in the mean scores between control group post-test achievement and the female students experimental group post-test achievement in geometry after the interventions at significant alpha level 0.05.

Table 25: Descriptive statistics of the students in School BB for the Post- Test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Control Group (Male)	15	7.07	3.218	.831
Experimental Group (Female)	15	12.40	5.289	1.366

Source: Field Data, (2021)

Evidence from table 25 have shown, the mean score achievements in post-test results for the experimental group (*M*=12.40, *SD*= 5.289) was higher than the post-test mean scores for the control group (*M*=7.07, *SD*= 3.218) after the adopting the instructional strategies approach. The standard deviation determines how the values are spread around the mean and if the standard deviation of a data set is smaller comparatively then the set of scores with smaller standard deviations is better (Fields, 2005).

Table 26: One- Samples t-test for Post Test

One-Sample Test

	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Control Group (Male)	8.506	14	.000	7.067	5.28	8.85
Experimental Group (Female)	9.081	14	.000	12.400	9.47	15.33

From Table 26, the significant value (t = 9.081) for the experimental group was higher than the significant value (t = 8.506) for the control group at alpha level is 0.05 in post-test results. The t-test conducted showed that the female students experimental group (*M*=12.40, *SD*= 5.289); t(14) = 9.081, P = 0.000 achieved higher mean scores in geometry than the male control group (*M*=7.07, *SD*= 3.218); t(14) = 8.506, P = 0.000 in geometry and that the H_1: $\mu > 7.67$. As such, the researcher rejects the null hypothesis (H_0: $\mu \leq 7.67$) and concluded that there existed statistically significant difference in the mean score achievements in geometry and core mathematics in general between the control group and the experimental group after adopting varied instructional strategies approach in teaching and that included: motivate students to focus attention in class, organize information for understanding and remembering, monitor and assess learning, step-by-step instruction, vary instructional approaches and learning materials, support students through guided practice and independent practice, and encourage students to self-monitor and self-correct and finally engage students in reflective practices and self-assessment in the study into the teaching and

learning processes during the study and it has minimized the impact determinants has on female students achievement in geometry and mathematics in general.

Again, though the mean scores of the control group in the pre-test was higher than the mean scores of the pre-test experimental group, the findings showed that the mean score achievements of the post-test for the female experimental group was higher than the mean scores of the control group in post-test results after adopting the instructional strategies approach into the teaching and learning processes to indicate that the instructional strategies method or approach was effective and capable of addressing the effect the determinants that influenced the female students achievement in geometry in study.

In conclusion, this study findings also support other several research findings such as Frimpong O. S. (2021) study which states, there existed a significant difference in students' achievement in mathematics when mathematics teachers used varied teaching strategies in the teaching and learning processes, especially during early grades of the student development as it indirectly varies the traditional lecture method of teaching. It also affirms other findings that advocated for the application of varied teaching methodologies, use of exercises, teacher preparedness, motivation of female students, use of question and answer, mathematics workshops (field trips) into the teaching and learning processes to improve learning outcomes (Peteros et al. 2020; Dennis et al. 2018)

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Over view

The chapter presents a summary of the major findings of the study. It evaluated the factors that influenced female student's achievement in geometry and core core mathematics in general in senior high schools. It consists of the summary of the research findings, and conclusions from the results and finally the recommendations for further studies.

5.1. Summary of the Study

The study examined female student's achievements in geometry using instructional strategies approach of teaching and learning: the determinants and way forward in senior high schools in Wa municipality. Hence, research questions were used to find out what determinants caused by mathematics teachers, the students that female students perceived influenced their achievements in geometry and examine their achievement in geometry using the instructional strategies approach rather the usual traditional method. Purposive sampling technique was used in selecting the schools and participating classes while simple random sampling was used to select the female students. In all, 180 respondents were used. A mixed methodology involving both quantitative and qualitative methods were adopted for the data collection and analysis in order to answer the research questions.

5.1.1 Key Findings to the Research Questions

The following findings were arrived at in this present study:

1. The findings from research question one (1) in examining female students achievement showed that there was no statistically significant difference between the achievement of the female and male students in geometry.
2. The student determinants (factors) that influenced female students' achievements in geometry as an answer to research question two (2) were:
    i. Female student's do not frequently practice geometry
    ii. Female student's lack confidence in learning geometry and that matter mathematics
    iii. Female students feel lazy and lack interest to learn geometry
    iv. Female student's desire to marry after completing SHS impact on their achievement in geometry and mathematics.
    v. geometry is the preserve of male students and not female students
    vi. they have weak fundamentals in geometry
    vii. geometry is difficult to learn.

