UNIVERSITY OF EDUCATION, WINNEBA

FACTORS INFLUENCING GENDER DIFFERENCES IN MATHEMATICS PERFORMANCE THE SENIOR HIGH SCHOOLS IN THE SAGNARIGU MUNICIPALITY OF THE NORTHERN REGION OF GHANA

AMBAYOR CLAUDIA TAGOOR

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

JUNE, 2023

DECLARATION

Student's Declaration

I, **Ambayor Claudia Tagoor** hereby declare that this dissertation, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is my own original work, and it has not been submitted, either in part or whole, for another Master's degree elsewhere.

Signature……..

Date…….

Supervisor's Declaration

I hereby declare that the presentation of this dissertation was done in accordance with the guidelines for supervision of dissertation laid down by the University of Education, Winneba.

Name of Supervisor: Prof. Michael Johnson Nabie

Signature……..

Date…….

DEDICATION

To my lovely husband, Laarinso N. Vitus and my mother, Mary Ambayor for their encouragement and prayers for the successful completion of the programme.

I also dedicate this work to my children: Sinyor N. Audrey, Sinyor N. Adeline, Sinyor N. Dandavid and Sinyor N. Justina. This is dedicated to my siblings: Alice, Regina, Emmanuel, Rose and Desmond.

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ABSTRACT

The aim of this study was to assess the factors influencing gender differences in mathematics performance among students of senior high schools in the Sagnarigu Municipality. Descriptive survey design was employed for the study. Two hundred and fifty (250) students and fifty (50) mathematics teachers were purposively sampled from the five senior high schools in the municipality. Questionnaire, inventory and the mathematics achievement test were used as data collection instruments. The data collected were analyzed quantitatively using descriptive and inferential statistics. From the data collected, the study observed that there was gender difference in mathematics performance among students in the municipality ($p=0.010$) with varying factors. The effect of the poor performance of female students in mathematics as indicated in the study could lead to the truncation of their academic career of the students since mathematics is admission requirement in all tertiary institutions in Ghana. The study recommends that mathematics teachers in the municipality need to give female students, the needed attention and special tuition they require to improve their performance.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter talks about the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions/hypotheses, significance of the study, scope of the study, delimitation of the study, limitation of the study.

1.1 Background to the Study

Formal education was introduced in Ghana, not to advocate discrimination but to provide equal opportunities for both males and females to acquire the requisite knowledge, skills and attitudes befitting society. This is evident as successive governments over decades consistently tried in the introduction of Free and Compulsory Universal Basic Education (FCUBE) in 1995 and Free Senior High School (FSHS) in 2017. These policy measures are to address the existing gap between males and females in educational enrolment and achievement. Every government tries to provide equal education for all citizenry of school going age irrespective of gender. Nonetheless, equal opportunities for both males and females does not necessarily imply equal academic achievement in schools (Wilmot & Hocker, 2001) especially in mathematics, because of some unjustifiable gender variation in interest in studying mathematics.

Mathematics is very important in the Ghanaian educational system. As such, it is offered as a core subject at the basic, senior high school and technical institutions in the country. Also, mathematics serves as a basic entry requirement for all tertiary institutions in the country with a minimum pass grade of C6 (Credit). However, this

subject provides knowledge and skills that every human being, including male and female need to acquire in order to become efficient and effective in dealing with real life challenges. Furthermore, the development in almost all aspect of human endeavor is based on effective understanding of science and mathematics for problem solving. Eshun (2004) concluded that students need to learn mathematics in order to understand the world around them. Therefore, the importance of mathematics in the development of every nation cannot be over emphasized.

Gender differences in mathematics achievement and ability has remained a source of concern to educational stakeholders due to the under-representation of women in the fields of physical sciences, mathematics and engineering (Asante, 2010). Mathematics has been perceived as a difficult subject for many students to effectively learn, especially among female students in Ghana. Female students' achievements in mathematics is a national concern. Many girls who gain admission into the university usually do not enter the mathematics related faculty as boys do. This view remains strong in the perception of the public, and the quiet hardworking girl is often motivated by self-silence and desire to please.

Girls appear to lose ground in mathematics education over time in every family structure, ethnic group, and by socio-economic distribution (Fryer & Levitt, 2010). This is why women are still under-represented in Science, Technology, Engineering and Mathematics (STEM) careers despite frantic efforts to increase the number of women in such fields (Hill, Corbett, & St. Rose, 2010). For example, over the past decades, there have been various programmes to increase girls' participation and performance in science and mathematics. Such programmes include Campaign for Female Education (CAMFED), STEM Olympics, Science Clinics for Girls (SCG), African Institute for

Mathematical Sciences (AIMS), Girls in Mathematics and Science Program (GMSP), African gifted foundation Scholarships for girls among others. Nevertheless, Mathematics as a subject is mostly considered to be difficult by many students, particularly girls. Consequently, gender inequality and differences in mathematics education and achievement have remained a global problem (Leder, 1990).

Though these intervention programmes are to enhance girls' participation and achievement in mathematics have been extended to the Northern part of the country for some time now, girls' performance in mathematics remains problematic. A summary of males and females' mathematics performance in the West African Secondary School Certificate Examinations (WASSCE) for Northern Region from 2014 to 2019 is presented in Table 1.1. These years had number of candidates 17,844, 23,324, 24,507, 25,633, 25,081 and 24,926 presented for 2014, 2015, 2016, 2017, 2018 and 2019 respectively see (Appendix D).

Table 1.1: Mathematics pass rate of male and female students in WASSCE from 2014 to 2019 in Northern Region of Ghana

Year	**Number of students that passed A1 to C6**		**Percentage (%) of pass rate**	
	Male	**Female**	**Male**	**Female**
2014	1533	468	14.072	6.734
2015	1303	493	9.272	5.318
2016	2422	688	16.174	6.532
2017	2299	710	15.618	6.506
2018	1356	343	9.532	3.159
2019	4113	1837	30.018	16.367

The candidature of females for the years were 6,950, 9,271, 10,532, 10,913, 10,855 and 11,224 respectively and that of the males were 10,894, 14,053, 14,975, 14,720,14,226 and 13,702 respectively. The WAEC data were categorized into two of

which A1 to C6 was considered pass and D7 to F9 was considered fail. The number of females who passed for the various years were 468, 493, 688, 710, 343, and 1,837 respectively and that of the males were 1,533, 1303, 2422, 2299, 1356 and 4113 respectively which was used to compute the percentage pass rate for the females and males.

However,, the percentage pass rate of the female students is lower compared to male counterparts on yearly basis. This suggests a hidden problem which cannot be generalized, as in the view of Tobias (1978), as resulting from a disability condition known as math anxiety.

Although, mathematics anxiety is said to be sets of beliefs and behaviours that prevent students from performing in mathematics, there are factors contributing to parity in mathematics achievement that may differ from location to location, ethnicity and etc. The problem of gender parity persists in the Senior High Schools within the Sagnarigu Municipality yet the factors contributing to the low performance has not been investigated. Therefore, it is essential to undertake the study to unearth the factors responsible for the differences in gender performance in mathematics among students of Senior High Schools within the Sagnarigu Municipal Assembly and the impact thereof.

1.2 Statement of the Problem

Mathematics has over the years been preserved as less difficult for male students across the globe (Leder, 1990). Gender parity in mathematics had existed in the Senior High School system since its inception in Ghana. This is evident in the Education Sector mathematics Performance Reports for 2012 and 2014 where the overall pass rate in WASSCE for males was 55% and 44 % for females in 2012 while the overall pass rate

for males was 51% and 44% for females in 2014. Assessing the factors that influences gender differences in mathematics performance in the five Senior High Schools in the Sagnarigu Municipality is worthy of study. This phenomenon if not investigated and curbed, will undermine gender equity in mathematics. It can also restrict most female students from progressing to the tertiary level since mathematics is a basic requirement for admissions. According to the Education Sector mathematics Performance Reports of Ghana, comparison of results based on regional bases showed that Northern Region was last for both years with percentage (pass) of 23% and 34 % respectively. Further assessment of the result shows low pass rate for female students in the Region. If these students are taught by the same teachers, what could be the factors contributing to the disparities in performance by gender?

The low performance of female Senior High School students in mathematics in the Sagnarigu municipality and the Northern Region as a whole, is a concern to parents, teachers and other educational stakeholders. Mathematics teachers have cited attitudinal factors such as low interest and poor attitudes to mathematics learning among others as some of the factors responsible for gender differences in mathematics achievement (Lee & Anderson, 2015). Even though several studies conducted over the years on gender differences in mathematics achievement seem to produce conflicting reports (Lindberg et al., 2008; Hyde et al., 2014), there is no study conducted in the Sagnarigu Municipality to ascertain the gender differences in mathematics achievement and the factors that contribute to that. There is therefore the need to undertake the study on the impact of gender difference on mathematics performance among students of Senior High Schools within the Sagnarigu Municipality of Northern Ghana and suggest possible remedies to improve on the academic performance of female students in mathematics at WASSCE.

1.3 Purpose of the Study

The purpose of this study was to assess the factors that influence gender disparity in academic performance in mathematics among SHS students in the Sagnarigu Municipality of Northern Ghana.

1.4 Objectives of the Study

The general objective of the study was to establish the factors that influence gender differences in mathematics performance among SHS students in the Sagnarigu Municipality. However, to achieve this, the specific objectives of the study were:

1. To establish whether there are differences in students' performance in mathematics in terms of gender in the SHS in the Sagnarigu Municipality.
2. To assess the contributing factors that lead to the differences in students' performance in mathematics based on gender in the Sagnarigu Municipality.
3. To establish the effect of female students' attitude towards mathematics on their career aspirations.
4. To evaluate teachers' perceptions of students' performance in mathematics by gender

1.5 Research Questions /Hypotheses

The following research questions guided the study:

1. What is the extent of gender differences in mathematics performance among students in the Sagnarigu Municipality?
2. What are the contributing factors that causes differences in performance in mathematics by gender in the Sagnarigu Municipality?

3. What is the effect of female students in the Sagnarigu municipality attitude towards mathematics on their academic performance?
4. What is the effect of mathematics teachers' perceptions of students' performance in mathematics by gender?

1.5.1 Hypotheses

Ho: There is no significant difference in students' performance in mathematics by gender in the Sagnarigu municipality

1.6 Significance of the Study

The findings of the study will add to the many solutions to mathematics education problems in senior high schools in Ghana and the world at large. Also, the study provides useful information to researchers, educators and to some extent learners in an effort to improve teaching of mathematics and improving students' (especially females) involvement in mathematics curriculum. Furthermore, the findings will enable teachers to evaluate their teaching methodologies and adopt those which could improve performance of all students in mathematics.

In addition, mathematics teachers will see the importance of being gender sensitive in order to avoid bias when delivering their lessons and it will emphasize on the need for more capability building among the mathematics teachers in the Sagnarigu Municipality and this could aid in changing the attitudes of the students and the entire society as a whole. Finally, the study will contribute to literature and fills research gaps which could be adopted and used in comparison to other studies elsewhere.

1.7 Scope of the Study

Geographically, the study area covers the Sagnarigu Municipal area of Tamale in the Northern Region of Ghana. The study assesses the WASSCE performance of students in mathematics based on gender among the five (5) Senior High Schools within the Sagnarigu Municipal Assembly. The study also assesses the mathematics performance of current WASSCE candidates within the municipality. It will establish the facts of disparities in performance of WASSCE candidates in the past five (5) years and the current final year students among the schools within the municipality. Furthermore, the study elucidates the factors that contribute to the differences in performance and suggest possible remedies to improve the teaching and learning of mathematics in the district and the country at large.

1.8 Delimitations of the Study

The study was carried out in senior high schools in Sagnarigu Municipality of Tamale in the Northern Region of Ghana to examine the impact of gender differences in mathematics performance. Even though the scope of the problem demands a nation or the whole northern region study Sagnarigu municipality is one of the districts in the northern region chosen for the study which has five senior high schools where the data would be gathered. However, the findings reflect the impact of gender differences on students' performance in mathematics in the Sagnarigu Municipality of Tamale which are applicable in other Districts and Municipalities in the country.

1.9 Limitation of the Study

Since the sample respondents were solely drawn from public senior high schools in Sagnarigu Municipality, this will reflect the situation in the municipality. Hence, the findings and conclusion may not be representative of all Senior High Schools in Ghana

and it could limit the generalization of the conclusion. Resources (time and funds) were other limitations of the study. Inadequate time and funds for the study restricted the extension of the research to other parts of the Region and the country at large.

1.10 Organization of the Study

The study is organized into five chapters. The introductory chapter which is chapter one explains the background of the study, statement of the problem, the objectives of the study, purpose of the study, research questions/hypotheses, significance of the study, scope of the study, delimitation of the study, limitation of the study and the organization of the study. The second chapter looks at the relevant literature on gender and mathematics performance, as well as the theoretical and conceptual bases of the study. The third chapter presents the methodology by discussing the research design, the population, sample and sampling techniques, research instrument, data collection and analysis techniques. Chapter four consists of analysis of the results from the data gathered on impact of gender difference on mathematics performance among Senior High School students in the Sagnarigu Municipality of Northern Ghana in the previous chapter and finally chapter five which is the concluding chapter, presents the summary of findings, drawn conclusion and the necessary recommendations of the researcher on the subject matter.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

The study was designed to assess gender differences on students' performance in mathematics, the factors that contribute to the differences, and the impact of female students' attitude towards mathematics on their career aspirations in the Sagnarigu Municipality of Northern Ghana. This chapter reviews literature related to the study. Literature review relates a study to the larger ongoing dialogue in the literature, filling in gaps and extending prior studies (Boote & Beile, 2005). The literature review provides a framework for establishing the importance of the study as a benchmark for comparing the results with other findings (Boote & Beile, 2005). The review of relevant materials permits a comparison of the findings of the current study and similar researches to provide a basis for confirming or disproving earlier judgments made. This literature reviewed is to assess the impact of gender difference on students' performance in mathematics female students' attitudes will cover the following areas:

a) Theoretical frameworks
b) conceptual framework
c) gender differences in mathematics performance among students in school
d) factors that influence gender difference in mathematics performance in schools
e) Educators' perception on gender performance in the study of Mathematics.

2.1 Theoretical Frameworks

This study was guided by the social learning theory by Bandura (1997). The theory states that in social situations, people often learn more rapidly by observing and modeling the behaviors of others. Education is always carried out in a social context. This theory is applicable to this study since the social factors underlie the gender difference in mathematics performance. This study is influenced to a great extent by observable teacher behaviours that affect students' performance, either directly or indirectly. The nature and the strength of the influence of teachers on learners

depended to a significant extent on a variety of contextual factors such as availability of equipment and materials, the number of students in a classroom and the teaching method used by the teacher.

In patriarchal cultures, male students link their achievement to future opportunities and outcomes. As a result of the decreased opportunities afforded to females, girls do not perceive such a link and thus do not achieve as boys do in domains that they perceive to be less useful. Boote & Beile (2005), argue that female students, who are faced with less opportunity, may see mathematics as less important for their future and are told so in a number of ways by teachers, parents and friends. Opportunity structures can shape numerous socialization processes that shape performance.

Over the last decades, diverse theories and frameworks have been developed and many have tried to identify factors that influence the mathematics performance in order to reduce gender inequality in mathematics achievement (Boote & Beile, 2005). The present research borrows heavily from the suggestions advanced by the Social Learning Theorists.

2.2 Conceptual Framework

The opportunity propensity model is a distinct model as proposed by Byrnes and Miller (2007) and has been useful in recent years in the field of mathematics studies. The conceptual model considered in this study pertains to how educational opportunities are given to students and the determinant that influence how these students employ these opportunities. The mathematics setting where children grow up varies significantly and this may be determinant to gender differences in mathematics performance. Students' performance in mathematics can be affected positively or negatively depending on the type of opportunity the mathematics environment exposes its students to. Byrnes and Miller (2007) an opportunity–propensity model of achievements presented in Figure 2.1.

