UNIVERSITY OF EDUCATION, WINNEBA

INVESTIGATING GENDER-BASE PERFORMANCE IN MATHEMATICS OF SENIOR HIGH SCHOOL STUDENTS IN SELECTED SCHOOLS IN SEKONDI-TAKORADI METROPOLIS

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DECLARATION

STUDENT'S DECLARATION

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

SIGNATURE: …………………………………...

DATE: ……………………………......................

SUPERVISOR'S DECLARATION

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

NAME OF SUPERVISOR: PROF. SAMUEL ASIEDU-ADDO

Signature: ………………………

Date: …………………………….

DEDICATION

This work is dedicated to my parents, Mr. and Mrs. Adika who gave me the physical strength to undertake and accomplish this thesis in the prescribed period of time.

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The preparation of a thesis is due to cooperative efforts from several key individuals and institutions. Though it might be impractical to mention all of them, some minimum credit is inevitable.

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ABSTRACT

The study sought to determine the overall mathematics performance of boys and girls in the selected schools and to identify factors that contribute to gender-based performance in mathematics among Senior High School students and finally to proffer a possible workable idea to enhance teaching and learning of mathematics to attain gender-based performance parity. The research designed employed was a cross-sectional survey design with quantitative and qualitative approach. The targeted population for the study was 500 final year students of which the accessible population was 200 senior high school final year students and 5 mathematics teachers selected from the 5 senior high schools in Sekondi-Takoradi Metropolis. The study employed convenient sampling to easily reach out to students because the distance between them were not so wide apart. Stratified sampling was also used to obtain gender balance as well as simple random sampling was used to employ 200 final year senior high school students which comprise of 107 males and 93 females, as well as 5 mathematics teachers in the metropolis. The instruments employed in this study were mathematics test, questionnaire and interview. The results from the independent sample t-test revealed that there was no significance difference in mathematics performance of boys and girls in the selected schools. Furthermore, the students had a negative perception on the factors that contribute to gender-based performance in mathematics as well as proffering a possible workable idea to enhance teaching and learning of mathematics to attain gender-based performance parity. It was recommended that Mathematics teaching and evaluation strategies should be gender bias free. Also in drawing school achievement plans, teachers should endeavor to add exchange programs internally to help increase the depth and quality of mathematics learning.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter deals with background to the study, statement of the problem, purpose of the study, objectives, research questions, significance of the study, delimitation, limitation of the study and the organization of the study.

1.1 Background to the study

Mathematics is perceived by society as the foundation for scientific and technological knowledge that is cherished by societies worldwide. It is an instrument for political, socio-economic, scientific and technological developments (Githua & Mwangi, 2003). However, Aderinoye (2004) noted that numeracy (mathematics) is a necessity in every society that adopts activities as part of their life among which are measuring and weighing. Corroborating this, Eze (2006) noted that mathematics helps to prepare learners for life and help them to acquire the skills they need in order to become efficient and effective in problem solving and in everyday life calculation. Kavkler, Magajna and Babuder (2014) have postulated that mathematics in this technological era became an essential tool for developing rational human personality. That is, mathematical knowledge develops in people critical thinking for most especially life and career decisions. It is also perceived as an essential precursor to success in modern society. It usefulness in science, technological activities as well as commerce, economics, education and even humanities is almost at par with the importance of education as a whole (Tella, 2008).

Mathematics occupies an important place in schools. This is because, it plays an important role of providing knowledge and skills that every human being, including boys and girls need to acquire in order to become efficient and effective in dealing with real life problems. According to Anamuah-Mensah, Asabere-Ameyaw, and Dennis(2005) mathematics has been classified as a core subject at the basic and second cycle level of education in Ghana. It is a requirement for admission into secondary school and prestigious courses at the tertiary (University, Polytechnic, Colleges of Education, etc.) This is to help students develop interest in the use of mathematics and the ability to conduct investigations using mathematical ideas. It is the acquisition of some of these qualities that mathematics education in Ghana aims to emphasis in the school system (CRDD, 2007). However, as mathematics is an important social construction, and is related to these underlying tasks, it is worth examining as a coherent entity Penner & Paret,(2008).This topic is premised on the current world trend and research emphasis on gender issues following the millennium declaration of September 2000 (United Nations, 2000) which seeks to promote gender equity, the empowerment of women and the elimination of gender inequality in basic and secondary education by 2005 and at all levels by 2015. In order to achieve full realization of these laudable objective of mathematics education, subject mastery and demonstrated achievement should be evenly distributed across gender.

Gender- based performance in mathematics and ability remains a concern as scientist seek to address the underrepresentation of women at the highest levels of mathematics, the physical sciences, and engineering (Asante, 2010). The introduction of formal education in Ghana did not advocate discrimination. It is for this reason that children of both sexes are given equal opportunities to pursue formal education. Since equal opportunity given to males and females does not imply equal achievement, there is the need to assess and compare the academic achievement of males and females in schools Wilmot (2001), particularly in mathematics. This is because there are still unjustifiable gender variations in interest in pursuing mathematics and its related disciplines.