3. The mathematics teacher determinants (factors caused by mathematics teachers) that female students perceive to influence their achievements in geometry as an answer to research question three (3) were as follows:
    i. inadequate completion of the geometry topic or the core mathematics syllabus before they sit for end of term exams or the WASSCE.
    ii. non varying of teaching methodologies
    iii. inadequate exercises given to students
    iv. mathematics teacher inadequately prepares before they come to teach

v. lack of motivation towards female students to learn geometry and core mathematics in general
vi. lack of sufficient attention towards female student's participation during classroom instructions
vii. inadequate extra classes for female students
viii. lack of asking female students questions during instructions
ix. lack of role model or mentorship for female students
x. lack of mathematics workshop for female students

The study findings therefore affirm Ehiametor (1990) study that, teaching that is accompanied with assignments, provides the teacher with data about the students' achievement and as such enables the teacher to appropriately assist the affected students.

4. Lastly, the present study finding in an answer to research question four (4) revealed that there existed statistically significant difference in the mean score achievements in geometry between the students control group and the experimental group after adopting varied instructional strategies in the teaching, and learning processes which included: motivate students to focus attention in class, step-by-step instruction, vary instructional approaches and learning materials, monitor and assess learning, support students through guided practice and independent practice, and encourage students to self-monitor and self-correct and finally engage students in reflective practices and self-assessment.

5.2 Conclusion

Based on the present study findings, the study, concluded that there was no statistically significant difference in achievement in geometry between male and female students in senior high schools in the study area and it supports Tetteh et al. (2018) study findings on 'gender difference in performance among pre – service teachers in mathematics' that there was no gender difference among the pre – service mathematics teachers in colleges in the Brong – Ahafo region of Ghana but contradicts Asante (2010) findings that the male students perform better than female students in geometry and mathematics in general.

Also, based on the study findings, study concluded that the students determinants that influenced female students' achievement in geometry were: student factors such as: female student's do not frequently practice geometry, female student's lack confidence in learning geometry and core mathematics in general, female students feel lazy and lack interest to learn geometry, female student's desire to marry after completing SHS impact on their achievement in geometry and mathematics, geometry is the preserve of male students and not female students, they have weak fundamentals in geometry, geometry is difficult to learn. And that these determinants influenced female student's achievement in geometry.

Further, the study also concluded that, the factors caused by mathematics teachers that influenced female students' achievement in geometry were i.e. inadequate completion of the geometry topic or the core mathematics syllabus before they sit for end of term exams or the WASSCE, non-varying teaching of methodologies, inadequate exercises given to students, inadequately preparation before coming to teach, lack of motivation towards female students to learn geometry and core mathematics in general, lack of

sufficient attention towards female student's participation during classroom instructions, inadequately organized extra classes for female students, lack of asking female students questions during instructions, lack of role model or mentorship for female students and lack of mathematics workshop for female students. Hence, the study concluded that factors caused by mathematics teachers in the teaching and learning processes influenced female student's achievement in geometry. These findings are in line with Ayebale, Habaasa and Tweheyo (2020) study, that mathematics teacher related factors such as mathematics teaching methods, and mathematics teacher attitude, significantly influenced students' achievements in geometry and mathematics in general, and Habtamu (2016) findings, that cited the mathematics teacher as one of the major factors that caused student's poor achievements in mathematics i.e. teaching methods, teacher competencies, teacher classroom management, teacher personality among other factors.

Based on the findings of the present study, the study also concluded that mathematics teachers should adopt the instructional strategies approach into the teaching and learning processes in teaching geometry in SHS especially in the study area because the study findings has revealed that the strategy is effective in improving female student's achievement in geometry and core mathematics in general. And that it has the ability to mitigate/ minimize the negative impact the determinants have on female student's achievement in geometry. And that the female students showed positive perceptions on used of instructional strategies teaching approach in terms of their interest, motivation, understanding, confidence towards learning and practicality, towards their mathematics teachers and achievements in geometry and mathematics in general. The researcher therefore calls on mathematics teachers to adopt it rather than using the old traditional method of teaching and learning. That is, when a concept is

taught, both geometric and algebraic expressions must be given coupled with real life examples (Mahir, 2009). The present study findings also support Frimpong O. S. (2021) study findings that, there existed a significant difference in students' achievement in mathematics when mathematics teachers used varied teaching strategies in the teaching and learning processes, especially during early grades of the student development as it indirectly varies the traditional lecture method of teaching

Finally, based on the study findings, the way forward and the study conclusion was that mathematics teachers should adopt the instructional strategies teaching and learning approach into the teaching and learning processes to help address the gaps and determinants or the factors identified in the study that influenced female students' achievement in geometry and core mathematics in general.

5.3. Recommendations

Based on the findings from this study, the researcher recommends that stakeholders in education adopts the instruction strategies approach of teaching and learning processes in the following ways:

1. Ghana Education Service should consider organizing;
    i. role model guidance and mentorship programs for the female students.
    i. training workshops, regularly for in-service mathematics teachers to help improve upon their content knowledge and methodologies.
    ii. counselling students on marriages and the prospects of education.

2. mathematics teachers should;
    i. endeavor to revise about the content to be taught before instructions.

ii. pay attention to female students' participation/ understanding during instructions.

iii. remember to encourage or motivate female students in their teaching.

iv. regularly engage female students with exercises.

v. organized extra classes if the need be for female students.

vi. complete the core mathematics syllabus

3. students/ female students should;

iii. demystify the perception that geometry is difficult and a preserve of males through mentorship and role model engagement

iv. self-motivate themselves and regularly practice geometry (mathematics) on their own.