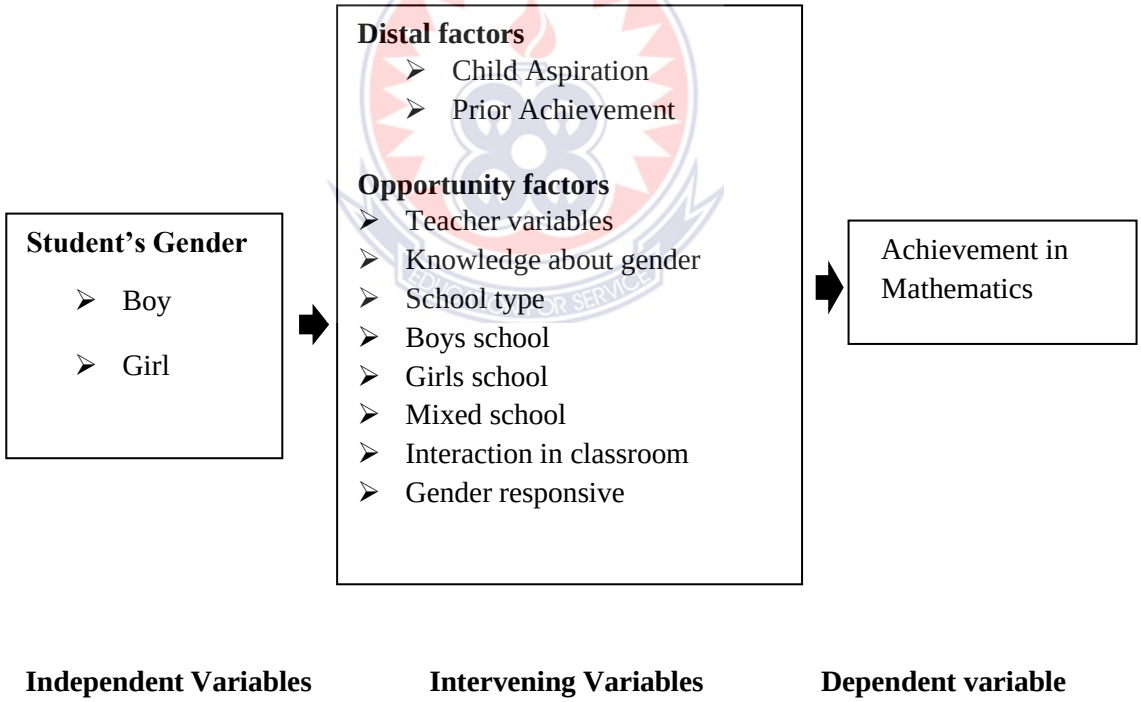

Figure 2.1: Opportunity-propensity model adapted from Byrnes and Miller (2007, p. 602)

Figure 2.1 shows the relationship between the factors that directly contribute to effective learning which also affects the students' achievement in mathematics. The

performance in mathematics involves independent variable, that is, students' gender, intervening variables such as distal factors and opportunity factors which include teacher, student and type of school which the output is the student's mathematics achievement. Females have many problems due to weak economic statuses such as eating, living and clothing which are their priorities before attending schools. High socio-economic status of families encourage education. Middle class families are found to use the medium of instruction in school (English) to communicate with their children at home. This has a positive impact on the performance of the children as they become well versed in the language even before entering school and thus have an initial advantage over those children from lower class homes that may be learning the language for the first time. Also, the language of instruction is the same language that is used in setting examination questions. Hence the success of the students depends on their understanding of the examination questions. Therefore, when students are already well versed in the language of instruction, this gives them a slight edge over students of a low-class family. The socio-economic status of parents has negative effect on their performance in mathematics. When income available to the family is not enough, it has significant impact on the education of the student. If the student constantly lack food, he or she might find it difficult giving his/her fullest attention to the lessons in class.

Also, a student whose parents cannot provide uniform or clothes may suffer serious emotional distress because he or she feels embarrassed before his or her mates. This emotional problem may make him play truancy as a way of covering up serious psychological troubles. It is also obvious that if the income is low certain facilities that enhance education in the home such as toys, books, writing materials, radios, televisions, videos, wireless sets etc., will not be available to the student and all these will go a long way to adversely affect his performance. Due to low economic status

many school children in Ghana especially the Northern sector work at home after school each day. The hours of working at home other than study have a negative effect on the students' achievement in school. That means more students are engaged in the domestic chores to support their parents. This has more negative impact on their education because they have less time for study and they get tired and cannot concentrate on their studies at home. Parents' minds are programmed on traditional concepts about girls coupled with consequences of socio-economic status girls face. Schools with high social economic status students are more likely to have greater support from parents, fewer disciplinary problems and more chance to attract talented and motivated teachers.

The students' level, home background index is a strong predictor of achievement in mathematics (Guo et al., 2015). Also, the student's aspirations towards mathematics affect his or her achievement in the subject. It is basically the acquisition of proficiency in a subject that leads to positive attitudes in that subject (Wang *et al*., 2011). The ability of the learners in terms of how they handle different mathematics questions also affects performance. However, the interactions among students in a classroom coupled with competition among them aids in high achievement in a subject.

The opportunity factors that mainly involve teacher variables, classroom interaction and school type as intervening variables have a great impact on mathematics performance. Mathematics teachers play an important role and therefore, have a strong influence on the students' learning of the subject. For instance, teachers' methods of teaching are part of their political decision in relation to whom they are empowering in the classroom through their actions. The way teachers present the content of the curriculum to the students might also be biased. Teachers use competition and speed among the students without their understanding or cooperative learning approach

(Huang et al., 2014). For instance, teachers forced students to use repetitive and rote learning approach during instructions (Huang et al., 2014). Petersen (1991) cited by Daneshamooz and Alamolhodaei (2012) studies revealed that females learn better in cooperative learning environment so when this learning style is taken away, females feel they do not understand mathematics and strategy of teaching is not effective and do not participate in the lesson. Hence, they do not get attention, interaction, feedback and praise from their teachers. This teacher-centred method may create social injustice because, the students do not have the opportunity to learn at their pace and learn through interaction and negotiation (Panthi et al., 2018). Students should be given the opportunity to reflect on what they have learned. The pedagogical choice of teachers toengage students in higher order thinking, reasoning and problem solving has a direct influence in the performance. Many students in Ghana can solve basic mathematics problems but they are not competent in critical thinking, reasoning and problem solving. For instance, what takes place in classroom environment can either narrow or increase the gap because the teacher may play a role in improving the students' academic score based on his or her teaching methodologies. This may go a long way to change the students' attitude.

The level of training and instructional approach coupled with teaching and learning materials at the disposal of teachers also have effects on students' achievement in mathematics. The teachers' inability to evaluate himself/herself in a classroom setting makes one unable to understand the students' problems especially for girls, hence ineffective communication in a mathematics classroom (Kapur, 2018; Joseph & Hailu, 2019). Teacher variables, Knowledge about gender, School type, Classroom interaction, Gender responsive, indecision also contribute to gender gap in mathematics

performance. Performance is therefore the reflection of the interaction between the independent variable and the school environment.

2.3 Gender gaps in Mathematics Performance in Schools

Gender is a social construction rather than a biological phenomenon. It refers to the sexual distribution between male and female. Gender involves the psychological and socio-cultural dimensions of being male or female (Ewumi, 2012). It is a set of characteristics distinguishing between male and female, particularly in the cases of men and women. A gender role is a set of expectations that prescribes how females or males should think, act and feel. Gender relates to the difference in sex (that is, either male or female) and how this quality affects their dispositions and perception toward life and academic activities (Vecchione et al., 2014).

Steegh et al. (2019) systematically reviewed studies on gender difference in mathematics competition in Germany. The study indicated that the attitudinal differences between males and females in mathematics is the major factor that leads to differences in mathematics performance among students. The study further indicated that during mathematics competitions, boys outperformed their girl's counterparts. The study concluded that male student does better in mathematics as compared to their female counterparts in secondary school. In another study conducted at Pakistan by Ullah and Ullah (2019) suggested that the male students performed well in mathematics as compared to their female counterparts.

According to Faith (2017), there is differences in the performance of boys and girls as a result of the difference in their cognitive ability and learning process. Also, a study found out that at the junior high school level, boys do well academically compared to their female counterparts especially in mathematics (Mutodi & Ngirande, 2016).

Furthermore, Susan and Wandera (2019) concluded that as boys and girls grow up, their differences in mathematics performance continued to widen. A study indicated that male and female students have low expectation on girls' performance in mathematics (Ngware et al., 2015). In addition, a study conducted at Ethiopia by Simegn and Asfaw (2018) which assessed the effect of attitude towards mathematics achievement for grade 10 and 12 students based on gender. It was revealed by the study that both genders performed equally very well in their early ages. However, the disparity is observed in their high school level. Also, the study indicated that attitude towards the subject is highly correlated to students' performance (especially female students).

In a study conducted in Uganda to assess students' achievement levels in mathematics among primary schools, Kakooza (2018) found that there was a significant gap between girls and boys in Mathematics achievement during the standardized examination. Indeed, the male counterparts outperformed their female counterparts. The female students were found to exhibit lack of confidence and motivation leading to their poor performance in the mathematics subject. Similarly, Mbaki et al. (2016) conducted a study in Kenya to assess the female students' performance in public secondary schools. Their study revealed that female students generally performed poorly in sciences and mathematics at all the educational levels. The female students were mostly affected by gender insensitive infrastructure which leads to their low confidence and hence academic achievements compared to their male counterparts. In the same country, Awuor (2016) study concluded that the female students performed very well compared to their male counterpart in mathematics.

In the Ghanaian context, a study was conducted by Tetteh et al. (2018) to assess the gender differences in performance in Mathematics among pre-service teachers. The

study found that although girls' clinics were organized to boost their performance in mathematics, tutors still needed to develop strategies that boost the performance of females. The study conducted by Anokye-Poku and Ampadu (2020) also indicated that male students do well in mathematics as compared to the female counterparts. However, a similar study conducted in Nigeria found out that mathematics performance favors male students as they performed better and with less efforts than their female counterparts. male students were found to spend most of their time revising mathematics while females only revised when it was most necessary. The less time the females spent on revising explained why their low performance. The study concluded that the conventional nature of females in problem solving strategy is the cause of their poor performance in mathematics as compared to their male counterparts.

2.4 Factors that influence Mathematics Achievement in Schools

In this section, the potential factors that can influence gender performance are examined.

2.4.1 Students' attitude

As indicated by Brown and Kanyongo (2016), a positive attitude towards a subject is when a student is aware of his or her ability and prepared for achievement. Students develop positive attitude when they have attained all the necessary skills and knowledge in a subject (Muneja, 2015). A demonstration of positive attitude towards mathematics can be seen by the participation of a student in class, the effort by the student in the subject and the quality of work the student gives to mathematics (Obinna-Akakuru et al., 2015). Ansah *et al*., (2020) suggested that affirmatory attitude is critical in promoting mathematics performance among students. Ngisa et al. (2017) observed in their review of literature that studies on students' attitude have been well documented

(Ansah et al., 2020; Armah et al., 2021; Asante, 2012; Butakor & Nyako, 2017; Butakor & Dziwornu, 2018; Tetteh et al., 2018; Yarkwah, 2020). Studies in Ghana (Chukwuyenum & Adeleye 2013; Ansah *et al*., 2020; Ajai &Imoko, 2015; Kyaruzi, 2021), other African countries and around the world (Leaper & Arias, 2011; Mohamed & Waheed, 2011; Mata et al., 2012; Peteros et al., 2020) have shown evidence of factors that affect gender achievement in school and their career prospects in science and mathematics areas.

Okyere's (2019) study on students' attitude on mathematics and performance among senior high school students revealed that mathematics performance is highly related to the attitude of the students. The study further showed that mathematics teachers that show positive attitude towards the subject causes their students to also show positive attitude towards the subject too especially the female students. In south Africa, Mutodi and Ngirande (2016) studied the effect of students' attitude and perception on mathematics performance. The outcome of the study indicated that there was a significant difference in perceptions (being negative or positive) and attitude between males and females. Also, the study showed that there was a positive correlation between performance and attitude and perceptions.

It was evident that a positive relationship exists between attitude and the academic achievement (Nga' nga et al., 2019). Although, there is a relationship between the attitude and academic achievement, Nga' nga's *et al*. (2019) study revealed that the low performance could not always be associated with the negative attitudes of the students. However, continuous poor academic performance in mathematics could result in a negative attitude that eventually leads to the truncation of education. Samuelsson and Samuelsson (2016) however suggested that the possibility of a student who has

never performed well academically in the past may as well fail the future and vice versa. Also, the students who report their likeness for sciences and mathematics perform better than those who do not like it. Motanya (2018) study on the influence of attitude on mathematics performance among female students in Kenya. The study assessed the relationship between attitude and mathematics performance and the outcome showed that female students perceived mathematics as a difficult subject. The study also indicated that most of the female students showed poor classroom participation during mathematics lessons as the students showed high level of fear and anxiety. The study however suggested to stakeholders to invest in changing students' mentality on mathematics.

Another study conducted in Kenya on the effect of attitude on the performance of students in mathematics by Ejakait et al. (2016) revealed that the academic achievement is highly related to the students' attitude towards the subject. The study recommended for administrators and teachers to develop activities related to mathematics to promote the attitude and perception of students in mathematics. In Netherlands, a study conducted by Van Hek et al. (2018) revealed that high school female students perceived mathematics and science, engineering and technology as too difficult, uninteresting and irrelevant. This could be the reason why some female students are not well committed to excellence in science and mathematics and thereafter establish a career for themselves (Motanya, 2018).

2.4.2 Student cognitive development in mathematics

Choice of subject by students depends on the student's capability and interest in that particular subject and their chance of passing. The interest and capability of the student is reinforced by the female student's estimation of their own ability in the comparative

difficulty subject. It is been speculated by researchers (Iwuanyanwu, 2022) that few female students study mathematics since they are less confident than male students of their own ability and to choose difficult questions. Females tend to underestimate their particular skills and ability (Ansah *et al*., 2020). According to Adamu (2018), females also tend to undermine their potentials in all areas of their lives such as their ability to learn, verbal spatial aptitude skills.

An investigation by Panaoura and Panaoura (2016) on the cognitive and metacognitive performance on mathematics in Middle East countries indicated that the processing speed, inhibition and control and working memory are the three main features that promote metacognitive performance of the mind. The study revealed that the processing speed and efficiency has a coordinating part they play in the cognitive system that either promoted metacognitive performance or delayed it. The study further agreed that in as much as mathematics is a creative subject, it is only students with better cognitive ability that can perform better. In concluding the study, the researchers suggested that female students perform better in mathematics as they have better cognitive abilities. In line with this finding, study, Chesimet et al. (2016) also indicated that female students are better in following pattens (both internally and externally) than males at the same academic level, hence they perform better in mathematics compared to their male counterparts.

More to the point, students attribute their success and failures to different factors. As presented by Soni and Kumari (2015), female students attribute their failure to personal factors and inability to succeed to inherent shortfalls. On the other hand, male students attribute their failure to external factors. They suggest that their inability to succeed could be as a result of unnecessary factors. However, females score higher grades as

compared to males (Bahar, 2016). Other studies (Seidel & Shavelson, 2017; Steegh et al., 2019) agreed that the performance of females is curtailed by the capabilities. Another study suggested that the differences observed among males and females in terms of their academic performance are due to social factors and consequences are reduced by trainings and workshops (Enu et al., 2019). Female students have a better study skill compared to their male counterpart which could be observed in their academic performance.

2.4.3 Learning environment

Learning environment consists of the physical, economic, social and culture conditions prevailing in the world together with forces that influences human development. Classroom environment according to research is the relationships between teachers and students and between students which include academic support, goal types, teaching methods, instructional materials, teachers' beliefs and teaching practices (Wetzel & Farrow, 2023). The type of school is imperious for effective learning.

According to Awuor (2016), the lack of facilities in schools such as qualified teachers, sufficient classrooms, rest rooms, laboratories and laboratory equipment and other important resources strongly influences performance of learners differently by their gender. In Ghana, the availability of learning resources is highly dependent on the level of the school. The classification of school depends on it being private or government own. However, the government own schools are categorized into A to D based on facilities. According to the Beijing declaration of 1998, discrimination of girls' access to education persists in many areas, due to customary attitudes that boys' education first and girls' second.

According to Saya et al. (2017), when parents are faced with constraints of resources or opportunities for schooling, they favor the male child; consequently, a male student accesses a better school with better resources as compared to the girl child. Also, a study argued that a school might be an important factor in determining school attendance (Likando, 2017). The study further stated that girls are easily affected by the accessibility of school and also its quality which girls related to negative physical and psychological issues of menses could not be overlooked (Van Hek et al., 2018). Lack of the required items such as an appropriate sanitary material, lack of water, separate toilets create fear and uneasiness in the girls resulting in poor learning and performance (Ullah & Ullah, 2019).

Akinyi and Musani (2018) assessed the influence of school-based factors on the performance of girls. Akinyi and Musani (2018) suggested mathematics performance of girls was affected by several school-based factors such as indiscipline, relationship and wastage of time. In the study, it was evident that boys performed well although when school-based factors affect them negatively. The study further recommended that guidance sessions and inviting resourced persons to talk to female students as they are affected more negatively by school-based factors than boys. In a study by Ngware et al. (2015) which assessed the quality of teaching and learning achievement gains pupils in primary schools found that the experiences and skills of teachers affected the performance in mathematics. According to the study boys and girls performed the same when subjected to the same factors. The study concluded that the learning environment particularly the teachers have major impact on the performance of mathematics. For instance, the learners acquire certain behaviors and habits by observing and imitating the character of teachers. Learners pick up their teachers 'choice of clothes, makes ups, the way they speak, walk and carry themselves, etc. These teachers reinforce traditional

sex roles by the way they assign different classroom tasks to male and females in the learning environment. Girls may be assigned in cleaning up the classroom whiles the boys may be asked to carry books or other heavy items out of the classroom and this is a social problem inherent in education gotten from the fact that education especially in modern complex societies implies a division of labour that is who plays what role comes to mind? This assigning of classroom tasks determines whom the teachers are empowering. Also, in the learning environment, the way teachers distribute their questions to the students could also bring some disparities and that may affect the females' performance. Since education takes place in social group, students' educational processes are affected by emotional tension, likes and dislikes, attitude and prejudices. Also, the learning environment is affected by socialization process and this affects personality formulation and personality change.