In light of these findings, the researcher further suggested that, a similar study into students' achievement in geometry and mathematics in general especially the female students. This is because a chunk of the weak achievements in geometry and core mathematics in general in the senior high schools in Ghana is influenced by the female student's achievement (Ghana Education Service Report, 2018).

REFERENCES

Ababio T. B. (2013). Nature of Teaching: What Teachers Need to Know and Do. *International Journal for innovation Education and Research. Department of Art and Social Sciences Education,* 1(3).

Aboagye O. K., Denke-Ke & Mante A. D. (2021). Factors Influencing Students' Perceived Difficulties in Studying Geometry: A Case of Konogo-Odumasi, Ghana. *Open Journal of Social Sciences*, 9, 526-540.

Abreh, K. M., Owusu, A. K & Amedahe, K. F. (2018). Trends in performance of WASSCE candidates in the science and mathematics in Ghana: Perceived contributing factors and the Way Forward. *Journal of Education,* 198(1), 113-123: 10.1177/0022057418800950.

Acer, D. & Gözen, G. (2019). Art detectives: young children's behaviour in finding and interpreting art elements within picture books. *International Journal of Primary, Elementary and Early Years Education,* 3(4).Doi:10.1080/03004279.2019.1646297

Adegun K. I. & Adegun O. B. (2013). Students and teachers' views of difficult areas in mathematics syllabus: Basic equirement for science and engineering education. *Journal of Education and Practice,* 4(12), 235-243

Adom, D., Mensah, A. J. & Dake A. M (2020). Test, Measurement, and Evaluation: Understanding and use of the concepts in education. *International Journal of Evaluation and Research in Education,* 9(1), 109-119

Adu – Gyamfi, Donkor, W. J. & Addo, A. A. (2016). Educational Reforms in Ghana: Past and Present. *Journal of Education and Human Development,* 1(3), 158-172.

Aiken, L. R., & Gredgwer, G. (2007). The effect of attitudes on performance on mathematics. *British Journal of Psychology, 27,* 90-123.

Alberta Learning (2002). Instructional Strategies. *Health and Life Skills Guide to Implementation,* Alberta, Canada

Ajogbeje, J. O. (2010). Self-concept as predictor of mathematics achievement among secondary school students in Ado-Ekiti, Nigeria. *Nigerian Journal of Guidance and Counselling*, *15*(1). https://doi.org/10.4314/njgc.v15i1.64658

Akey, T. M. (2006). *School context, student attitudes and behaviour, and academic achievement: An exploratory analysis.* Jossey Bass.

Anamuah-Mensah, J. (2007). *The Educational Reform and Science and Mathematics Education.* A Keynote Address at the Stakeholders of Nuffic Practical Project Meeting.

Alhajraf, M. N. (2014). The Impact of Demographic and Academic Performance. *International Business research,* 7(4). Doi:10.5539/ibr.v7n4p92

Armah, R. B., Coffie, P. O., & Okpoti, C. A. (2018). Investigating the effect of Van Hiele Phase–based instruction on pre–service teachers' geometric thinking. *International Journal of Research in Education and Science (IJRES), 4(1), 314-330. DOI:10.21890/ijres.38320 1.*

Asante, O. K. (2010). *Sex difference in mathematics performance among senior high students in Ghana. Gender and Behaviour*. Dio:10.4314/gab.v812.61947 Retrieved from https://www.researchgate.net/publication/231598245

Assuah, C. K. (2011). Teacher and Student Perceptions of Teacher Oral Communication Behavior in the Algebraic Classroom. *African Journal of Educational Studies in Mathematics and Sciences*, 9.

Assuah, C. K., Yakubu, W., Asiedu-Addo, S. K. & Arthur, Y. D. (2016). Primary school mathematics teachers' ideas, beliefs, and practices of constructivist instructional strategies.*African Journal of Educational Studies in Mathematics and Science,* 12.

Awanta, E. & Aseidu, A. S. (2008). *Essential Statistics Techniques in Research,* Accra: Salt 'N' Light publishers.

Ayebale, L., Habaasa, G. & Tweheyo, S. (2020). Factors affecting student's achievement in mathematics in secondary schools in developing countries: A rapid systematic review. *Statistical Journal of the IAOS,* 36(S1), 73-76. DOI: 10.3233/SJI-200713

Aysen O. (2012). Misconceptions in geometry and suggested solutions for seventh grade students. *International Journal of New Trends in Arts, Sports and Science Education*, 1(4), 1-13

Baah-Duodu S., Osei-Buabeng V., Ennin. C., Hegan. E. J & Nabie J. M. (2020). Review of Literature on Teaching and Learning Geometry and Measurement: A Case of Ghanaian Standards Based Mathematics Curriculum. *International Journal of Advances in Scientific Research and Engineering (ijasre),* 6(3). DOI: 10.31695/IJASRE.2020.33766

Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development*, *72*(1), 187-206. https://doi.org/10.1111/1467-8624.00273.