It has been well documented that the lack of adequate school facilities in most African countries which leads to some students either sitting on the floor, under trees or wooden structures in a very crowded classroom, with teacher to learner ratio of 1: 60 (Ngware et al., 2015). In most cases, female students find it difficult to study. Although, some governments in Africa allocate millions of monies to cater for sanitary pads for adolescent girls in school which priority is given to slums and remote rural school yet the learning and poor academic performance still persist. It was also observed by Asante (2018) that inadequate school facilities lead to other shortcoming such as more failure and class repetition rate which led to high drop-out of female students.

Also, a study conducted by Steegh *et al*., (2019) on gender differences in teaching and learning mathematics in Sweden showed that there exists difference in perceptions of classroom set-up among boys and girls. Steegh *et al*., (2019), concluded that boys take

mathematics subject as more important than girls and this suggested why boys performed better than girls. In addition, the study indicated that boys felt more involved in classroom and discussion group than girls. Van Hek et al. (2018) studied the effect of school resources and practices on the performance of male and female students in Netherlands. It was evident that good resources impacted positively on the academic performance of boys than girls. The study further suggested that when the population of boys are high in a classroom, they would perform better but girls the opposite works better. The study conclude that female students benefitted more from schools that are socio-economically advantaged.

2.4.4 Parental and family attitudes

The student gets his or her initial education through interaction with those immediately around him or her that is parents, siblings and other relatives and neighbors. Hence, the quality of the socialization of the child, whether positive or otherwise, will depend very much on the caliber of people around. His or her personality is shaped through the influences of those around him or her. Oke (1986) maintains that in extended family children are reared together, children are encouraged to work together, encouraged to have the spirit of we feelings, they are discouraged from forming selfish attitudes and are told to desist from fighting and quarrelling amongst themselves. The effect is that in school such children are not selfish and quarrelsome and easily adjust to groups and respect seniority and are less aggressive. These show that there is peace and love in their homes. Also, when several wives live together in a particular home locked up in rivalry, quarrel and fighting, children pick up aggressive and quarrelsome attitudes and exhibit them at school. In such families, socialization of children depends on the older siblings. If the older siblings acquire certain bad or undesirable habits from outside, the younger ones easily acquire such negative attitudes. The family's influence on the

education of the child does not end with his socialization during childhood but extends to his formal education too. Studies (Yilmaz Bodur & Aktan, 2021) have shown that the attitude of the parents who have positive attitude towards education generally do well in school. In such families, whether rich or poor, parents consciously make provision for the education of their children. Families that are ill-disposed to formal education, no matter how affluent they may be tend to be half-measured towards the schooling of their children. It is not uncommon to come across rich African parents who refuse to send their children especially girls to school. According to Weerasinghe (2017), parents have a higher expectation for male children in mathematics performance than female children. The doubting of the female child's performance lowers the child's confidence which leads to their poor performance in the subject. Also, Mutodi and Ngirande (2016) observed in their study that parent either foster positive or negative attitude to their children. Mutodi and Ngirande (2016) further concluded that parent promoted the development of naturalists and interpersonal skills in girls while promoting practical skills in boys. Having in mind that mathematics is very practical subject which is meant for the male child. A study indicated that parent promote gender inequality with their disparity expectations for their children (Saya et al., 2017).

A mother' s education level plays a role in her daughters' chance in participating in science and mathematics at school. The mother becomes the child's educator and could introduce scientific explanation to the unexplained puzzles and events of the world in which a child may find understandable. Therefore, the science-oriented mother aids in the child scientific thinking and reasoning potentials (Likando, 2017). According to Brown and Kanyongo (2016), the parental involvement in education and the resources uses for the children either promote or derail the performance of their children.

Students' awareness of the non-involvement of their parents in their academic activities leads to poor performance and the vice versa.

An investigation of the parental influence on students' mathematics performance in Turkey by Kilic and Askin (2016) indicates that parents that are involved in their children school work leads to the success of their wards. The study further found out that the attitude of parents also could influence their children's academic performance at school. Kilic and Askin (2016) concluded that parents play a crucial role in the mathematical performance of their children. A study conducted in India by Soni and Kumari (2015) which assessed the role of parental mathematics attitude in their children achievement of mathematics. Soni and Kumari (2015) found that father's positive attitude towards mathematics improved the performance boys in mathematics. On the other hand, mothers' attitude towards mathematics had no effect on the performance of boys in mathematics. However, the female child could be influenced and perform very well in mathematics by both parents' positive attitude. They concluded that parental positive mathematics attitude was important in aiding the performance of mathematics. Also, a study at China by Li and Qiu (2018) on how family background influences the educational achievement of a child in primary education discovered that parenting attitude and their educational support given to the child influences the performance of the ward. The study noted that the socio-economic level of the parents also influences the academic performance of children. The study further agreed that since mathematics is one of the main subjects in primary school, creativity and better family background is a motivation for a performance.

2.4.5 Cultural beliefs

Formal education was introduced to Ghana through the missionaries and colonialists. The Ghanaian cultural system allowed only boys to be educated till female education was massively promoted for the past five decades. In a study conducted at Malawi indicated that some subservient culture practices like kneeling to parents and elders have led to female children believing that males are superior to them especially in handling difficult tasks such as mathematics (Saya *et al*., 2017). According to Bahar (2016), stereotypical perception resulted in boys studying "difficult" subjects while girls were left to study art subjects.

Saya et al. (2017) conducted a study on the effect of socio-cultural practices on the academic performance of female students in primary school. The study showed that since 2012, female students' performance in mathematics had been discharging. Saya (2017) also noticed that stereotype gender roles are the main factors leading to poor performance for females than males. Saya (2017) suggested that parents should equally share house chores among both genders to enhance female students the opportunity to focus on their academic performance. In study conducterd by Ngware et al. (2017) among primary schools to establish the gender gap in mathematics achievement showed that boys performed better than girls in mathematics primary school national examination. The study also showed that boys received more encouragement than girls. The study concluded that gender gap at the entry level comes from the community and other cultural differences.

Also, Brown and Kanyongo (2016) assessed the gender and mathematics class participation observed that during early primary classes, girls performed better than boys and the girls showed more eagerness to learn than boys. The study also suggested

that there were no major cultural differences that would influence the performance of either male or female. The study also noticed that as boys and girls progress to higher levels, mathematics performance of girls is lowered while that of boys is improved. The study concluded that gender stereotypes existing in the community influenced female students as the technical subjects were believed to be hard and only boys would handle them successfully.

2.4.6 Teaching methods

Teaching of mathematics as a subject has shifted from the traditional exhibited methods to a more hands on approach as suggested by Strengthening Mathematics Science in Secondary Education (SMASSE) project (2009). Research and science into education has led to a gradual shift away from the autonomous, mundane and rigid teaching techniques to newer and modern methods that afford our students the opportunity to train their mental faculty and become critical thinkers and problem solvers. There is therefore a need for teachers to restrain from being solely interested in the end results to acquiring knowledge on the ways they can reach their aims in a more sustainable and effective manner. The Traditional/ Conventional Teaching methods were typically characterized by a teacher – dominated interaction; where teachers solely served as the source of knowledge while learners serve as passive receivers; in plain words, knowledge was being poured from one receptacle to an empty one. The traditional teaching methods put responsibility on the teacher and it is believed that if students are present in the lesson and listen to the teacher's explanation and examples, they will be able to use the knowledge. Even though the modern teaching methods share some common characteristics with the traditional methods, it makes use of various activities such as, group work, storytelling, presentation, lecturing, games, individual assignment, and numerous other activities within one lesson. Modern teaching methods promote

contextual learning and active learning where students are trained to think, talk and share information. They are trained to think analytically, make conclusions, find evidence and identify the pros and cons. Such learning involves peer instruction, group discussions and collaborative solutions, to problems rather than only memorization of knowledge. In addition, modern teaching methods make use of technological devices such as, the internet, multimedia, and other modern devices. This has enhanced access to information and knowledge.

Mathematics education need to adopt student centered approach and activities to enhance retention. Pedagogy applied need to harness learner centered method, together with the integration of other methods when teaching since not all scientific areas can be delivered practically such as mastery learning approach (MLA) (Saya *et al*. 2017). Some curriculum makers should be selected for possessing sound professional skills and expertise in how to effectively teach a particular subject. Such could be classroom teachers who must have firsthand contact with the taught and therefore know their learning needs, difficulties and abilities as well as how best to motivate them to learn.

Indeed, when respected representatives of classroom teachers are included in curriculum design teams, it adds credibility to the work of the team and thereby enhances the eventual implementation of the curriculum. Teachers need to use teaching methods in consideration of gender being taught. A study conducted by Ganyaupfu (2014) on the teaching methods and students' academic performance observed that a teacher-interactive approaches were the most effective teaching methods that promote the performance of students. The study also observed that student centered approaches were more effective than teacher centered methods. Ganyaupfu (2014) concluded that student-centered methods are more effective and have a positive correlation on

mathematics performance. Also, Saya *et al*. (2017) study on the relationship between teaching approach and student performance in mathematics showed that mathematics performance in secondary schools had continued to be low for both genders. The study further proves the point that positive correlation exists between teaching methods and student's achievement. The study concluded that the introduction of ICT in teaching mathematics is one of the primary determinants that could improve mathematics performance in the Kenya.

In Ghana, a study conducted by Enu and Nkum (2019) on the factors affecting student's mathematics performance, among other objectives, the study focused on school-based factors such as teaching and learning methodologies. The study observed that inadequate teaching and poor learning materials resulted in the poor performance of the students. It also revealed that teachers' methodologies and the student's self-motivation are vital factors in promoting mathematics performance. The study concluded that students need a deep understanding of the mathematics before applying it in examination therefore the need for educators to adopt holistic concepts when handling the subject.

2.4.7 Lack of positive role models

Female students' performance in education is most likely to be influenced by role models. In a study conducted by Anokye-Poku and Ampadu, (2020), in Malawi showed that school girls lack female role models in mathematics and this impacts their skills, interest and attainment in the subject. The ratio of women teachers in mathematics in most African countries are particularly low because few women with necessary mathematics background do accept to teach or attend teacher training colleges. As indicated by Anokye-Poku and Ampadu, (2020) , inadequate female schols

and female teachers is the fundamental or vital constraint for them. According to Khadjavi et al. (2022), female mathematics role models are those who have been able to leave a legacy pave in mathematics. These instances of women within math's discipline who are at different levels of their studies and careers sharing their views on working in Mathematics which can often be seen as male dominated environments (Khadjavi *et al*., 2022). The presence of group members in an academic or professional context in mathematics can improve sense of belonging, self-efficacy, attitudes, and identification, and can change the perception of a domain in which the group is negatively stereotyped from that of a threat to that of a challenge (Khadjavi *et al*., 2022) findings indicated female role models in mathematics brings positive changes that can in turn increase effort, performance, and active participation, and influence individuals' career aspirations. The stereotype inoculation model also suggests that similarity and identification with role models are important moderators of these effects (Khadjavi *et al*., 2022). In addition, role model gender has been found to be important for inspiring females, but not males (Lockwood, 2006). Does lack of female role models in mathematics impact the performance of girls in mathematics? The findings which influence the female students' perception of mathematics and more girls were encouraged to take up mathematics and as a result get into some respectable male dominated careers like engineering, medicine, astrology, accounting and others.

According to the gender policy on the elimination of gender disparities in primary and secondary education emphases on the implementation of the education strategic plan (ESP) 2010-2020 which strongly focuses on the achievement of equitable access to good quality and gender parity in education and guarantees improving opportunities for all children in the first cycle education. However, the policy was expanded when the Free Senior High School (FSHS) policy was introduced in 2017. In Ghana, there is high

proportion of women teachers in the basic school and non-STEM subject. This foster competition among female students at that level of education (Enu et al., 2019). The impact of female's head teachers on girl's performance was considered stronger than that of female teachers. Government of Sierra Leone (2020) reported that education system has very few role models to effectively motivate the female child to aspire for higher education.

A study conducted by Marx and Roman (2002) examined the impact of the gender of a mathematics role model on women and men's mathematics performance and performance state self-esteem, and found that women and men had equivalent mathematics performance and self-esteem with the female role model, but men performed better and had higher self-esteem with a male role model. Two follow-up studies used only female role models, but manipulated perceptions of competence, and tested the effects on mathematics performance, performance state self-esteem, and mathematics self-efficacy. Women performed better with a competent female role model, whereas men performed worse with a competent female role model. Mathematics self-efficacy was higher for female participants in the competent female role model condition, compared to the non-competent female role model condition. Female mathematics role models can encourage girls' participation and performance as the effect of female role model competency on female's state self-esteem varied, with a study finding that women had lower performance state self-esteem in the competent female role model condition than in the non-competent female role model condition and the other finding the opposite pattern (Khadjavi *et al*., 2022).

A student who falls out of place in a mathematics class will give up the task given her or face it poorly, and thus end up with a poor performance. In the case where the female

student feels at home or competent in a mathematics class, her achievement need will increase and thus she can perform better. It is only when the female's need of belonging to those who can do well in mathematics is met that the female student can work harder and perform better to meet the achievement needs. Mathematics teaching and learning has been an area of much interest to scholars who at different times and in different ways have written on issues related to performance.

According to the study conducted by Sharma et al. (2013), female students performed better as compared to male students in the subjects taught by female teachers. Also, in France, Khadjavi *et al*. (2022) conducted a study on the effect of role models on the academic performance observed that female students were more inspired to perform better in schools with female teachers in mathematics. Khadjavi *et al*. (2022) also observed that boys depend less on their mathematics performance as compared to girls. It further stated that the role female teachers play improve the academic performance of the students and it motivates the female students in the subject. From the study it was also clear that female students that were taught by female teachers performed well as compared to those taught by male teachers. Khadjavi *et al*. (2022) concluded that female students need female teachers as role models in mathematics to improve their studies.

According to Verniers and Martinot (2016) looked at the virtues of a hardworking role model in improving female students' mathematics performance observed that both genders scored the same on a difficult mathematics test after being exposed to a hardworking female role model. The study also noted that hardworking role models promoted the performance of both genders. The study concluded that self-efficiency,

which is a motivation for a better mathematics performance is promoted by hardworking role models of both genders.

2.4.8 Peer influence

At the age of five or six, the Ghanaian child enters the social world of his or her peers or age mates to receive major socialization influences from the peer group. In the peer group, the child is free, has more initiative and active in his or her learning than he is in most adult-dominated groups. Within the peer group, there are often opportunities to discuss topics in relations with adults all aimed at breaking away from parental constraints and to establish independent identity. Through this, the child forms his or her social personality, his way of getting along with other people, of being friendly or reserve, brash or timid. Through playing and working with people equal to him or her in age and power, the child or the adolescent learns cooperation and fair play and responsibility. A boy learns to be masculine and a girl learns to be feminine, and boys and girls learn the customs to dating and courting in the peer group. Most of the sex information obtained by most boys and girls comes from the peer group. This peer group consists of individuals roughly the same age, status and interest. Children usually belong to several peer groups from the neighborhood, children, schoolmates, girl or boy scouts and church friends. This peer group contribute to socialization by providing children with experiences that are unlikely to be provided by the family. Gender identity is developed during the early years by the interaction between a child, peers and adults (Saya et al., 2017). As the education of an individual progress steadily, also do the gender identity of the individual also develops. As the children interacts with their peer, their gender identity also solidifies and this influences their daily activities. Peer interactions affects the academic performance of developing children. As suggested by Brown and Kanyongo (2016), females are more influenced by their peers than males

because females are more emotional than males. As a result of that, working together for academic achievement is taken as a feminine activity.

As there is positive and negative peer influence, when female students influence one another positively, there is an improvement in academic performance even when it comes to difficult subject (Manoah et al., 2016). Male students are likely to be influenced less either positively or negatively as they consider it as a feminine activity. According to Mbaki et al. (2016), male students are ridiculed by their peers when they work hard in school. This has led to female students performing better as they could involve one another in a study. Furthermore, peer pressure influences learners in thinking that there are boys' and girls' subjects which leads to gender norms that are very difficult for individuals to break (Ullar, 2019). When used positively it can foster the performance and vice versa is also possible (Awour, 2016; Okyere, 2019).

A study conducted by Likando (2017) on the factors causing poor academic performance among female students in Zambia showed that peer pressure was among the leading causes. The study found out that female students were affected by peer pressure than boys as the issue of low self-esteem affects females than males. It also observed that humble background and lack of the necessary learning materials played a role in peer pressure among females. The study finally concluded that peer pressure was mainly experienced in the senior high school stage more than in the junior high schools.

In another study Biton and Gonzaga (2019) on the effect of peer pressure on students' academic performance observed that peer pressure and influence are the major factors which affect the performance of students either negatively and positively. The study also observed that parents and teachers have a role to play in promoting or reducing

peer pressure. The study concluded that peer pressure when positively used to promote the performance of students, the negative influence can also promote poor performance of students. Luketero and Kangangi (2018) studied the effect of peer pressure on academic performance of students in Kenya. Luketero and Kangangi (2018) revealed that peer pressure is also among the major factors contributing to students' poor performance. In addition, they observed that the less motivated students influence the motivated students in performing poorly.

2.5 Educators' Perception and Knowledge of the Subject on Gender Performance in the Study of Mathematics

According to Enu et al. (2019), teachers who teach mathematics are also accused of disrespecting the cognitive style of learners through the use of teaching approaches that conform to their learning styles and do not encourage female students to pursue mathematics. The mathematics teachers play a climactic role in the teaching of the subject and indirectly the teacher influences the learners' acquisition of knowledge. The teacher's attitude and the methods used affect generation, reduces gender differences among learners. The teacher's characteristics aids in the definition of the learner's attitude towards the subject (Herman, 2017).

In another study, the researcher (Ntawiha, 2016) agreed that female students taught by female teachers in mathematics perform better than when a male teacher teaches them. Female teachers' pay a role in the development of positive attitude to female students, hence the high performance (Riswanto & Aryani, 2017). Although in most schools, male teachers are more than the female teachers in the teaching of mathematics, there was a high discrepancy in the performance of the subject. Motivation and the capacity of the teacher to academically satisfy the learners was also a determinant to the

academic performance of both gender (Tarhan et al., 2019). Katemei and Omwono (2015) revealed that in Africa, mathematics is seen as a technical puzzle that only males could solve hence discouraging the potentials of female students in the subject.

Ekperi (2019) assessed the impact of teacher's characteristics on students as a case study of a public secondary schools in Nigeria. The study observed that teachers' knowledge on the subject and their methods employed correlate positively with the students' academic performance. In secondary schools, Ekperi (2019) highlighted the importance of mastery of subject matter knowledge as very vital in promoting the performance of the students. Ekperi (2019) also found that the teacher's attitude is a factor of the quality of knowledge they transmit to their students which is a vital component in promoting performance. Ekperi (2019) suggested that periodic evaluation and monitoring of teachers could provide better teaching approaches that would improve the academic performance of the students.

Kurgat and Gordon (2014) examined the impact of teachers' characteristics and attitude on the students' performance. Kurgat and Gordon (2014), found that the positive attitude of the teacher towards mathematics and students promoted the high performance by the students. The study also observed that there were no major performance differences from either male or female teachers. Kurgat and Gordon (2014) further found that teachers' quality and experience over the years are critical indicators of how well a learner could perform in a subject. The study recommended that teachers praise the students and engage them beyond the classroom as important determinants that must be considered to improve students' mathematics performance.

2.6 Summary of Literature Review

Bandura's Social learning theory is employed in this study. The theory explains how learning occurs by watching a model who is not reinforced or punished. Bandura believes that when a child observes behaviour, but makes no observable response, the child may still have acquired the modelled response in cognitive form hence this theory is applied to this study since the social factors under lie gender differences in mathematics performance. Teacher's behaviour, observed by students could affect them directly or indirectly. The extent to which this impact has on students is dependent on contextual factors.

Patriarchal culture connects males' achievement to future opportunities and consequences. The same opportunities is not accorded to females hence females do not have that link in mind and do not perform as males do in fields females see to be less useful to them.

Opportunity structures shape many socialization processes which also shape performance. A less opportunity may see mathematics as less important and a high opportunity may see mathematics important. Different theories and frameworks came up to attempted to identify the factors influencing gender differences in mathematics performance in order to bridge the gender gap in mathematics performance.

The opportunity propensity model is employed for the conceptual framework. The model talks about the educational opportunity students are exposed to and how students use these opportunities students are brought up from varied mathematics environment and that may have impact positively or negatively base on the opportunities these students are exposed to. Some of the opportunities are parent's socio-economic status, gender stereotyping, students' level and home background.

Numerous studies have been carried out within and outside Ghana and the findings show that males outperform females in mathematics. In Ghana, a lot of programs have been organized to cushion the females in mathematics achievement yet the gender gap is widening. The conclusion drawn from the literature reviewed is mathematics performance favor the males than the female students hence the gender gap is widening.

The factors affecting gender differences in mathematics performance outlined in this study are students' attitude, students' cognitive development in mathematics, learning environment, parental and family attitudes, cultural beliefs, teaching methodology, lack of positive role models, peer influence and students' attitudes. Students' attitudes towards mathematics impact significantly in mathematics achievement. All the studies reviewed attribute poor performance in mathematics by students is as a result of students' attitude towards mathematics.

Teachers' attitude towards mathematics also affects mathematics performance. Students observe and copy teachers' behavior towards mathematics and also do accordingly. A teacher with positive attitude towards mathematics will impact positively in mathematics performance and vice versa.

Students pursuing subjects they have the interest in perform in those subjects than when they are forced in to pursue subjects they do not like. Females underrate themselves and think they are not capable of pursuing subjects like mathematics. Females lack confident and undermine their potentials in studying mathematics. Females' poor performance in mathematics is attributed to internal factors and their male counterpart's poor performance attributed to external factors.

Interpersonal relationship that exists in the mathematics environment is significant in mathematic. A school with all facilities available does effective learning. Females are comfortable in schools that have all facilities at their disposals leads to effective learning and good performance. School lacking facilities does not do well in terms of performance students parents' constraint resources or opportunities for schooling tends to favor the males than the female students. School-based factors which indiscipline, relationship and waste of time affect the performance of female students. Researchers recommended guidance services to be organized for the female students who are affected more by school-baes factors. Teachers play key role the learning environment thus assigning task and distribution of questions in class. Socialization process also impact the learning environment and this affects personality formulation and personality change.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the research methodology. Specifically, it describes the research design, the population, the sample and sampling procedure, instrumentation, validity and reliability of the instruments, data collection procedure, data analysis, and ethical considerations.

3.1 Research Design

A research design describes the guidelines to follow in carrying out a study, including when, from whom and under what conditions the data will be gotten and also, shows the general plan as to how to set up research, what happened to the subjects and what methodology to use to collect the data (McMillan & Schumacher, 2014). Research design gives a specify plan of coming out with empirical evidence which aids in answering the research questions. McMillan and Schumacher (2014) classified research design into four main categories: quantitative, qualitative, mixed method and analytic. The researcher preferred mixed method design. This method combines quantitative and qualitative designs. The researcher chose this design because this method gives complete investigation and the researcher is not limited to traditional examples. Also, Mixed method studies show the results quantitative and explains why it was obtained qualitative.

Triangulation designs under mixed method collects quantitative data and qualitative data concurrently. The researcher chose triangulation research because the strengths of each method is applied in order to have a comprehensive and valid set of data. Also,

the results of each method come together and show triangulation and gives credibility in the findings.

This process is summarized in figure 3.1. 1

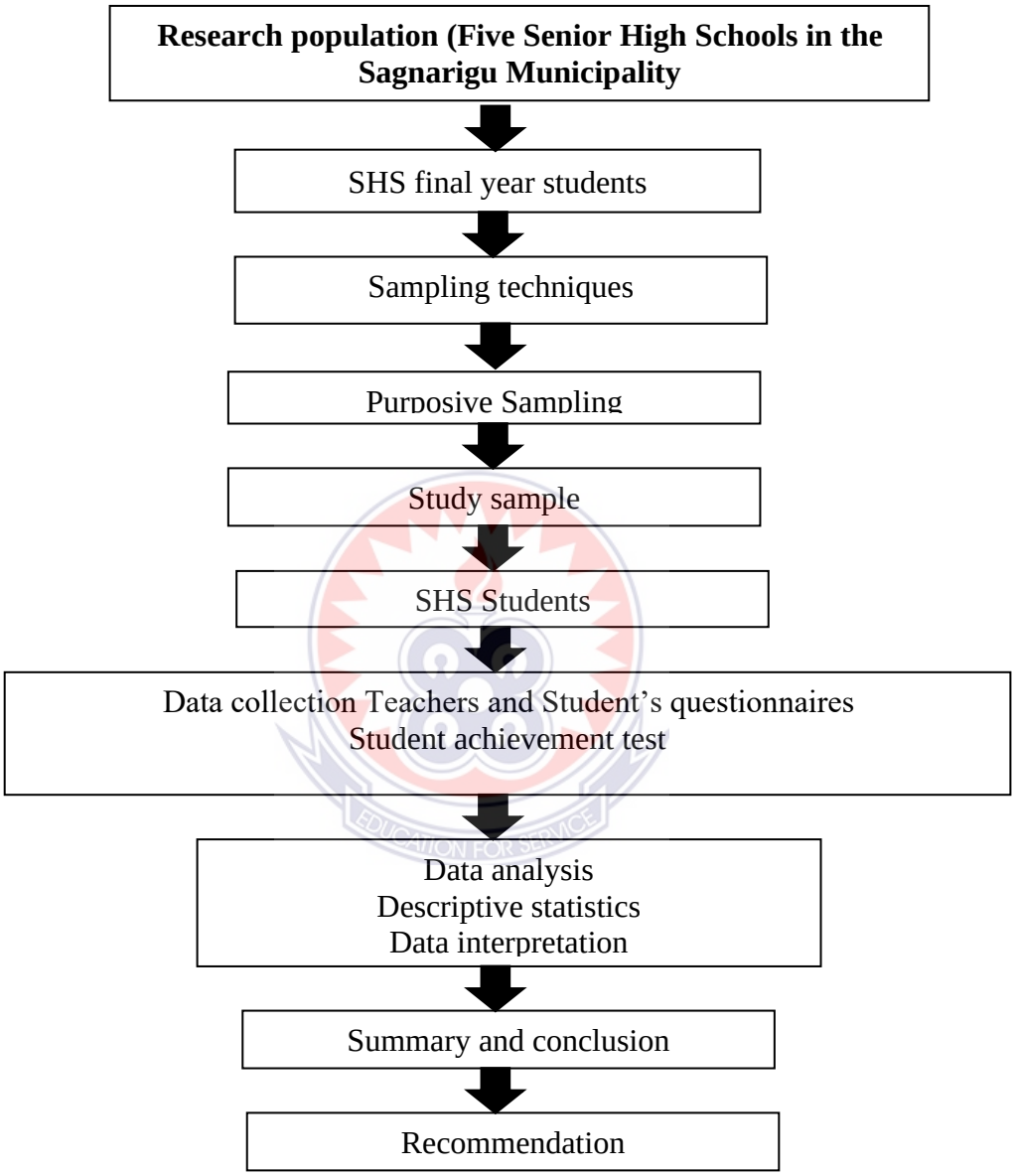

Figure 3.1.1: Design and process of the study

3.2 Population of the Study

In this research, population is the larger group upon which a researcher wishes to generalize. It includes members of a defined class of people, events or objects (Creswell, 2009). Creswell (2009) further indicated that population is the sum

aggregate or totality of the phenomena of interest to the researcher. The population of the study was made of all senior high schools' students and teachers in the Sagnarigu Municipality of the Northern region of Ghana. The target population of this study comprised mathematics teachers and final year students of the five-senior high/ technical schools located in the Sagnarigu Municipality. Namely; Tamale Senior High School, Northern school of Business, Tamale Islamic Senior High School, Kalpohin Senior High School and Tamale Technical Institute. All the schools are mixed schools, boarding and day and owned by government.

The accessible population was made of 94 mathematics teachers and final year students from all the five senior high schools in the municipality. Tamale senior high final year students were 1476, Islamic senior high school final year students were 1433, Northern School of Business final year students were 1664, Kalpohin Senior High School form threes 1680 and Tamale Technical Institute final year students were 1264 totaling 7517. This comprised 5758 males and 1759 females' final year students at the senior high schools and 94 mathematics teachers.

3.3 Sample, Sampling Techniques and Procedures

Sagnarigu municipality is one of the newly created districts in the Northern Region of Ghana and was purposively selected for the study. Sagnarigu municipality was chosen because, a lot of research is carried out on gender differences in mathematics performance and factors associated to it no such study is carried out in the Sagnarigu municipality. Also, mathematics performance in the Northern Region over the years have been poor and always ranked last when comparison is made with other Regions of which Sagnarigu municipality is part. There are five senior high schools in the municipality namely; Tamale Senior High School, Northern school of Business, Tamale Islamic Senior High

School, Kalpohin Senior High School and Tamale Technical Institute. The sample for the study was final year students and mathematics teachers in the five SHS in the Sagnarigu municipality. The schools had candidature of 1476, 1433, 1264, 1664, and 1680 respectively totaling 7517. This comprised 5758 males and 1759 females' final year students at the senior high schools and 94 mathematics teachers in the municipality. All the schools are mixed schools, boarding and day and owned by government.

The sample size for this study were two hundred and fifty (250) final SHS students and fifty (50) mathematics teachers representing 4.3%. This is approximately 4 % of the target population. The choice of 4.3 % of the target population is based on Dornyei's (2007) assertion that between 1% and 10% of a study population gives an adequate sampling fraction.

In all, 250 final years students from the target population were sampled through purposive sampling technique, which teachers of the students' selected classes with appreciable number of female students from the five schools for fair representation.

The researcher intended to have equal representation of students (males and female). However, as a result of the programs offered in the Senior High Schools selected for the study, it was evident that some other programs were either male or female dominated. Also, at the time of the administration of the questions, the final years students were writing their mock so at that time, the home economics final years where appreciable number of females were having their practical. Therefore, there was no equal representation of males and females for the study. Hence, this yielded a sample size of 113 (45.2%) female students. In all, 137 male students were also sampled. The

researcher employed purposive sampling technique because it was important to obtained the needed group for the study and avoid bias.

Furthermore, mathematics teachers from the five schools in the Sagnarigu municipal were sampled purposively for the study taking into consideration the fact that the teachers should be teaching the sampled batch of students for the academic year. In total, 50 mathematics teachers were sampled comprising females and males that is 40 male and 10 females.

3.4 Data Collection Instruments

Three instruments were used in gathering data for this study. These were administration of questionnaires, collection of secondary data from West Africa Examination Council (WAEC) through an inventory instruments and mathematics achievement test. The questionnaire aids the study to achieve the objectives two to four. The student achievement test was used to determine the performance of students to establish whether or not there are differences in their' performance in mathematics based on gender. According to McMillan and Schumacher (2014) secondary data are data that have already been collected, no involvement of the user in the collection process. The secondary data collected from WAEC documents would aid the study to establish the existence or otherwise of gender disparities in mathematics performance among SHS students.

3.4.1 The questionnaire

The questionnaires were designed for mathematics teachers and the final year students. The students' questionnaire consisted of three sections. Section A, section B and section C. Section A was made up of three (3) items that collected information on respondents' demographic characteristics which included program, sex and age.

Section B contained two (2) items and elicited factors that affect the learning of mathematics. Section C contained twenty-one items and elicited students' attitude towards learning mathematics. All the items in section B and C were close-ended and of the five-point Likert type scale: strongly agree (SA), agree (A), Neutral (N), Disagree (D) and strongly disagree (SD)). Robson (2002), reiterates that Likert-scale looks interesting to respondents and people enjoy completing a scale of this kind. The questionnaire was used to answer research questions 2, 3 and 4. The items were built to reflect on the key themes raised in the research questions. The students' questionnaires consisted of personal data, mathematics performance of the students indicating gender differences or parity in mathematics achievement, factors influencing gender differences in mathematics achievement and students' attitudes to mathematics learning (see appendix A).

The teachers' questionnaire had two sections A and B. Section A had five (5) items that collected information about socio-demographic characteristics about the teachers which included teachers' level of education, area of specialization, age sex and working experience. Section B consisted of three (3) questions which was to find out the easier way to teach mathematics, students lose of interest in mathematics and the effect of the gender of the teacher in teaching and learning of mathematics (see appendix B).

3.4.2 Secondary data

The result of the West Africa Senior Secondary School Certificate Examination (WASSCE) for Northern Region students' performance statistics in mathematics (core) subject by gender for the years 2014 -2019 obtained to assess the pass rate. This secondary data collected from the West African Examination Council on regional basis was categorized considering A1-C6 as pass and D7-F9 as failed. It was analyzed into

percentages and used comparing the pass rate in terms of gender and subsequently assessed the impact of the performance with regards to academic progression of the female students. The instrument was also used to establish the fact that gender differences exist in mathematics performance of which Sagnarigu Municipality is part. The researcher tried but could not get the WASSCE analysis of the five senior High Schools from the district office. The regional analysis of WASSCE was gotten from West African Examination Council (WAEC) This inventory instrument collected from WAEC shows there are discrepancies in the performance in mathematics by gender for the six years. This secondary data instrument will help throw more light on the gender gaps in the performance in mathematics discussed in this research literature (see appendix E)

3.4.3 Mathematics achievement test

There were two (2) written tests for the students. The test items were based on indices and logarithms in the SHS syllabus. All the sampled students were taught indices and logarithms and have fair knowledge about the topics. The student's achievement test consisted of ten questions. The duration of the achievement test was one hour. The student's achievement test comprised of ten objectives items (Q1-Q10) and two theory questions. Question one was on the application of the laws of indices in multiplication and division of algebraic expressions. Question two was on writing large numbers in index notation and simple equations involving exponents. Question three was on solving equations involving indices. Questions four and five were on application of indices in solving problems involving standard forms. Question six to nine were on logarithms. The questions were on application of the laws and properties of logarithms in solving problems in logarithms. The theory comprised of two questions. Question

one was on solving indices when the bases are not the same. The second question was on application of the laws of indices.