Baah-Korang, K., Gyan, E & McCarthy, P. (2015). Gender differences in participating in elective mathematics of senior high schools in Ghana. *Journal of Education*, 6(8)

Bernard, H. R. (2002). *Research Method in Anthropology: Qualitative and Qualitative methods. (*3rd edition). Alta Mira Press.

Brandy & Bowd, (2005). Impact of instruction teaching style and content course on mathematics anxiety of pre-service teachers. *Journal of Technology Education*, 2(1)

Bush, T. (2009). *Evaluation in mathematics*. Harper and Row.

Callahan, W. J. (2001). Adolescent attitudes towards mathematics. *Mathematics Teacher,* 66(4), 751-755.

Cheryan, S., Master, A., & Meltzoff, A. N. (2015). Cultural stereotypes as gatekeepers: Increasing girls' interest in computer science and engineering bydiversifying stereotypes. *Frontiers in Psychology*, *6*(49). https://doi.org/10.3389/fpsyg.2015.00049

Churcher, K., Aseidu-Owuba, L. & Adjabui M. (2015). Assessment of Students' Performance in Mathematics at the Second Cycle Schools in the Kassena-Nankana municipality. *Global Educational Research Journal*, 3(1), 2360-7963.

Clarke, P. A. L. & Vidakovic D. (2009). Pre- service mathematics teacher's attitude and developing practices in urban classroom: Are they ''winging'' it? *Research and Practice in Social Science,* 5(1), 22-43

Colleges of Education Examinations (2008). Chief Examiner's Report on Geometry, Trigonometry, Statistics and Probability. *Institute of Education*, U.C.C., Cape Coast.

Colleges of Education Examinations (2009). Chief Examiner's Report on Geometry, Trigonometry, Statistics and Probability. *Institute of Education*, U.C.C, Cape Coast.

Conference Board of the Mathematical Science (2012). *The Mathematical Education of Teachers II*: *Issues in mathematics education,* 17. American Mathematical Society, Providence, Rhode Island in Cooperation with Mathematical Association of America, Washington, D.C.

Darfour, M. (2016*). Causes of poor students' academic performance in mathematics among junior high school students in Bantama sub – metro in Kumasi metropolis*. http://ir.uew.edu.gh

Dramanu, B. Y., & Balarabe, M. (2013). Relationship between academic self-concept and academic performance of junior high school students in Ghana. *European Scientific Journal, ESJ*, *9*(34).

Dennis, H., Mereku, D. K. & Alhassan N. M. (2018). Influence of Teachers' Coverage of Mathematics Curriculum Materials (MCM) on their Performance in Mathematics. *African Journal of Educational Studies in Mathematics and Sciences*, 14.

Enu. J, Agyman, K. O. & Nkum, D. (2015). Factors Influencing Student's Mathematics Performance in Some Selected Colleges of Education in Ghana. *International Journal of Education Learning and development.* 3(3), 68-74.

Ehiametor, E. T. (1990). *Business and Economic Seduction, Principle and Practice*: LagosEvan Bras Ltd.

Eraikhuemen, L. (2003). The Influence of Gender and School Location on Students' Academic Achievement in Senior Secondary School Mathematics. *Journal of Theory and Research in Education.* 7(2), 99-112.

Ernest, P. (2004). *Philosophy of Mathematics Education (2nd edition)*. Taylor and Francis Group, Routler, Falmer.

Eshun, B. A. (1999). The pattern of mathematical achievement of secondary school students in Ghana: *Journal of Science and Mathematics Education*, 2(1), 22-33

Etsey, K. (2005). Causes of low academic performance of primary school pupils in Shama Sub-metro of Shama Ahanta Metropolitan Assembly (SAEMA) in Cape Coast, Ghana. *Regional Conference on Education in West Africa*, Senegal, Dakar.

Fabiyi T. R. (2017). Geometry Concepts in Mathematics Perceived Difficult to Learn By Senior Secondary School Students. *Journal of Research & Method in Education*, 7(1), 83-90.

Farrant, J. S. (1980). *Principles and Practice of Education.* Shech Wag Tong, Hong Kong: Longman, Sheck Wag Printing Press Ltd.

Female Education in Mathematics and Science in Africa, FEMSA (1997). 3rd project committee report on girl's problem with mathematics and science in primary and secondary schools in Cameroon, Ghana, Tanzania and Uganda. *Female education newsletter,* 8, 4-5.

Fennema, E., & Sherman, J. A. (1976). Mathematics attitude scales: instrument designed to measure attitudes towards the learning of mathematics by females and males. *Journal for Research in Mathematics Education,* 7, 324-326. Doi:10.2307/748467

Fields, A., (2005). *Discovering Statistics Using SPSS,* (2nd edition). Sage Publications, London.

Freeman, C. E. (2004). Trends in educational equity of girls & women: 2004. *Education Statistics Quarterly,* 6(4), 357-66.