The objectives of student's achievement test were to assess students' knowledge on manipulating and expressing large numbers in standard form and to ascertain students' abilities to apply indices in solving problems in standard form. The items test students' knowledge on applying the laws and properties of logarithms to solve problems as well as ~~to~~ assess students' mathematical content knowledge in the domain (see appendix C)

3.5 Pilot Study

Pilot study, according to Pilot and Hungler (1995), is a small-scale version or trail done by investigator in preparation for the major study. In this study, the student achievement test and questionnaire were piloted with 50 SHS three (3) General Arts students of Business Senior High School, in the Tamale metropolis to establish the internal consistency and reliability of both. Business SHS was chosen for the pilot test because it runs similar courses. Also, students' demographic characteristics were similar because they were of the same year group as the sampled population. All students in the school take mathematics as a core subject and have treated indices and logarithm as part of the year first year syllabus. However, participants were assured of confidentiality, and the instruments were responded to anonymously with no identification information. They were given sometime within the instructional hours to provide their responses after which all instruments were received.

3.5.1 Validity of the test

Validity refers to whether a test truthfully does what it is constructed to do (Taale & Ngman-Wara, 2003). The validity of a test is dependent upon the use of the test. A test is valid if its results are appropriate and useful for making decisions and judgment about

an aspect of students' achievement ((Taale & Ngman-Wara, 2003)). For face validity, the test items used were validated by two experienced teachers who had taught mathematics for five years in the municipal for the study. They checked the test items to ensure they are within the content of the topics taught. The content validity of the test items was examined by the other mathematics teacher who were able to judge how well the measuring instrument meets the standard. The researcher revised the instruments before collecting the data based on the suggestions the experts made. According to Taale and Ngman-Wara (2003), content validity is most appropriately considered in connection with achievement testing. An achievement test has content validity if it represents faithfully the objectives of a given instructional sequence and reflects the emphasis accorded those objectives as the instruction was carried out. In other words, it is the degree or the extent to which the test items adequately cover the subject matter or the part of the curriculum covered during instruction.

3.5.2 Reliability of questionnaire instrument

Joppe (2000) defines reliability as the extent to which results are consistent over time and if the results of a study can be reproduced under the same methodology, then the research instrument is considered to be reliable. Data from the pilot test was used to determine the reliability of the research questionnaire. Item analysis was at this point carried out to identify items whose removal would enhance the internal consistency of the instrument. An attempt was made to improve the internal consistency by removing items with low item correlations (i.e., correlations between a certain item and the rest of the items excluding that item). Items meeting any of the following criteria were deleted: correlation coefficient between an item and the total score less than 0.30 and if internal consistency (Cronbach α) of the whole scale was high after deleting the item. The 26 items resulted in a Cronbach alpha reliability coefficient of 0.6.

The Bartlett's Test was significant at $p < 0.05$. According to Babbie, (2005) alpha value of 0.70 and above shows a reasonable internal consistency and that the alpha values between 0.60 and 0.69 indicate minimally adequate reliability. They however added that a lower alpha value may be due to a handful of items in a scale. According to Ary, Jacobs and Razavieh (2002), if $p<0.05$ result is used to make decisions about a group or for research purposes, reliability coefficients of 0.50 to 0.60 are accepted. The instrument was therefore accepted as reliable by the researcher based on the purpose and objectives of this study. Thus, the final questionnaire had 23 items.

3.5.3 Test reliability

The reliability of a test refers to how well it provides a consistent set of results across similar test situations, time periods and examiners (Taale & Ngman-Wara, 2003). In other words, it is the consistency with which a test measures whatever it measures from one measurement to another, over and over again, over times. Also, Reliability concerns the degree to which an experiment, test, or any measuring procedure yields the same results on repeated trials (Patton, 2002). The researcher administered test to the participants. The test with alternate form method was used to determine the reliability. In this method, the correlation coefficient between the sampled schools scores is an estimate of the reliability of either one of the alternate forms and this is known as the coefficient of stability and equivalence. Hence, a strong correlation coefficient between the two tests was at 0.67 which shown the test was reliable.

3.6 Data Collection Procedure

In conducting a study, Creswell (2005) advises researchers to seek and obtain permission from the authorities in charge of the site of the study because it involves a prolonged and extensive data collection. In line with this, an introductory letter was

obtained from the Head of Department of Mathematics Education from the University of Education, Winneba. This letter provided the details of the study, including data collection, and issues of confidentiality and anonymity. This letter was used to obtain permission from the Sagnarigu Municipal Education Office. A written permission was obtained from the Municipal Director to enable the researcher have access to the five Senior High Schools in the municipality. The approval letter that was given was used to open the gate for data collection in the schools. After permission was granted, the researcher first met the sampled participants to inform them of the impending administration of the questionnaires and test.

The questionnaires were personally administered to the students in the sampled schools. The participants agreed to complete the questionnaire the same day and submitted them on the same day. Respondents adhered to the agreed time schedules and presented the completed questionnaire at the end of the day. This was done to ensure high coverage, completion, and return rate. The completion and return rate were 100%. The mathematics achievement test was also personally administered to the 250 final year students sampled in their respective school. The researcher went to the five schools and had earlier discussion with the mathematics teachers and it was agreed that the mathematics achievement test should be conducted at the time the students had a mathematics lesson. The heads of department asked the teachers teaching final year students to release one of their classes for the test to be conducted. A day was fixed for the test to be conducted. The students were informed about the test to be conducted so at exactly the time and day agreed the researcher went and conducted the test. The invigilation was done by the researcher so no student got the chance to copy. The duration of the test was one hour and at exactly that time the students answered the questions and submitted their answer sheets with in the allocated time the same day.

Respondent adhered to the agreed time and rules for the achievement test. This was done to ensure high coverage, fairness, and competition. The researcher used five days to administer the test.

An introductory letter from the university of education, Winneba aided in the request for the WASSCE (SC) results of students for the past six years (2014-2019) from the West Africa Examination Council. The request granted within a period of seven months for the study to be carried out.

3.7 Data Analysis

The three instruments used were questionnaire, student mathematics achievement test and inventory. The questionnaire was used to collect quantitative and qualitative data. The student mathematics achievement test was used to collect quantitative data and the inventory instrument was used to collect quantitative data.

The first research question was answered comparing mean score difference from mathematics achievement test. The scores of the mathematics achievement test of the research participants were arranged in ascending order and analyzed with student T-test for all the five (5) schools to determine the level of significance differences in the mean scores based on gender difference. The second research question was analyzed into frequencies, percentage and ranked using the questionnaire. A question was posed to the participant to select among four various factors which contributes to students' performance in mathematics based on gender. The results obtained were ranked to know the factor the affect students most in the teaching and learning of mathematics. Percentage analysis was performed on the responses of the teachers on the effect of the gender of the teacher on mathematics performance. Correlation analysis was conducted to assess the correlation between three (3) variables namely mathematics achievement

test (MAT), Attitude of students towards learning mathematics (AD) and Factors affecting mathematics performance (FA).

The third research question was answered with Section C of the students' questionnaire, teachers' questionnaire and the WASSCE (SC) results obtained from WAEC. The Likert scale was followed for items in Section C of the students' questionnaire used in the study. This scale is based on statements that are classified as positive or negative. Each statement is made up of five options of which one is selected according to the respondent's feelings. Weights of 1, 2, 3, 4 and 5 were attached to the options of "Strongly Disagree (SD)", "Disagree (D)", "Undecided (U)", "Agree (A)", and "Strongly Agree (SA)" respectively when the statement is positive. This was reversed for a negative statement. For instance, to a positive statement, 'one can use mathematics in daily life', if the response is SA, it received a weight of five. However, to a negative statement, "it is not important for females to learn mathematics", if the response is SA, it received a weight of one. A neutral response of "Undecided (U)" to each item gained a mean weight of three. The data were analyzed with the IBM SPSS version 23 package. The obtained data were ranked based on percentages with the IBM SPSS version 23. Subsequently, the data collected for C1 to C8 were analyzed using factor analysis (FA). FA is used to find the main attitude that influences the female students' learning and performance in mathematics. It was used to reduce the variables into less factors which describes the data in general. The factor analysis was performed employing the steps in figure 3.2 below. The teachers' questionnaire on factors contributing to students' loss of interest in learning mathematics responses were analyzed with SPSS version 23. Research question 4 answered using students' questionnaire and percentage analysis was performed on the responses to the questions.

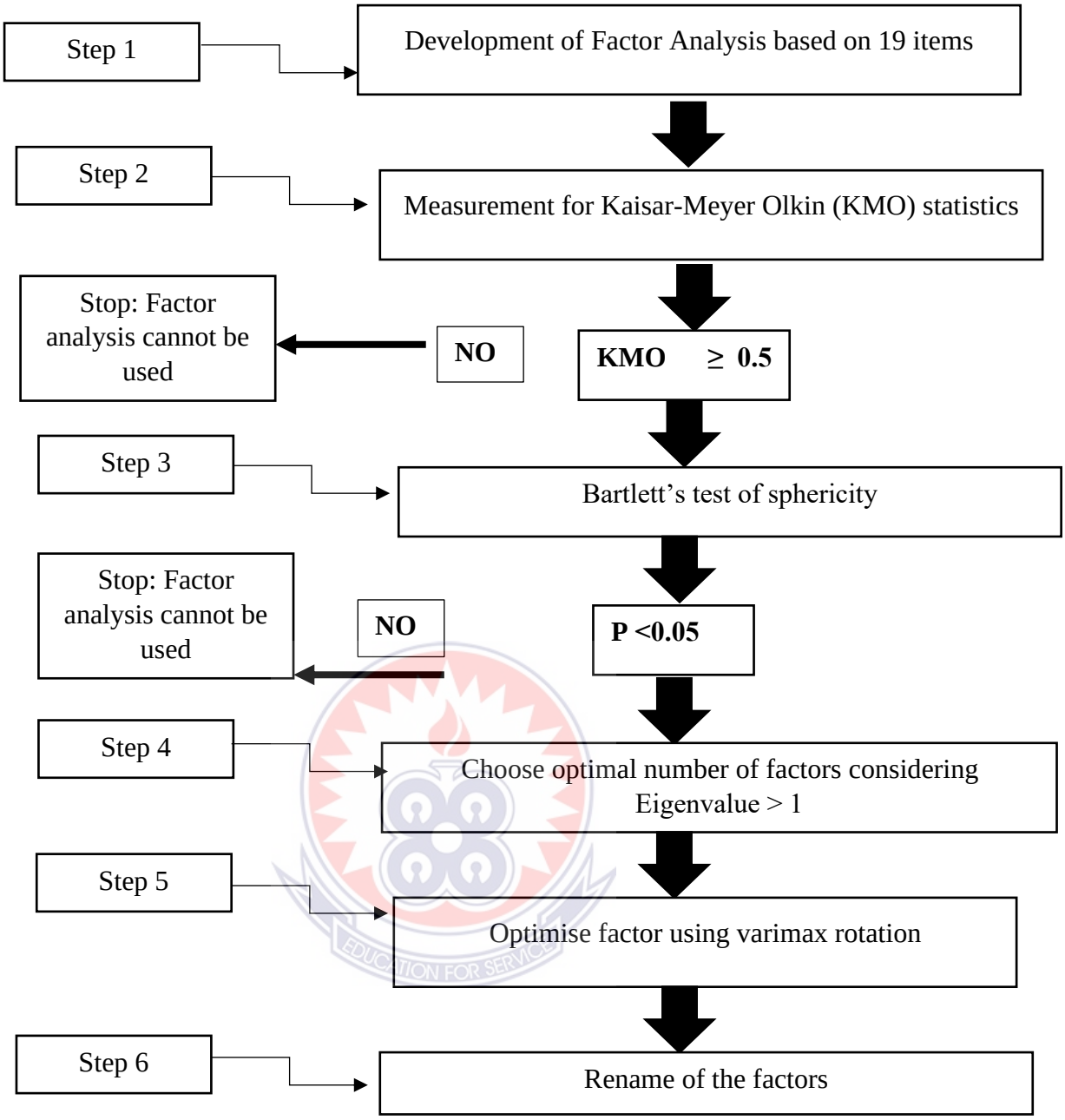

Figure 3.2: Flow chart of factor analysis processes

After the factors were identified, the reliability analysis was carried out. Reliability test informs how accurate measurement made on the factor. The reliability level of Cronbach's Alpha value (Choi, Fuqua and Griffin, 2001) was determined based on the Table 3.

Table 3.1: Reliability level of Cronbach's Alpha

Cronbach's Alpha	Internal Consistency
0.8 – 1.00	Excellent
0.6 -0.8	Good
0.4 -0.6	Medium
0.2 – 0.4	Medium weak
0.0 -0.2	Weak

Finally, the fourth research question was also analyzed from the questionnaire which posed question seeking to know the effect of teacher's perception on students' performance in mathematics. The data obtained was analyzed considering responds of gender and further specifications by the respondents. The data were expressed in percentages and represented in graphs and tables. The results were used to evaluate and discuss the impact of gender differences on mathematics performance among students of Senior High Schools with the municipality.

3.8 Ethical Considerations

Resnik (2009) defines ethics in research as the discipline that study standards of conduct, such as philosophy, theology, law, psychology or sociology. In other words, it is a method, procedure or perspective for deciding how to act and for analyzing complex problems and issues. Protection of participants and their responses were assured by obtaining their informed consent, protecting privacy and ensuring confidentiality. In doing this, description of the study, the purpose and the possible benefits were mentioned to participants. The researcher permitted participants to freely withdraw or leave at any time if they deemed it fit.

a. No harm to participants

In Babbie's opinion (2004), the ethical norms of voluntary participation and no harm to participants have, become formalized in the concept of informed consent.

Accordingly, participants base their voluntary participation in research studies on the full understanding of the possible risks involved. Harm can either be physical or emotional (Trochim, 2006). Throughout this study, the researcher made an effort to ensure that participants were not harmed psychologically or emotionally.

b. Anonymity

Research participants' well-being and interests need to be protected. Participants' identities in the study should be masked or blinded as far as possible (Trochim, 2006). The people who read the research and the researcher should not be able to identify a given response with a given respondent (Babbie, 2004). Participants in the study were asked not to write their names on the questionnaire and test papers or anything that will reveal their identity instead, code names were used.

c. Confidentiality

Confidentiality indicates the handling of information in a confidential manner (Strydom, 2002). This implies that the researcher must jealously guard all the information disclosed by the participant so that only the researcher has access to it. The test scores and completed questionnaire of the participants were kept out of view of the student sand were not accessible to other students and mathematics tutors. They were kept by the principal investigator and used for this research only.

d. Plagiarism

As a way of preventing plagiarism, all ideas, writings, drawings and other documents or intellectual property of other people were referenced indicating the authors, title of publications, year and publishers.

3.9 Summary of the Chapter

The chapter consists of research design, the population of the study, the sample and sampling procedure, instrumentation, validity and reliability of the instruments, data collection, data analysis and ethical considerations. The researcher used mixed research design because the design. This method combines quantitative and qualitative designs. The researcher chose this design because this method gives complete investigation and the researcher is not limited to traditional examples. The target population consisted of mathematics teachers and students of SHS in the Northern Region. The accessible population consisted of 94 mathematics teachers and final year students of the SHS in the Municipality. The sample size for the study were 250 final year students and 50 mathematics teachers. Three instruments were used to collect the data for the study. The questionnaires and the achievement test were piloted at Business Senior High School in the Tamale Metropolis and the validity and reliability of the instruments were examined. That generated Cronbach alpha of 0.6 indicating the two instruments were reliable and SPSS version 23 was used to analyze the data.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This study investigated gender differences in mathematics achievement and factors that influence the differences among the SHS students in the Sagnarigu municipality of the Northern region of Ghana.

This chapter presents and discusses the results of the study. The data is presented in tables and figures and discussion is done in relation to the factors influencing gender difference in mathematics performance among students of Senior High Schools within the Sagnarigu Municipality. The presentation begins with the demographics of the respondents and followed by case-by-case presentation of data on the four research questions.

4.1 Biographic Data of Participants

In the questionnaire, 3 items were designed to collect data on participants bio-data. The students' responses to items on participants biographic data namely: programme of study, sex, age, were analyzed descriptively and presented in Table 4.1.

Table 4.1: Demographics of student respondents

Demographics	Category	Frequency	Percentage (%)
Program of study	General Science	133	53.2
	General Arts	36	14.4
	Visual Arts	2	0.8
	Business	26	10.4
	Home Economics	11	4.4
	Technical Science	29	11.6
	Agricultural Science	13	5.2
	Total	**250**	**100**
Sex	Male	137	54.8
	Female	113	45.2
	Total	**250**	**100**
Age	15 years	0	0.0
	16-18 years	131	52.4
	19 years and above	119	47.6
	Total	**250**	**100**

From Table 4.1, majority (53.2 %) of the student respondents were General Science students, 14.4 percent were General Arts students, 0.8 % were Visual Arts students, 10.4 percent were Business Students, 4.4 percent were Home Economics students, 11.6 percent were Technical Science students and 5.2 percent were Agricultural Science students.

In terms of sex presentation of respondents, the student respondents were fairly represented in the study. However, more than half (54.8 %) of the respondents were male whilst 45.2 % were female. For age distribution, about 52.4 percent were within the 16-18 years age cohort while 47.6 % were 19 and above years. Which implies that they are matured and could provide the detailed information which questionnaire requires of them.