Frimpong, O. S. (2021). The role of teaching and learning materials and interaction as a tool to quality early childhood education in Agona East District of the Central Region, Ghana. *African Educational Research Journal*, 9(1), 168-178. Doi:0.30918/AERJ.91.20.112.

Geary, D. C. (2000). *Influential factors causing the gender differences in mathematics 'achievement scores among Iranian Eight graders.* TIMSS 2003 Data. Retrieved 2010 from htt://www.ie.a.ne/fileadmin/upload.

Ghana Education Service (2011). *Teaching Syllabus for Core Mathematics for Senior High Schools, ii*. Curriculum Research and Development Division (CRDD)

Ghana Education Service (2018). *Educational Sector Performance, Report.* Ministry of Education.

Gay, L. R., & Airasian, P. (2003). Education research. Competencies for analysis and applications. New Jersey.

Guay, F., Ratelle, C. F., Roy, A., & Litalien, D. (2010). Academic self-concept, autonomous academic motivation, and academic achievement: mediating and additive effects. *Learning and Individual Differences*, *20*(6), 644-653. https://doi.org/10.1016/j.lindif.2010.08.001.

Hiebert, J., & Lefevre, P. (1986). *Conceptual and procedural knowledge in mathematics: An introductory analysis,* 1(27). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Habtamu G. (2016). Assessment of grade10 students' performance in mathematics: the case of jimma zone. *International Journal of Current Research*. https://www.researchgate.net/publication/314262060

Ilker E., Sulaiman A. M. & Rukayya S. A. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics.* 5(1), 1-4. Doi: 10.11648/j.ajtas.20160501.11

Illeris K. (2017). *How We Learn: Learning and Non-learning in School and Beyond, (2nd edition).* Routledge.

Jacobs, J. E. & Simpkins, S. D. (2005). Twenty-five years of research on gender and ethnic differences in math and science career choices: what have we learned? *New Directions for Child and Adolescent Development,* 110, 85-94.

Kamoru, U., & Ramon, O. G. (2017). Influence of self-concept, study habit, and gender on attitude and achievement of secondary school students in mathematics. *Journal for Leadership and Instruction*, *16*(1), 49-52.

Kaplan, R. M., & Saccuzzo, D. P. (2012). Psychological testing: Principles, applications, and issues. Cengages learning.

Konstantinous-Katzia P., Tsolakia E., Meletiou-Mavrotherisb M. & Koutselini M. (2013). Differentiation of teaching and learning mathematics: an action research study in tertiary education. *International Journal of Mathematics Education in Science and Technology,* 44(3).

Leary R. M. & Tangney P. J. (2012). *Self, Self-concept and Identity*, (2nd edition), 4,69- 104. The Guilford Press

Liakopoulou, L. (2011). The professional competence of teachers: which qualities, attitudes, skills and knowledge contribute to a teacher's effectiveness? *International Journal of Humanities and Social Science,* 1(21), 66-78.

Lockheed, M. (1991). Improving education. *Education Review*, 16(3), 303-311.

Mahir, N. (2009). Conceptual and procedural performance of undergraduate students in integration. *International Journal of Mathematical Education in Science and Technology,* 40(2), 201–211. doi:10.1080/00207390802213591

Maio, G. & Haddock, G. (2009). *The psychology of attitudes and attitude change.* Doi:10.4135/978144214299

Marishane, M. A., Marishane, R. N. & Mahlo, F. D. (2015). Teacher capacity for curriculum differentiation in teaching foundation phase mathematics. *Educational Management and Policy Studies*, 11(3), 256-262.

Mason M. (2002). *The Van Hiele Levels of Geometric Understanding*. Retrieved from http:/jwilson.coe.uga.edu/EMAT8990/GEOMETRY, 2002.

Mensah J. K, Okyere M. & Kuranchie, A. (2013). Student attitude towards mathematics and performance: Does the teacher attitude matter? *Journal of Education and Practice*, 4(3).

Mereku K. (2010). Five Decades of School Mathematics in Ghana. *Mathematics connections,* 9(3)

Mullis, I.V.S., Martin, M. O., Gonzales, E. J., & Chrostowski, S. J. (2004*). TIMSS 2003 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*. Chestnut Hill, MA: Boston College.

Munn, V. (2009). *Beliefs about teaching mathematics*. MacMillan.

National Science Foundation, (2016). National Centre for Science and Engineering Statistics. *Doctorate Recipients from U.S. Universities: 2015*. Special Report NSF 17-306. Arlington, VA

National Mathematical Centre, NMC (2009). *Mathematics improvement programme*, Abuja. www.nmcabuja.org/mathematics improvement programmes.html

National Research Council (2000). *How People Learn: Brain, Mind, Experience, and School, Expanded Edition.* John Bransford, Ann L. Brown, and Rodney, R. Cocking(eds.), Committee on Developments in the Science of Learning, Committee on Learning research and Educational Practice, Commission on Behavioral and Social Science and Education. Washington, Dc: National Academy Press.