The teachers' demographic characteristics that were analyzed descriptively are presented in Table 4.2

Table 4.2: Demographics of teacher respondents

Demographics	Category	Frequency	Percentage (%)
Sex	Male	40	93.0
	Female	3	7.0
	Total	**43**	**100.0**
Age	30-35 years	6	14.0
	35-40 years	14	32.6
	40-45 years	12	27.9
	45-50 years	6	14.0
	Above 50 years	5	11.7
	Total	**43**	**100.0**
Educational level	Degree	32	74.4
	Masters	11	25.6
	Total	**43**	**100.0**
Area of specialization	Mathematics	34	79.1
	Statistics	4	9.3
	Others	5	11.6
	Total	**43**	**100.0**
Working experience	Less than 5 years	5	11.6
	5-10 years	16	37.2
	10-15 years	12	27.9
	15-20 years	4	9.3
	More than 20 years	6	14.0
	Total	**43**	**100.0**

In the teachers' questionnaire, 5 items were designed to collect data on participants' bio-data. The biographic of the teachers were level of education, area of specialization, age, sex and working experience. The questionnaire was administered to 50 mathematics teachers out of these 7 teachers did not submit their filled questionnaire. Hence the researcher had 43 respondents. The age was kept in class interval and the working experiences was also in class interval. So, teachers who were within a particular age or working experience were captured and the frequency was recorded.

This frequency was converted to percentage and a frequency table was drawn for the teachers' responses. The teachers' responses were analyzed descriptively and presented in Table 4.2.

As observed from Table 4.2, in terms of sex, majority (93.0%) of teacher respondents are males whilst females were 7.0%. This suggested that mathematics teachers are predominantly males. In terms of age, from Table 4.2, it could be observed that the age ranged of the teachers were 30-35 years (14.0%), 35-40 years (32.6 %), 40-45 years (27.9 %), 45-50 years (14.0 %) and above 50 years (11.7 %) indicating that majority of the teachers were within the 35-40 age cohort. This tends to suggest that respondents were mature and had some years of experience of teaching. With respect to their educational level, about 74.4 percent of the respondents were first degree holders and 25.6 percent were second degree or masters' holders. The data further revealed that majority of the respondents (79.1 %) specialized in mathematics while 9.3 % specialized in statistics and 11.6 percent specialized in other program of study. In terms of years of working experience, the data indicated that teachers had experience ranging: less than 5 years (11.6%), 5-10 years (37.2 %), 15-20 years (9.3 %) and more than 20 years (14.0 %) suggesting that majority of the teachers have taught for 5-10 years.

4.2 Findings Related to Research Questions

The purpose of this study was to assess the factors that influence gender disparity in academic performance in mathematics among SHS students in the Sagnarigu Municipality. To achieve this, the following findings related to the research questions are clearly presented and discussed under this section.

4.2.1 Research Question 1: What is the extent of gender differences in mathematics performance among students in the Sagnarigu Municipal?

To answer the research question 1, the mathematics achievement test was administered to the sampled 250 final year students in the municipality. All the 250 students participated in the test. At the end of the test, participants submitted their scripts which were marked with a total score of ten (10); the objective section was scored five (5) marks while the theory were scored five (5) marks too. The marks were arranged in ascending order and recorded. The males were denoted (M) and the females (F) and that was done for all the schools and one frequency table was drawn to present the results. The results of the student's achievement test areas shown in Table 4.3.

Table 4.3: Mathematics achievement test score of students in the five SHSs in the Sagnarigu Municipal

SHS	Islamic		Northern Business		Kalpohin		Tamale		Tamale Technical			
Score	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**Total**	**Percentage**
0	-	-	-	1	-	-	-	-	-	-	**01**	**0.4**
1	-	-	-	2	-	-	-	-	-	-	**02**	**0.8**
2	1	-	-	6	-	1	-	3	6	-	**17**	**6.8**
3	-	-	-	8	8	1	-	6	2	2	**27**	**10.8**
4	2	1	-	4	3	2	-	4	2	-	**18**	**7.2**
5	2	1	3	7	3	4	-	3	3	2	**28**	**11.2**
6	2	3	2	2	2	3	`	4	5	3	**26**	**10.4**
7	9	-	5	5	1	4	1	1	7	2	**35**	**14.0**
8	4	8	1	1	6	2	4	5	5	1	**37**	**14.8**
9	8	4	3	-	6	-	5	2	2	-	**30**	**12.0**
10	3	2	-	-	3	1	10	2	8	-	**29**	**11.6**
Total	**31**	**19**	**14**	**36**	**32**	**18**	**20**	**30**	**40**	**10**	**250**	**100**
Percentage	**12.4**	**7.6**	**5.6**	**14.4**	**12.8**	**7.2**	**8.0**	**12.0**	**16.0**	**4.0**	**-**	**-**

From the data in Table 4.3, it was observed that about 17.52 percent of the male students scored below the average mark (5.0) while 36.28 percent of the female

students also scored below the average mark. However, 14.8 percentage of the students scored 8 whilst 0.4 percentage scored zero.

Furthermore, to answer the research question one, on the extent of gender differences in mathematics performance among students in the Sagnarigu Municipality, a student T-test was performed using the mathematics achievement test score of the students in the Sagnarigu municipality and the results were presented in Table 4.4. A student T-test was also performed on the scores of the five schools in the Municipality. The t-test was preferred due to the fact that the researcher compares two means of continuous data simultaneously at a given time. Also, in comparing two means simultaneously, the study required to make all pairwise comparisons, the probability of rejecting the null hypothesis when it is true would increase and there would be the likelihood of the study getting greater significant difference by random and there is less likely to commit an error.

Table 4.4: Mathematics achievement test score of student participants of the five SHS in Sagnarigu Municipality

	Mean	Df	Std. Dev	F	Sig.
Mathematics achievement test	7.0949	1	2.40674	29.587	.010
of students	5.4513		2.39042		

Significant: $p<0.05$

From Table 4.4, mean score of male students (M = 7.0949, SD = 2.40674) and for female students (M = 5.4513, SD = 2.39042), [p = 0.010] which indicates significant difference among students in mathematics performance in terms of gender in the Sagnarigu Municipality. It was clear that male students performed better than their female counterparts.

Further analysis of the mathematics achievement test of students was conducted to assess the existence of the difference in the academic achievement among the students based on gender in the various SHS in the municipality.

A student T-test was performed for Tamale Technical Institute and the results are presented in Table 4.5.

Table 4.5: Mathematics achievement test score of students of Tamale Technical Institute

Tamale Technical Institute	Gender	Mean	Df	Std. Dev	F	Sig.
Mathematics achievement test of students	Male	6.4000	1	2.73440	0.769	0.385
	Female	5.6000		1.64655		

Significant: $p<0.05$

The mean score of male students (M = 6.4000, SD = 2.73440) and for female students (M = 5.6000, SD = 1.64655), [p = 0.382] which indicates no significant difference in mathematics achievement performance between gender among the students.

Also, a Student T-test was performed for Tamale Senior High School using the mathematics achievement test scores and the results are presented in Table 4.6.

Table 4.6: Mathematics achievement test score of students of Tamale SHS

Tamale SHS	Mean	Df	Std. Dev	F	Sig.
Mathematics achievement test of students	9.2000	1	0.95145	40.087	0.001
	5.4667		2.51524		

Significant: $p<0.05$

The mean score of male students (M = 9.2000, SD = 0.95145) and for female students (M = 5.4667, SD = 2.51524), [p = 0.001] which indicates significant difference in mathematics achievement performance between gender among the students. This showed that there is significant difference among the mean score of the students of Tamale SHS in the municipality.

Furthermore, a simple T-test was performed for Tamale Islamic Senior High School using the mathematics achievement test scores and the results are presented in Table 4.7.

Table 4.7: Mathematics achievement test score of student participant of Tamale Islamic SHS

Tamale Islamic SHS	Mean	Df	Std. Dev	F	Sig.
Mathematics achievement test of students	7.3871 7.4211	1	1.92661 1.92399	0.004	0.952

Significant: p<0.05

The mean score of male students (M = 7.3871, SD = 1.92661) and for female students (M = 7.4211, SD = 1.92399), [p = 0.952] which indicates no significant difference in mathematics achievement performance between gender among the students. There is difference in the mean score of female and male (0.034) suggesting that the female student performed well compared to their male counterparts.

Also, a T-test was performed for Kalpohin Senior High School using the mathematics achievement test scores and the results are presented in Table 4.8.

Table 4.8: Mathematics achievement test score of student participant of Kalpohin SHS

Kalpohin SHS	Mean	Df	Std. Dev	F	Sig.
Mathematics achievement test of students	6.3125 5.8333	1	2.60814 1.94785	0.471	0.500

Significant: $p<0.05$

The mean score of male students (M = 6.3125, SD = 2.60814) and for female students (M = 5.8333, SD = 1.94785), [p = 0.500] which indicates no significant difference in mathematics achievement performance between gender among the students. Although, there is difference in mean score of the students in terms of gender. This could be due to the mathematical ability of the students since about 53.2 % of the students were general science students.

Finally, a T-test was performed for Northern Business Senior High School using the mathematics achievement test scores and the results are presented in Table 4.9.

Table 4. 9: Mathematics achievement test score of students of Northern Business SHS

Northern Business SHS	Mean	Df	Std. Dev	F	Sig.
Mathematics achievement test of students	6.9286 4.0000	1	1.43925 2.01424	24.565	0.000

Significant: $p<0.05$

The mean score of male students (M = 6.9286, SD = 1.43925) and for female students (M = 4.0000, SD = 2.01424), [p = 0.000] which indicates significant difference in mathematics achievement performance between gender among the students. This showed that there is significant difference among the mean score of the participating students in the above-mentioned school in the municipality.

Critical assessment of the data of each participating school in the municipality indicated that two out of the five schools showed significant difference in the mathematics achievement performance of students based on gender. However, the overall field data indicated that there is significant difference in mathematics achievement performance among sampled students in the Sagnarigu municipality which corroborate other studies conducted across the country and the world. It also corroborates with the data obtained from WAEC (Appendix D).

4.2.2 Research Question 2: What are the contributing factors leading to differences in performance in mathematics by gender in Sagnarigu Municipality?

To answer the research question, students were asked to rank as SA, A, U, D and SD considering the variables on factors that affect the learning and performance of students in mathematics. The responses were further analyzed into frequencies, percentage and ranked as presented in Table 4.10.

Table 4.10: Factors that affect the learning of mathematics

Which of the following factors affect you most when learning mathematics?	Frequency	Percentage
Inadequate mathematics textbooks and learning resources	110	44.0
Language used by the teacher is difficult to understand	53	21.2
Lack of confidence	49	19.6
Lack of interest in mathematics	38	15.2
Total	**250**	**100.0**

As observed from Table 4.10, 15.2 percent of the students said lack of interest in mathematics was their main problem in learning mathematics, 44.0 percent also said inadequate mathematics textbooks and learning resources, 21.2 percent agreed that language used by the teacher is difficult to understand and 19.6 percent agreed that lack

of confidence was their challenge. From the results in Table 4.10, it could be deduced that students were of the view that mathematics textbooks and learning resources was the major challenge with lack of interest in mathematics as the least factor.

From the student's perspective, the study also unraveled the factors that contribute to the formation of attitude towards mathematics learning and performance. The results are presented in Table 4.11.

Table 4.11: Factors promoting attitude formation in mathematics

Statement	Strongly Agreed F (%)	Agreed F (%)	Undecided F (%)	Disagreed F (%)	Strongly Disagreed F (%)	Mean	Standard deviation
I do a lot of mathematics exercises on my own or with a friend	139 (55.6)	81 (32.4)	07 (2.8)	14 (5.6)	09 (3.6)	1.692	1.0204
Learning mathematics is just remembering what the teacher says and does while in class	89 (35.6)	63 (25.2)	22 (8.8)	47 (18.8)	29 (11.6)	2.456	1.4284
The best way to learn mathematics is to discover a concept by oneself	106 (42.4)	87 (34.8)	26 (10.4)	16 (6.4)	15 (6.0)	1.988	1.1529
I do mathematics for the sake of it	28 (11.2)	50 (20.0)	38 (15.2)	59 (23.6)	75 (30.0)	3.412	1.3863
My friends don't like learning mathematics	45 (18.0)	57 (22.8)	40 (16.0)	46 (18.4)	62 (24.8)	3.092	1.4574
My parents and siblings encourage me to learn mathematics and to perform well in the subject	146 (58.4)	72 (28.8)	08 (3.2)	12 (4.8)	12 (4.8)	1.688	1.0711
Being a girl or a boy interferes with my learning and my performance of mathematics	35 (14.0)	35 (14.0)	38 (15.2)	44 (17.6)	98 (39.2)	3.540	1.4701
I learn mathematics well regardless of the gender of my teacher	113 (45.2)	54 (21.6)	25 (10.0)	26 (10.4)	32 (12.8)	2.240	1.4389

About 55.6 % and 32.4 % of the students strongly agreed and agreed that they do a lot of mathematics exercises on their own or with a friend. On the factors related to learning mathematics, about 35.6 % and 25.2 % of the students agreed that learning mathematics is just remembering what the teacher says and does while in class. Also, 77.2 % (SA and A cumulatively) of students Agreed that the best way to learn mathematics is to discover a concept by oneself. While 53.6 of the students said they do mathematics for the sake of it. However, 43.2 % of the students disagreed that their friends do not like learning mathematics while 40.8 % of them agreed that their friends do not like learning mathematics.

Also, 87.2 % (SA and A cumulatively) of the students agreed that their parents and siblings encourage them to learn mathematics and to perform well in the subject. 56.8 % of the students agreed that gender does not affect their learning of mathematics despite the fact that girls have more negative attitude (Arhin & Offoe, 2015).66.8 % of the student accented to the fact that they learn mathematics well regardless of the gender of the teacher. However, as indicated by Goddard Spear (1989) that the sex of the teacher also affects the learning of the subject. Spear emphasized that assessment of male students by female teacher can produce generous marks and girls also by a male teacher.

To assess the impact of the gender of the instructor on the academic performance of the students in mathematics, percentage analysis was performed on the response and presented in Figure 4.1.

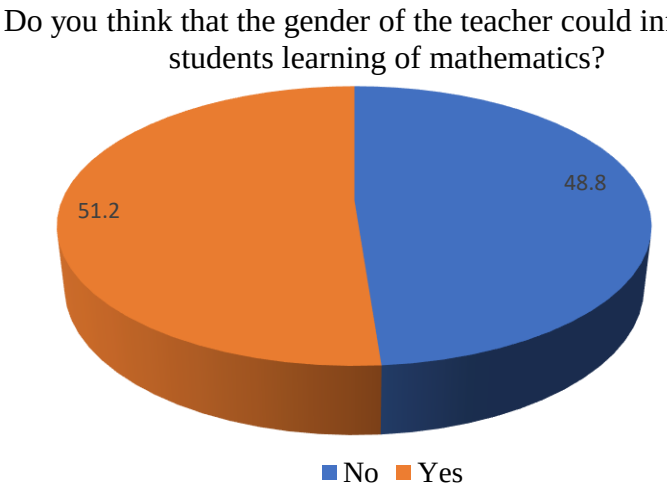

Figure 4.1: Response for the effect of the gender of the teacher on the academic achievement of students

From Figure 4.1, teacher respondents were asked if the gender of the teacher could influence students learning of mathematics. 51.2 % of the respondent said yes while 48.8 % said no. However, teachers' specification of their responses in an open ended which required the teachers to give reason for affirming that the gender of the teacher affects the academic performance of the student. From their responses, it was derived that some of the factors that could affect female students' performance and learning of mathematics are role model, method of teaching, equality and gender stereotype.

Correlation between the attitude of the female students, the factors that affect their academic performance and their Mathematics Achievement Test (MAT). Correlation analysis was conducted to assess the correlation relationship between three variables namely: Mathematics Achievement Test (MAT), Female students' attitude towards mathematics (AD) as well the factors that affect female students learning and performance in mathematics (FA) as shown in Table 4.12.

Table: 4.12 Correlation between attitude of female students towards mathematics, Mathematics Achievement test (MAT) and factors that affect their learning and performance in mathematic

		MAT	AD	FA
MAT	Pearson Correlation	1	.034	.186**
	Sig. (2-tailed)		.597	.003
	N	250	250	250
AD	Pearson Correlation	.034	1	. 302**
	Sig. (2-tailed)	.597		.113
	N	91	250	250
FA	Pearson Correlation	.186**	.302**	1
	Sig. (2-tailed)	.003	.000	
	N	250	250	250

From the Table 4.12, it could be found that the result of the co-efficient of Pearson product moment between the three variables and the scores were 0.034, 0.302 and 0.188 in decreasing order. Assessing the level of significance of the correlation between the variables, it was observed from the Table 4.12 that correlation between students' attitude and MAT is not significant with a value of 0.597, which is greater than 0.05. Also, the correlation between female students' attitude and the factors that influence the learning and academic performance in mathematics showed level of significance (0.00) which is less than 0.05. Furthermore, there was significance correlation between the factors that influence the learning and academic performance in mathematics and MAT of the participant (0.03). It was evident that the factors that influence the learning in mathematics could subsequently affect the academic performance of the participant.

4.2.3 Research Question 3: What is the effect of female students' attitude on their academic performance in mathematics?

To answer the research question, students were asked to rank statement as SA, A, U, D and SD on the impact of female students' attitude towards mathematics as presented in Table 4.13. The study assessed the effect of female students' attitude towards mathematics and it effect on their performance.

Table 4.13: Attitude development towards learning mathematics

Statement	Strongly Agreed F (%)	Agreed F (%)	Undecided F (%)	Disagreed F (%)	Strongly Disagreed F (%)	Mean	Standard deviation
I enjoy learning mathematics	140(56.0)	72 (28.8)	24 (9.6)	11 (4.4)	03 (1.2)	1.6600	0.90979
I would like to continue doing mathematics after completing senior high school education	103(41.2)	64 (25.6)	37 (14.8)	22 (8.8)	24 (9.6)	2.2000	1.32022
Mathematics helps me make decisions on my future (prospective career)	158(63.2)	40 (16.0)	06 (2.4)	21 (8.4)	25 (10.0)	1.8600	1.37110
I think it is the teacher who can make mathematics learning easier	107(42.8)	68 (27.2)	22 (8.8)	36 (14.4)	17 (6.8)	2.1520	1.29909
Among the subjects taught, mathematics is my favourite	88(35.2)	56 (22.4)	28 (11.2)	44 (17.6)	34 (13.6)	2.5200	1.45949
I am given a lot of unnecessary mathematics assignments	19(7.6)	25 (10.0)	27 (10.8)	80 (32.0)	99 (39.6)	3.8600	1.25487
I am well-provided with mathematics textbooks and other learning resources	51(20.4)	51 (20.4)	27 (10.8)	59 (23.6)	62 (24.8)	3.1200	1.49752
I feel extremely anxious and fearful, when mathematics examinations are mentioned or brought	48 (19.2)	42 (16.8)	28 (11.2)	47 (18.8)	85 (34.0)	3.3160	1.54716

From the Table 4.13, 56.0 % and 28.8 % of the students strongly agreed and agreed respectively that they enjoyed learning mathematics. Also, 41.2 % and 25.6 % of the students strongly agreed and agreed respectively showed positive attitude toward learning mathematics by saying they would like to continue doing mathematics after completing senior high school education. However, 42.8 % and 22.4 % of the students strongly agreed and agreed respectively that mathematics could help them make decisions on their future (prospective career). Also, 35.2 % and 22.4 % of the students strongly agreed and agreed respectively that the teacher can make mathematics learning easier.

Also, 32.0 % and 39.6 % of the students disagreed and strongly disagreed that among the subjects taught, mathematics is their favorite indicating a negative attitude and this could have a negative effect on the academic performance of the student in mathematics. While 23.6 % and 24.8 % disagreed and strongly disagreed that they are given a lot of unnecessary mathematics assignment. Also, 34.0 % and 18.8 % of the students disagreed and strongly disagreed respectively that they are well-provided with mathematics textbooks and other learning resources. This was in line with the responds of students when asked to give problems that affects their learning. Finally, 15.2 % and 55.2 % of the student disagreed and strongly disagreed respectively that they feel extremely anxious and fearful when mathematics examinations are mentioned or brought. This suggest a negative attitude towards the subject since these students constitute 70.4 % of the respondents and also being affirmed by the mathematics achievement test.

Also, the study intended to assess the relationship between the teachers' teaching approach and impact on students' attitude towards mathematics. To achieve this a

ranking scale analysis was performed on the factors that contribute to students' loss of interest in the learning of mathematics and the scale was presented in Table 4.13.

Table 4. 14: Factors that contributes to students' loss of interest in learning mathematics

Which of the following can make students lose interest in learning mathematics?	Mean	Std. Deviation
when teaching aid models are available and used in class	1.1163	0.32435
abstract explanation of some mathematics topics	1.1163	0.32435
verbal explanation by teacher without physical demonstration	1.2791	0.45385
lack of instrument especially for constructing graphs and three-dimension diagram	1.3256	0.47414
Different approaches and methodologies employed in teaching student before joining Senior High School	1.6047	0.49471
Examination demands (challenges) of some mathematics topics	1.6047	0.49471
when using physical environment around the class	1.7209	0.45385
Working Experience	2.7674	1.21179

From the data in Table 4.14, the teachers, ranking the variables that cause students to lose interest in mathematics agreed on the following; the working experience (mean value of 2.7674) plays a major role on the factors and consequently could affect the academic performance of the female students, the physical environment around the class room (mean value of 1.7209) could also deepening the understanding of mathematics or otherwise, examination demands of some mathematics topics (mean value of 1.6047), different approaches and methodologies employed in teaching student before joining the SHS (mean value of 1.6047), lack of instruments especially for construction of graphs and three dimensional diagrams (mean value of 1.3256), verbal

explanation by teacher without physical demonstration (mean value of 1.2791), abstract explanation of some mathematics topics (mean value of 1.1163) and when teaching aid models are available and used in class (mean value of 1.1163). According to the ranked variables by the teacher (Table 4.14), it could be deduced that the experience of the teacher plays a major role in the learning and academic performance of female students in mathematics.

The attitude that influences the female student's learning and performance in mathematics as indicated in Table 4.18 were subjected to factor analysis to find out the hidden patterns of these attitudes affects the students' learning and performance in mathematics. Factor analysis is used to make complex data simple and more focus to analyze. Table 4.15 indicates the value of KMO and Bartlett's Test. From Table 4.15, the value of KMO obtained was 0.638 (> 0.5), which was greater than 0.5. The hypotheses used to test Bartlett's Test were H_0: There is no correlation between variables and H_1: There is correlation between variables. The p-value obtained is 0.000 (<0.05); which was less than a predetermined value $\alpha = 0.05$, therefore H_0 was not accepted and there was a relationship between variables. The result indicates that the data was adequate to be analyzed using factor analysis (DeCoster, 2012).

Table 4.15 KMO and bartlett's test

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling_Adequacy	.638
Bartlett's Test of Sphericity Approx. Chi-Square	212.796
df	36
Sig.	.000

According to table 4.15, eight (8) components were first identified before extraction using factor analysis. After extraction was done, four variables were considered as the attitudes based on eigenvalues greater than 1, where the eigenvalues were; SP1 = 2.638, SP2 = 1.483, SP3 = 1.117, and SP4 = 1.019.

After extraction was done, it was found that the total cumulative variances for the four attitudes were 69.518%. A total of 29.308 % was explained by SP1, 16.478 % was explained by SP2, 12.414 % was explained by SP3 and 11.318 explained SP4 after extraction.

In addition, rotation was used to ease the interpretation of the data and to optimize the structure of the four attitudes. Similar to the extraction method, the eigenvalues were greater than 1 as shown in table 4.16. The variance for the first attitudes (SP1, SP2, SP3 and SP4) were not changed. However, the rotation confirmed that SP1 was more correlated to the dependent variable compared to other perceptions.

Table 4.16: Total variance explained

Total Variance Explained						
Component	**Initial Eigenvalues**			**Rotation Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1.	2.638	29.308	29.308	2.638	29.308	29.308
2.	1.483	16.478	45.786	1.483	16.478	45.786
3.	1.117	12.414	58.200	1.117	12.414	58.200
4.	1.019	11.318	69.518	1.019	11.318	69.518
5.	0.896	9.952	79.470			
6.	0.703	7.808	87.279			
7.	0.470	5.222	92.500			
8.	0.425	4.726	97.226			
9.	0.250	2.774	100.000			

Results from Table 4.17, SP1 is a major contributor that containing items I1 (0.879), I2 (0.798), I5 (0.892), and I7 (0.273). The second highest contributor is SP2 which contains items I3(0.799), I4 (0.469) and I6 (0.218). The third contributor is SP3 consist of items I6 (0.599) and I7 (0.560). The last contributor is SP4 contained components of I4 (0.601), I6 (0.487), I7 (0.337) and I8 (0.358).

Table 4.17: Rotated component matrix

Component	1	2	3	4
I1. I enjoy learning mathematics	0.879			
I2. I would like to continue doing mathematics after completing senior high school education	0.798			
I5. Among the subjects taught, mathematics is my favourite	0.829			
I7. I am well-provided with mathematics textbooks and other learning resources	0.273			
I3 Mathematics helps me make decisions on my future (prospective career)		0.799		
I4 I think it is the teacher who can make mathematics learning easier		0.469		
I6. I feel extremely anxious and fearful, when mathematics examinations are mentioned or brought		0.218		
I6. I am given a lot of unnecessary mathematics assignments			0.599	
I7. I am well-provided with mathematics textbooks and other learning resources			0.560	
I4 I think it is the teacher who can make mathematics learning easier				0.601
I6. I am given a lot of unnecessary mathematics assignments				0.487
I7. I am well-provided with mathematics textbooks and other learning resources				0.337
I8. I feel extremely anxious and fearful, when mathematics examinations are mentioned or brought				0.358

According to Figure 4.2 all of the components that have been classified into four attitudes can represented by the attitudes that influence female students' studies and performance in mathematics. From Figure. 4.2, learning goals can be identified as the

major attitude (SP1) and corroborate with similar studies and observations made by Monoah, (2016). Subsequently, it could be inferred from figure 4.2 that the confidence of the student aids her to learn mathematics which could positively affect the students' academic performance.

Anxiety which is the third rated attitude could affect the students learning and subsequently their academic performance in mathematics. The methods adopted by the teacher could also influence the learning and performance of female students in mathematics.

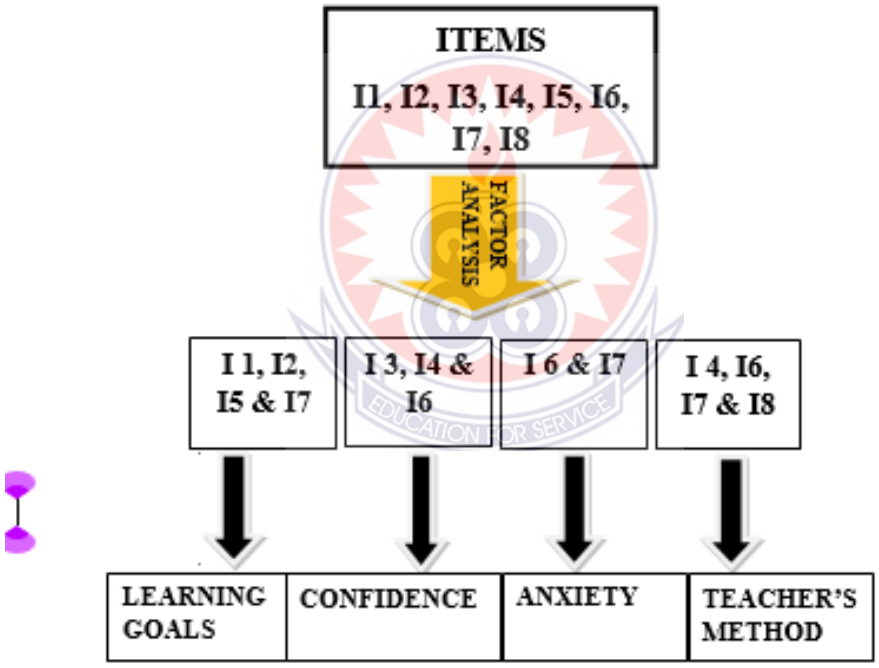

Figure 4.2: Summary of Factor Analysis (FA)

4.2.4 Research Question 4: What is the effect of teachers' perceptions of students' performance in mathematics by gender?

To answer the research question, percentage analysis was performed on the responses to the question: does the teacher's perception about your performance in the subject affect you? and the data was presented in Figure 4.3.

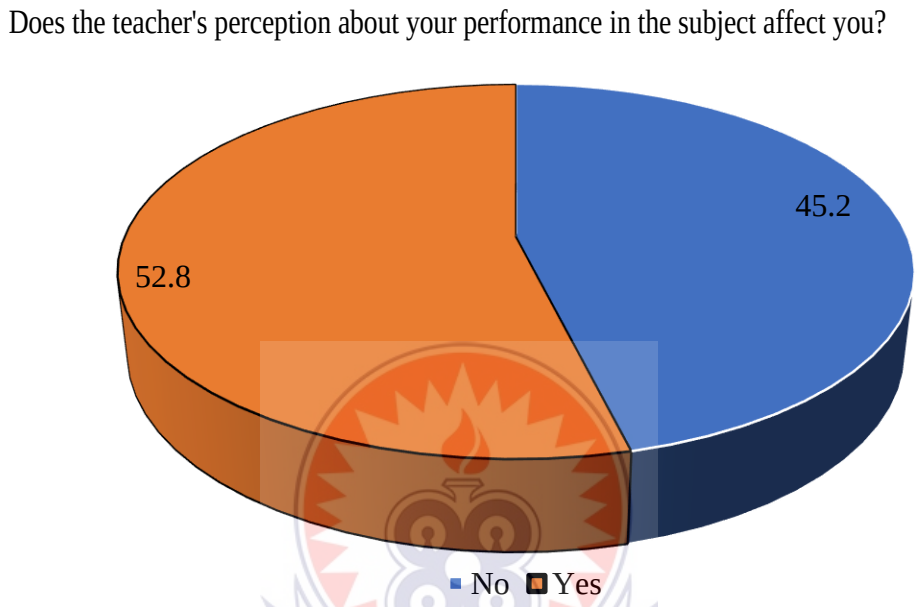

Figure 4.3: Data presentation on the effect of teacher's perception on student academic achievement

From Figure 4.3, to assess the impact of teacher's perception of student's performance in mathematics on students. A question was posed to the student; does the teachers perception about your performance in the subject affect you? About 52.8 % of the respondent (students) said yes. This implied that the perception of the teacher could influence the academic performance of the student especially females. The responds conform with a study conducted by Ullar, 2019 which also observed that teachers praise on the students and engaging them beyond the classroom were important determinants teachers must consider to improve student's mathematics performance.

To assess students' expectation on how mathematics lesson could be made interesting for them. A question was posed to students participants that, what according to you could make learning of mathematics interesting and easier to understand , about 23.6% of the respondents said attitude towards mathematics by students must be improved, 12.8% of them recommended cooperative learning to improve their performance in mathematics, 12.8% also recommended that there should be availability of textbooks and Teaching and Learning Materials (TLMs), 17.2% suggested that the teachers' subject content knowledge was key, 6.8% said lack of confidence, 6% said the language used by mathematics teachers in teaching is difficult to understand but if improved could aid the understanding of the subject. However, 8.4% of the students did not respond to the question.

Also, students were asked what other comment did they have in regards to mathematics learning. Fifty-eight (58) of the respondents recommended that well trained teachers were required, 72 of them stressed on attitude of students towards the subject, 48 of them stressed on inadequacy of textbooks, 7 of them said the time allocated to the subject should be increased while 7 of them stated that the number of topics to be covered were many and should be reduced.

4.3 Discussion of Findings

4.3.1 Research question 1: Do gender differences in mathematics performance exist in students in the Sagnarigu Municipality? The findings from the student's achievement test analysis shown that gender differences in mathematics performance exist amongst S.H.S students in the Sagnarigu Municipality. The males have performed better than the females. This supports all the researches literatures that have being reviewed for this study on gender gaps in mathematics performance in schools. All the studies

concluded that male students outperformed female students in secondary schools. Gender differences in mathematics performance exist about secondary school students.

4.3.2 Research question 2: What are the contributing factors leading to differences in mathematics by gender in the Sagnarigu Municipality?

The responses from the teachers on the factors that could influence female students' performance in mathematics, pedagogical skills can arouse the interest of the students. They said that effective teaching and learning of mathematics was based on the methodological approach used by the teacher in delivering the lesson. That is orderly delivery of content that have understanding and motivational packages are required. The literature that was reviewed for this study, also talked about the teaching methods been paramount.

From the researcher's study, it was observed that mathematics teachers are predominantly males but from the study's literature one of the factors that influenced gender differences in mathematics performance was lack of positive role models and has impact on the female students' skills, interest and achievement in mathematics. The teachers' response to the question which indicated the factors that could affect female students' performance and learning of mathematics most of the teachers also recommended that if a female colleague stood before them, that would aid reduce the negative perception and motivate them in order to become like her. That would evoke the inherent spirit to strive hard to learn the subject and they would have positive attitude towards mathematics. Some of the teachers also said the presence of a role model could influence positively or negatively in the teaching and learning of mathematics and that was paramount was the pedological content knowledge which is needed to be practical and time consuming and females do not have time. The physical

makes up of female teachers' characteristics have negative impact in learning mathematics. The respondents and the literature reviewed are all of the view that mathematics performance depends significantly on the teaching practices. The teachers been helpful and support students, responsive with teaching experiences can impact students positively and make them to be self-reliance. These teachers' view is in line with the views of the feminist's theory in the theoretical framework. The view in the findings is in line with the view in literature.

4.3.3 Research question 3: What is the impact of female students' attitude towards mathematics on their career aspirations?

Some students say they enjoy learning mathematics and others said mathematics is impossible to learn. Meaning if a student has positive mind set about mathematics performs well and does everything to always do well in the subject. That particular student is not moved by the teachers' behaviors or motivation but the interest is inherent. On the other hand, if the student has negative mind about mathematics will also put the blame on the teachers' behaviors or that the teachers do not motivate them. Even no matter what their friends or the teachers try to let them like the subject it will not yield results because the student has made his or her mind that he or she can never do well in mathematics no matter the external motivation he or she gets. If the learning environment is conducive for him or her the performance is still the same. In this research literature, Seidel and Shavelson (2017) suggested that affirmatory attitude is critical in promoting mathematics performance amongst students. These students' attitudes are well documented in research literatures as one of factors that bring gender gap in mathematics performance and if students especially females might truncate their

education at the S.H.S level and might affect their career aspirations and even the few that might go to the tertiary level will not want to take up mathematics courses.