Ndhlela, B. (2012). *Causes of poor performance by South African students in mathematics*. Cape town: Juta and Company.

Neale, D. C. (1969). The Role of Attitudes in Learning Mathematics. *Arithmetic Teacher*, 16(8), 631-640

Ngeche, N. M. T (2017). Students and Teachers Attitude as Correlates of Performance in Mathematics in Cameroon Secondary Schools. *International Journal of Humanities Social Sciences and Education,* 4(12),1-10. http://dx.doi.org/10.20431/2349-0381.0412001.

Noraini I. (2006). *Teaching and learning of mathematics: Making sense and developing cognitive abilities.* Perak: Utusan Publication Sdn. Bhd. Nigeria.

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math= male, me= female, therefore math≠ me. *Journal of Personality and Social Psychology*, *83*(1), 44. https://doi.org/10.1037/0022-3514.83.1.44.

Ntow D. F. & Hissan Y. (2021). The impact of concept-based instruction on senior high school students' achievement in circle theorems. *African Journal of Educational Studies in Mathematics and Sciences,* 17(1).

O'Brien, R. (2001). An Overview of the methodological approach of action research. *Theory and Practice of Action Research.* htt://www.web.ca/~robrien/papers/arfinal.html.

Peteros E. & Gamboa, A. (2020). Factors affecting mathematics performance of junior high school students. *International Electronic Journal of mathematics education*, 15(1), Doi:10.29333/iejme/5938.

Philipou, G. & Christou, C. (1998). *A Study of the Mathematics Teaching Efficacy Beliefs of Primary Teachers,* 31, 211-231

Ponte, J. P. (2012). *Developing Algebraic and Didactical Knowledge in Pre –Service Primary Teacher Education*, 2, 75-82. Taipe: PME

Reid S. & Reid. M. (2017). Learning to be a Math Teacher: What Knowledge is Essential? *International Electronic Journal of Elementary Education,* 9(4), 851-872.

Roopa, S. & Satya M. R. (2012). Questionnaires Designing for a Survey. *The Journal of Indian Orthodontic Society,* 46(4), 37-41. Doi:10.5005/jp-journals-10021-1104

Sa'ad, U. S., Adamu A. & Sadiq, M. A. (2014). Causes of Poor Performance in Mathematics among Public Senior Secondary Students in Azaree Metropolis of Bauchi State, Nigeria. *Journal of Research and Methods in Education, 4.*

Serebour K. O. (2013). *Factors Teachers, Students and Parents Perceive as Influence Junior High School Students' Mathematics Learning.* UCC

Sincero, S. M. (2012). Self-concept theory. Retrieved from http://bit.ly/2KrXjqG

Tambychik, T., Subahan, T., & Meerah, M. (2010). Students' Difficulties in Mathematics Problem-Solving: What Do They Say? *Procedia Social and Behavioral Sciences*, 8, 142- 151. https://doi.org/10.1016/j.sbspro.2010.12.020

Telima A. (2011). Problems of teaching and learning of geometry in secondary schools in River State, Nigeria. *International Journal of Emerging Science*, 1(2), 143-152.

Tetteh, N. K. H, Wilmot, M. E. & Ashong, D. (2018). Gender differences in performance among pre-service teachers in the Brong-Ahafo region of Ghana. *International Journal of Education, Learning and Development,* 16(5), 38-45.

Thames, M. H. and Balls, D. L. (2010). What mathematical knowledge does teaching Require? Knowing mathematics in and for teaching. *Teaching Children Mathematics,* 17(4). 220-225.

Thompson, D. R. & Chappell, M. F. (2007). Communication and representation as elements in mathematical literacy. *Reading and Writing Quarterly,* 23, 1-18.

Timmerman, H. L., Luit, V. J. H, & Toll, S. W. (2017). The relation between mathematics Self-concept, test and mathematics anxiety, achievement motivation and mathematics achievement in 12 to 14-year-old typically developing adolescents. *Psychology, Society and Education*, 9(1), 89-103. Doi:10.25115/psye.v9i1.465

Tongco, M. D. C. (2007). Purposive sampling as a tool for informant selection. *A Journal of Plants, People, and Applied Research*, 5, 147-158. http://hdl.handle.net/10125/227

Tullis G. J. & Goldstone, L. R. (2020). Why does peer instruction benefit student learning? *Cognitive Research: Principles and Implications*, 5(15) https://doi.org/10.1186/s41235-020-00218-5

Uduosoro I. U. (2011). Perceived and actual learning difficulties of students in secondary school mathematics. *International Multidisciplinary Journal*, 5 (5), 357-366.

Van Hiele, P. M. (1999). Developing Geometric Thinking through Activities that Begin with Play. *Teaching Children Mathematics,* 5, 310-316.

West African Examination Council (2017). *Chief Examiners Report on the West African Senior High Schools Certificate Examinations*, WAEC, Accra. University of Cape Coast, Cape Coast.

West African Examinations Council (2016). *Chief Examiners' Report on West African Senior School Certificate Examination May/June* 2016, WAEC, Nigeria.

Wilmot, E. M. (2009). Teacher Knowledge and Student Performance: Begle Revisited in Ghana. *Journal of Science and Mathematics Education*, 4(1),13-30.

Yarkwah, C. (2020). *Female students' participation in mathematics education at the university level in Ghana*. University of Cape Coast, U.C.C.

Zan, R., & Martino, P. D. (2007). Attitudes toward mathematics: overcoming positive/negative dichotomy. *The Montana Mathematics Enthusiasts Monograph*, *3*, 157-168.

Ziegler G. M. & Loos, A. (2010). *Teaching and Learning "What is Mathematics"*. Springer Spektrum, Heidelberg.

Zimmerman, B. J. (2013). Theories of Self-regulated Learning and Academic Achievement: An Overview and Analysis. *In Self-regulated Learning and Academic achievement,*1, 10-45. Routledge.

APPENDIX A

Students Questionnaires

Please provide appropriate responses/ answers to the best of your ability to the given questionnaire. Your personality or identity is confidential under this survey. Your honest and thoughtful information to each item is therefore required. Thank you for your cooperation. Please choose only one option by marking (√) the suitable option or on the contrary provide a brief answer.

Gender: Male [ ] Female[ ]

Form ……..…

Region/ Hometown …….....

Choose by marking only the option you think reflects the specific five point likert scale to indicate your choice of a Math teacher attribute that influence your performance in Math.

Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Geometry is difficult to understand.					
2. I hardly practice geometry on my own.					
3. I have weak fundamentals in geometry.					
4. I lack confidence in					

learning geometry.

5. Geometry is for males and not for both males and females.

6. I feel lazy and lack interest to learn geometry.

7. I will marry after completing SHS as such I am not motivated enough to pass mathematics.

8. Mathematics teacher should vary their teaching methods.

9. Mathematics teacher should regularly give exercises.

10. Mathematics teacher should revise on the topic before coming to teach.

11. Female students should be encouraged/ motivated to learn geometry.

12. Mathematics teacher should pay attention to females' performance in mathematics class.

13. Organized extra classes for the weak performing female students.

14. Ask females many questions during mathematics lessons.

15. Female students should regularly practice geometry (mathematics) their own.

16. Organized mathematics workshops regularly for female students.

17. The inadequate completion of the topic geometry, do not affect my WASSCE achievement in mathematics.

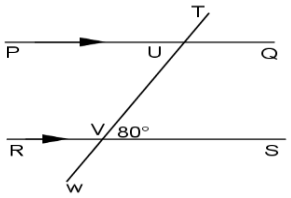
APPENDIX B

PRE-TEST QUESTIONS

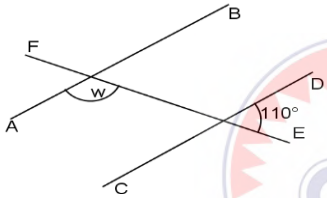
RESEARCH QUESTION ONE TEST QUESTIONS

Answer all questions (20marks)

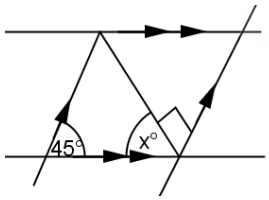
1. If $\overline{PQ}$// $\overline{RS}$ and<UVS = 80°, find angles (a) TUQ (b) QUV (c) SVW in the figure below;



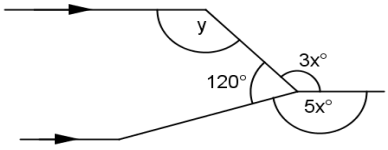
2. In the diagram AB and CD are parallel lines. What is the value of w?



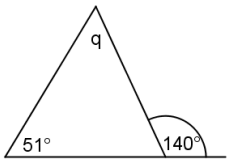
3. Find the angle marked $x°$ in the diagram below;



4. Find the value of the angle marked y in the diagram below;



5. Find the angle marked q in the figure below,



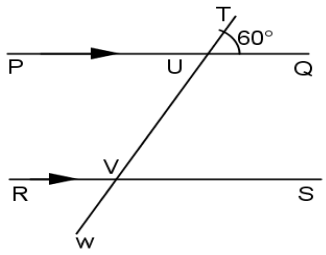
APPENDIX C

POST-TEST QUESTIONS

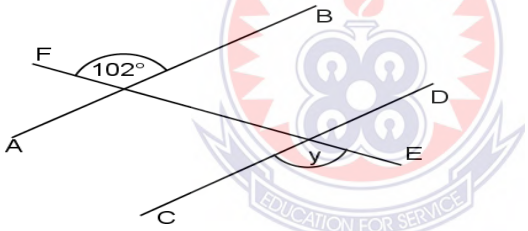
Answer all questions

(20marks)