4.3.4 Question 4: What is the impact of teachers' perceptions of students' performance in mathematics by gender?

The responses from the students indicate that teachers' perceptions of students' performance impacted greatly on their performance in mathematics. Meaning when the teacher has high expectation about a student that reflects in his or her performance. Also, low expectation about a student reflects in his or her performance. The student knows no matter what he or she strives to work harder cannot make it in mathematics. From the research literature, Herman, (2017) stated that the teachers' characteristics aid in the definition of the learners' attitude towards the students. The findings support literature reviewed for this research.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This is the final chapter of this study. The chapter provides the summary of the chapter one to four and research findings. It also highlights the conclusion of the study, implications for practice and further outlines some recommendations and directions for future research.

5.1 Summary of Study Findings

Following the results and discussions, these findings were made;

1. The study indicated that there was gender difference ($p = 0.010$) in mathematics performance among students in the Sagnarigu Municipality. The male student performed well compared to the female counterpart.
2. The study further unearths some factors which could influence the student's performance. The students agreed that lack of mathematics textbooks and learning resources is the most pressing factor among others. On the side of the teachers, they agreed that working experience and gender of the teachers could be a contributing factor. However, they also specified that some factors among others which could contribute to gender difference in mathematics are teachers serving as role model, methods of teaching, equality and gender stereotype.
3. The study also furthermore observed that female students' attitude towards mathematics leads to poor academic performance. The poor academic performance

which was established in the current study suggested that it could be as a result of learning goals, confidence, anxiety and method of teaching by the instructor.

4. A correlation analysis indicated that there is significant correlation between the mathematic achievement test score of the student and female students' attitudes.
5. About 52.8 % of the students said the perception of the teachers affect their academic performance and 23.6 % of the students said attitude of students influence their performance in mathematics.

5.2 Conclusion

Within the limits of the study, data collected and analyzed, conclusion based on objectives are as follows;

To establish whether there is difference in students' performance in mathematics by gender. It was concluded that there is significant difference in students' performance in mathematics among genders. It implies, male students of Senior High Schools in the Sagnarigu Municipal Assembly performed well as compared to their female counterparts.

The factors that influence student's academic performance as unearthed by the current study were; lack of interest in mathematics, inadequate mathematics textbooks and learning resources, language used by teachers is difficult to understand, lack of confidence, working experience of teacher among others. In conclusion, the major factors that could influence students' academic performance in mathematics were inadequate mathematics textbooks and teachers' working experience.

The attitudes cultivated by the female students towards the study of mathematics could lead to their non-performance in the WASSCE exams. Hence, these attitudes are the

students' learning goals, confidence, anxiety and method of lesson delivery by the teacher.

It was established from the data collected that teacher's perception of student's performance in mathematics by gender could affect the student as indicated by the respondents.

5.3 Recommendations

In the light of the findings of this study, the following recommendations are put forward.

It was established that the male students outperformed their female counterparts in mathematics in the Sagnarigu Municipality. Therefore, mathematics teachers in the municipality need to give female students, the needed attention and special tuition they required as to improve their performance and confidence in the subject.

It is also recommended that the Ghana Education Service and Management of the various Senior High Schools should ensure that the mathematics teachers posted to their schools have the requisite qualifications. This could also foster a more positive attitude of the female students towards the subject.

It is also recommended that the teachers of the Senior High Schools in the Municipality must be given in-service training periodically to equip them enough to deliver their subject. Teachers should be encouraged to alternate or mix their methods of teaching and also introduce TLMs or other demonstrative approaches which could deepen the understanding of the subject and also improve student academic achievement. These hands-on activities are popular teaching methods used by a vast majority of teachers.

It was found out in the course of the study that the negative perception and attitude of learners towards the subject account for gender difference in mathematics achievement. In this regard, mathematics teachers in the SHS should serve as role models and mentors to coach the young students to achieve their carrier aspiration.

Finally, teachers should create opportunities for students to be engaged in their learning which will enable them achieve the following:

5.4 Suggestions for Further Research

With reference to the research and its institutions, the following research areas are proposed for investigation.

The study covered only senior high schools in the Sagnarigu Municipality in the Northern Region of Ghana. In order to have a broader understanding and overview on the impact of gender difference in student's mathematics achievement, it is recommended that further studies need to be conducted in other municipalities or districts to widen the scope of the study population. Further studies should assess and relate the performance of candidates to their attitude towards the subject.

Furthermore, a study needs to be conducted to evaluate the impact of culture and gender difference in mathematics achievement in Senior High Schools in Ghana.

To add to the above, women potentials should be identified with regards to the underrepresentation in STEM and that will help design intervention programs that will meet their needs to improve STEM achievement and occupational choices.

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APPENDICES

APPENDIX A

Students' Questionnaire

Dear Participant,

This questionnaire is in accordance with research being conducted on the topic; "Impact of gender difference on mathematics performance among students of senior high schools within the Sagnerigu Municipality of the Northern Ghana" for academic purposes only as part of a requirement for the award of a Masters of philosophy degree, hence your participation is highly required. Information provided in this questionnaire shall be treated as confidential and will not be disclosed to a third party. You have the right to withdraw from the study at any point in time without any consequences. Thanks for your co-operation.

A. SOCIO-DEMOGRAPHIC CHARACTERISTICS

1. Course……

2. Age: 15 ( ) 16 -18 ( ) 19 years and above ( )

3. Sex: Male ( ) Female ( )

B. RELATED QUESTIONS

1. Which of the following factors affect you most when learning mathematics? (Tick from the following options)

Student opinion	
Lack of interest in mathematics	
Inadequate mathematics textbooks and learning resources	
Language used by the teacher is difficult to understand	
Lack of confidence	

Any other, specify

.....

.....

C. Related Question

(1) **Instructions**: This section has statements that you are to decide carefully whether you strongly agree (SA), Agree (A), Unsure (U), Disagree (D), or Strongly Disagree (SD). Put a tick [√] against each statement depending on your feelings. If you make a mistake, cross by putting (X) through the tick [√] and then tick in the appropriate box in the table below

Rank the following perception statement as SA, A, U, D and SD.

Student opinion	**SA**	**A**	**U**	**D**	**SD**
I enjoy learning mathematics					
I would like to continue doing mathematics after completing senior high school education					
Mathematics helps me make decisions on my future (prospective career)					
I think it is the teacher who can make mathematics learning easier					
Among the subjects taught, mathematics is my favourite					
I am given a lot of unnecessary mathematics assignments					
I am well-provided with mathematics textbooks and other learning resources					
I feel extremely anxious and fearful, when mathematics examinations are mentioned or brought					

i. What are the factors that contribute to the formation of attitude towards mathematics learning and performance?

Student opinion	SA	A	U	D	SD
Mathematics should not be a compulsory subject					
I do a lot of mathematics exercises on my own or with a friend					
Learning mathematics is just remembering what the teacher says and does while in class					
The best way to learn mathematics is to discover a concept by oneself					
I do mathematics for the sake of it					
My friends don't like learning mathematics					
My parents and siblings encourage me to learn mathematics and to perform well in the subject					
Being a girl or a boy interferes with my learning and my performance of mathematics					
I learn mathematics well regardless of the gender of my teacher					

2. What according to you can make learning of mathematics interesting and easier to Understand? ----------

3. Does the teacher's perception about your performance in the subject affect you?

(a) Yes..... (b) No.....

4. What other comment do you have in regard to mathematics learning? ----------

- ----------

THANK YOU

APPENDIX B

Questionnaire for Mathematics Teacher

Dear Participant,

This questionnaire is in accordance with a research being conducted on the topic; "Impact of gender difference on mathematics performance among students of senior high schools within the Sagnerigu Municipality of the Northern Ghana" for academic purposes only as part of a requirement for the award of a Masters of philosophy degree, hence your participation is highly required. Information provided in this questionnaire shall be treated as confidential and will not be disclosed to a third party. You have the right to withdraw from the study at any point in time without any consequences. Thanks for your co-operation.

1.SOCIO-DEMOGRAPHIC CHARACTERISTICS

a.Level of Education: Certificate ( ) diploma ( ) degree ( ) masters ( )

b.Area of specialization (Degree) ……

c.Age: 20 -25 ( ) 25-30 ( ) 30 -35 ( ) 35 - 40 ( ) 45 – 50 ( ) above 50 ( )

d.Sex: Male ( ) Female ( )

e.Working experience: Less than 5 years ( ) 5 -10 ( ) 10 -15 ( ) 15 -20 ( ) more than 20 years ( )

B. RELATED QUESTIONS

When do you find it easier to teach mathematics?

When teaching aid models are available and used in class	
When using physical environment around the class	

Which of the following can make students lose interest in learning mathematics?

Tick (√) as many options as possible

Abstract exploration of some mathematics topics	
Lack of instrument especially for constructing graphs and three Dimension diagrams	
Verbal explanation by teachers without physical demonstration	
Examination demands (challenges) of some mathematics topics	
Different approaches and methodologies employed in teaching student before joining Senior High School	

Do you think that the gender of the teacher could influences students learning of mathematics? Tick (√)

Yes ☐ No ☐

Reasons

……..

……..

……..

APPENDIX C

Mathematics Achievement Test

SUBJECT: MATHEMATICS

FORM: SHS3

DURATION: 1 Hour

SECTION 'A'

OBJECTIVES

INSTRUCTION: Answer **all** questions

1. Simplify $\frac{(ab)^{-3}\times(a^{-2}b)^{2}}{(ab^{-1})^{-2}\times(a^{3}b)^{-2}}$

   A. ab

   B. $\frac{a}{b}$

   C. $\frac{b}{a}$

   D. $a^{-15}b^{4}$

2. If $729^{x}=\frac{1}{81}$, find the value of x

   A. $\frac{2}{3}$

   B. $\frac{3}{2}$

   C. $-\frac{2}{3}$

   D. $-\frac{3}{2}$

3. Find x if $3\times9^{1+x}=27^{-x}$

   A. $-\frac{3}{5}$

   B. $\frac{3}{5}$

C. 2

D. -2

4. Multiply 6.4×10^{-2} by 8.5×10^{4} and leave your answer in standard form.

A. 54.40×10^{6}

B. 54.40×10^{2}

C. 5.44×10^{2}

D. 5.44×10^{3}

5. Evaluate $\dfrac{0.0125\times6300}{2500\times0.009}$

A. 35×10^{-1}

B. 3.5×10^{-1}

C. 3.5×10^{0}

D. 35×10^{2}

6. Find the value of $\dfrac{\log 81}{\log 1/3}$.

A. -4

B. 4

C. 12

D. -12

7. Find the value of $6\log(x+4)=\log 64$.

A. 6

B. -6

C. 2

D. -2

8. If $\log_3 x+\log_3(1/x^3)=2$, find the value of x

A. $\dfrac{1}{3}$

B. 3^1

C. 9

D. -9

9. Solve $\log_{10} 2x=1$

A. 5

B. 10

C. 20

D. $\frac{1}{5}$

10. solve for x if $2^{x(x-3)} = \frac{1}{4}$

A. $-1, -2$

B. $1, 2$

C. $-1, 2$

D. $1, -2$

SECTION 'B'

ATTEMPT ALL QUESTIONS

1. Solve $3^{2x} = 5^{x+1}$

Simplify $\frac{\log_2 8 + \log_2 2\sqrt{2}}{\log_2 1/\sqrt{2} - \log_2 \sqrt{2}}$

APPENDIX D

Marking Scheme for Student's Achievement Test

Section A

Each question carries half (1/2)

1. B
2. C
3. B
4. D
5. C
6. A
7. D
8. A
9. A
10. B

Section B

Each question carries two and half marks

1. 3*2X = 5*X+1

2XLog3= (x+1) log5

Xlog3*2 =xlog5 +log5

Xlog 9 -xlog5 =log5

X (log 9 -log 5) =log 5

X= log5/ log 9 -log 5

= 0.6990/0.9542 – o.6990

= 0.6990/0.2552

= 6990/2552

=2.74 (3 significant figures)

2. $Log_2^8 + log_2^{2root2} / log_2 1/2 - log_2 root\ 2$

$\log_2^{2*3} + \log 2 \times 2^{1/2} / \log 2^{-1/2} - \log 2^{281/2}$

$3 \log_2^2 + 3/2 \log 2^2 /-1/2 \log 2^2 - ½ \log 2^2$

3+ 3/2 / -1/2 -1/2

-9/2

-4 1/2

APPENDIX E

THE WEST AFRICAN EXAMINATIONS COUNCIL, ACCRA

WASSCE(SC) FOR NORTHERN REGION STUDENTS' PERFORMANCE STATISTICS IN MATHEMATICS(CORE) SUBJECT BY GENDER (2014 - 2019)

Ex Year	Sub Name Gender	Candidature	A1	B2	B3	C4	C5	C6	D7	E8	F9
2014	**MATHEMATICS(CORE)**										
08	**Northern** Female	6,950	1	4	37	31	90	305	665	1,471	4,258
	Male	10,894	21	40	224	114	252	882	1,475	2,602	5,107
		17,844	**22**	**44**	**261**	**145**	**342**	**1,187**	**2,140**	**4,073**	**9,365**
2015	**MATHEMATICS(CORE)**										
08	**Northern** Female	9,271	5	1	55	46	93	293	469	929	7,320
	Male	14,053	21	24	222	110	223	703	1,073	2,114	9,468
		23,324	**26**	**25**	**277**	**156**	**316**	**996**	**1,542**	**3,043**	**16,788**
2016	**MATHEMATICS(CORE)**										
08	**Northern** Female	10,532	8	21	108	57	103	391	560	1,118	7,798
	Male	14,975	139	119	539	215	359	1,051	1,256	2,005	9,097
		25,507	**147**	**140**	**647**	**272**	**462**	**1,442**	**1,816**	**3,123**	**16,895**

2017	**MATHEMATICS(CORE)**										
08	**Northern** Female	10,913	1	6	45	25	94	539	1,277	2,669	6,182
	Male	14,720	29	38	299	137	353	1,443	2,161	3,717	6,396
		25,633	**30**	**44**	**344**	**162**	**447**	**1,982**	**3,438**	**6,386**	**12,578**
2018	**MATHEMATICS(CORE)**										
08	**Northern** Female	10,855	8	10	49	23	45	208	461	1,398	8,590
	Male	14,226	62	58	235	97	216	688	998	2,156	9,605
		25,081	**70**	**68**	**284**	**120**	**261**	**896**	**1,459**	**3,554**	**18,195**

Ex Year	Sub Name	Gender	Candidature	A1	B2	B3	C4	C5	C6	D7	E8	F9
2019	**MATHEMATICS(CORE)**											
08	**Northern**											
		Female	11,224	52	54	275	146	262	1,048	1,322	2,201	5,785
		Male	13,702	309	263	912	356	610	1,663	1,771	2,429	5,233
			24,926	**361**	**317**	**1,187**	**502**	**872**	**2,711**	**3,093**	**4,630**	**11,018**

APPENDIX F

Letter of Introduction (UEW)

UNIVERSITY OF EDUCATION, WINNEBA
FACULTY OF SCIENCE EDUCATION
DEPARTMENT OF MATHEMATICS EDUCATION
P. O. Box 25, Winneba, Ghana
math@uew.edu.gh
+233 (020) 2041076

August 5, 2020

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

LETTER OF INTRODUCTION

I write to introduce to you the bearer of this letter, **Ambayor Claudia Tagoor**, a postgraduate student in the University of Education, Winneba. She is reading for a Master of Philosophy in Mathematics Education (M.PHIL) and as part of the requirements of the programme, she is undertaking a research titled – ***Factors influencing gender differences in Mathematics performance in some selected Senior High Schools in the Sagnarigu municipality of the Northern Region of Ghana***

She needs to gather information to be analysed for the said research and she has chosen to do so in your institution. I would be grateful if she is given the needed assistance to carry out this exercise. Thank you.

Yours faithfully,

UNIVERSITY OF EDUCATION, WINNEBA
SIGN
DATE
DEPARTMENT OF MATHEMATICS EDUCATION

Prof. Michael J. Nabie (PhD)
Head of Department

www.uew.edu.gh

APPENDIX G

Letter of Introduction (GHANA EDUCATION SERVICE)

GHANA EDUCATION SERVICE

In case of reply the date and reference number should be quoted

REPUBLIC OF GHANA

Sagnarigu Municipal Education Office
P. O. Box 377, E/R
Tamale, N/R

Our Ref:: GES/NR/SMEO/SS.2
Your Ref: .....

29th August, 2020.

LETTER OF INTRODUCTION
MRS. AMBAYOR CLAUDIA TAGOOR

Mrs. Ambayor Claudia Tagoor is a student of the University of Education Winneba.

She is pursuing master of philosophy in mathematics Education. She is undertaking her research work on the topic, factors influencing gender differences in mathematics performance in some selected senior High Secondary Schools in the Sagnarigu Municipality which your school is chosen.

I would be very happy if you could use your good offices to help the applicant in the conduct of her research work.

Thank you.

SAMATA MAHAMA (MS)
MUNICIPAL DIRECTOR OF EDUCATION
SAGNARIGU

THE HEADMASTER/MISTRESS
TO WHOM IT MAY CONCERN
SAGNARIGU

cc:
Mrs. Ambayor Claudia T.
Tamale SHS
Sagnarigu

ais