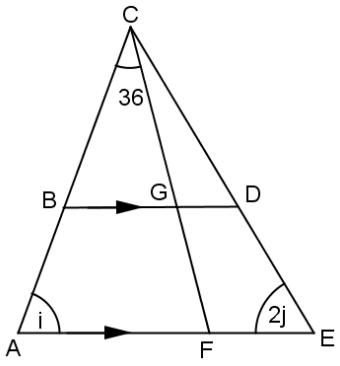
1. Find angle (a) TUQ (b) QUV (c) SVW in the diagram below, given that $\overline{PQ}$// $\overline{RS}$ and $< TUQ = 60°$



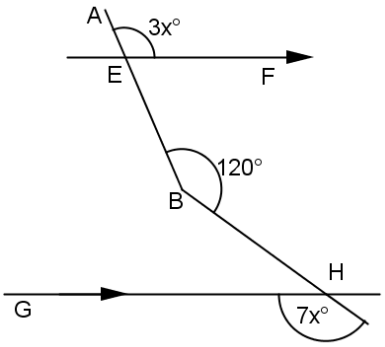
2. In the diagram, AB and CD are parallel lines. What is the value of y?



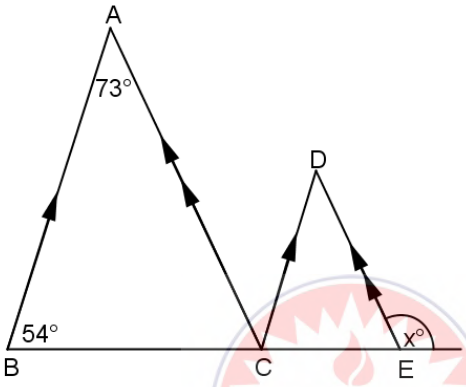
3. In the diagram, $BD//AE$ and ΔBCG is an isosceles triangle. If $< BCG = 36°$ and $|BC| = |CG|$, find the value of i.



4. In the diagram, $\overline{EF}$ is parallel to $\overline{GH}$. If $< AEF = 3x°$, $< ABC = 120°$ and $< CHG = 7x°$. Find the value of $< GHB$.



5. Find the value of x in the diagram below,



APPENDIX D

PRE-TEST /RESEARCH QUESTIONS ONE MARKING SCHEME (20marks)

1. (a) $< TUQ = 80°$ (Corresponding angles) (1mrk)

   (b) $< QUV = 180° - 80° = 100°$ (Co-interior angles) (1mrk)

   (c) $< SVW =< QUV = 100°$ (Corresponding angles) (2mrks)

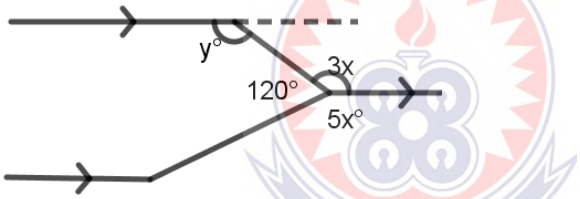
2. $w + 110° = 180°$ (1 mark)

   $w = 180° - 110° = 70°$ (2marks)

3. $45° + x + 90° = 180°$ (Supplementary angles) (1mark)

   $x = 180° - 90° - 45°$

   $x = 45°$ (2mark)

4. 

   (Projecting a line correctly, 1mrk)

   $120° + 3x + 5x = 360°$ (1mrk)

   $8x = 360° - 120°$

   $x = 30°$ (1mrk)

   $3x = y$ (Z angles) (1mrk)

   $3(30°) = y$ (1mrk)

   $y = 90°$ (2mrk)

5. $q + 51° = 140°$ (Co-interior angles) (1mrk)

   $q = 140° - 51° = 89°$ (2mrk)

APPENDIX E

POST-TEST QUESTIONS MARKING SCHEME (20marks)

1. (a) $< TUQ = 60°$ (1mrk)

   (b) $< QUV = 180° - 60°$ (Supplementary angles) (1mrk)

   $< QUV = 120°$ (2mrks)

   (c) $< SVW =< QUV = 120°$ (Corresponding angles) (2mrk)

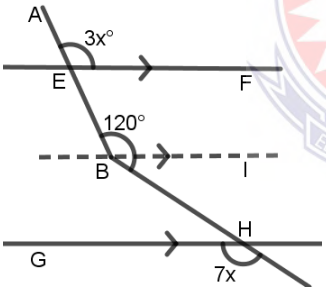
2. $< AGE = y = 102°$ (Corresponding angles) (2mrk)

3. $GBC = i$ (Corresponding angles) (1mrk)

   $< GBC =< BGC = i$ (1mrk)

   $i + i + 36° = 180°$

   $2i = 180° - 36°$ (2mrks)

4. 

   (Projecting line correctly, 1mrk)

   $< EBI = 3x°$ (1mrk)

   $< HBI = 120° - 3x°$

   $< GHB =< HBI = 120° - 3x°$ (Z angles) (2mrks)

5. $< ACB = 180° - 54° - 73° \quad = 53°$ (1mrk)

   $< CED =< ACB = 53°$ (1mrk)

   $< ACB + x = 180°; \quad x = 180° - 53° = 127°$ (2mrks)