It has widely been reported in the literature that boys outperform girls in mathematics especially at the elementary and secondary level (Neuschmidt, Barth, & Hastedt, 2008; Frempong, 2010; Bassey, Joshua, & Asim, 2011; Chowa, Massa, Ramos, & Ansong, 2013). However, studies from countries such as United Arab Emirate (UAE) and Malaysia have shown that girls were outperforming boys in mathematics (Alkhateeb, 2001; Azina & Halimah, 2012). According to Alkhateeb (2001), girls from UAE outperform boys in mathematics and also show little anxiety in performing mathematics tasks unlike girls from most Western countries. Also analyzing the TIMSS 2007 data from Malaysia, Azina and Halimah (2012) found that girls performed significantly higher than boys in mathematics. Following these gender differences in mathematics performance between boys and girls, studies have attempted to investigate the reasons associated with these differences. For instance, female students are reported to exhibit less confidence in their mathematical abilities than males (Else-Quest, et al, 2010). Further, the stereotyping of mathematics as a male subject can affect mathematics performance and cause anxiety on the part of females, thereby affecting their interest in mathematics (Else-Quest et al., 2010). It has become a general feeling or stigma that mathematics is boy's domain. A study through a meta-analysis reveals that males tend to do better on mathematics tests that involve problem-solving (Hyde, Fennema, and Lamon 1990). Females tend to do better in computation, and there is no significant gender difference in understanding mathematics concepts. Another study shows that females tend to earn better grades than males in mathematics

According to Kauchak and Eggen (2011), the brains of male and female children are wired differently for learning. Their findings showed that the components of the brain that focus on words and motor skills develop a year ahead for girls than for boys, thus giving the female child opportunities and advantages in reading and performing small motor tasks. Although Samuelsson and Samuelsson (2016) found that boys perceive mathematics to be more important than girls do, Ajai and Imoko (2015) maintain that performance is a function of orientation not gender, thus male and female students are capable of competing and collaborating in mathematics. Nejad and Khani (2014) opine that girls right from primary to secondary school underestimate their abilities in mathematics even though their performances remain the same as that of boys.

In spite of the massive research on gender differences in mathematics performance, (Springer and Alsup, 2003) have shown that boys and girls perform equally on mathematical reasoning ability at the elementary school level. However, Tapia and Marsh (2004) contend that up to 1994, measurable gender differences in mathematics scores are apparent only from age 13 and since that time, whatever gap existed seems to have disappeared. International comparison of gender studies has revealed that several countries have in effect achieved gender equity in mathematics and this fact presents a challenge to those countries that have not yet done so.

Over the last three decades, diverse theories and frameworks have been developed and many have tried to identify factors that influence mathematics performance in order to reduce gender inequality in mathematics achievement (O'Connor-Petruso & Miranda's) study (as cited in Campbell 2005). Geary (2000) has argued that research evidence shows that gender differences in mathematics achievement are due to various factors such as biological factors, mathematics learning strategies, sex hormones on brain organization, and symbolic gender. Other important factors that emerged in research on gender and mathematics are cultural, family influences and socio-economic status of parents (Kaino & Salani, 2004).

Literature about gender and academic performance in mathematics exist with different views and findings. Studies conducted in countries like U.S.A, Australia and Asia have shown that boys performed better than girls in mathematics (Fennema, 2000; Kaiser-Messmer, 1994). However, according to Hanna (2006), the gender gap in Mathematics has been decreasing in recent decades and is quite small. The problem with "gender gap" has reinvented itself as researchers have studied it and found partial explanations and solutions as to why achievement of girls and boys was not at the same level. Several explanations on biological factors have been proposed for the existence of the gender gap in mathematics (Baron-Cohen & Wheelwright, 2004; Baron-Cohen et al., 2001). However, as shown by international assessments (OECD, 2015) the gender gap in mathematics differs substantially across countries. Another attributable reason for a gap in mathematics performance between males and females is the inherent unfairness in school-based assessment (Griffith, 2005; Asim, et al 2007) which may result from teachers' incompetency in assessment (Asim, et al., 2007). Although the causal direction is difficult to assess, girls display less mathematics self-efficacy (self-confidence in solving mathematics related problems) and mathematics self-concept (beliefs in their own abilities), and more anxiety and stress in doing mathematics related activities (OECD, 2015; Heckman & Kautz, 2012, 2014; Lubienski et al., 2013; Twenge & Campbell, 2001). An early research study in this area has shown that male advantage in mathematics performance is a universal phenomenon.

A large-scale study in the U.S.A. by Hydea and Mertzb (2009) revealed that girls have reached parity with boys in mathematics performance, including at high school where a gap existed in earlier decades. O'Connor-Petruso, Hayes and Serrano (2004) have shown that gender differences in mathematics achievement become apparent at the secondary level when female students begin to exhibit less confidence in their mathematics ability and perform lower than males on problem solving and higher-level mathematical tasks. There is also evidence that women sometimes perform more poorly on important tests of mathematics achievement than they should, given their ability. That is, their scores on these tests do not reflect their true ability, because of a phenomenon called stereotype threat (Forgasz et al, 2000). Gender differences in mathematics education in developing countries is one critical area of research that needs further exploration. There is limited information about the status of contextual research on women and girls in those settings in relationship to their mathematical education. However, a lot of gender programmes have been carried out, not much research has been done within the classroom in the African continent. Our understanding of gender in classroom practices is most often based on what has been studied in global level and not contextualized from specific classroom environments. Although there has been a massive research effort conducted in the area of mathematics, the African continent begins to face up to the realities of gender differences in classroom practices. In as much as the main aim of the educational policy in Ghana is to promote among others, gender equity in access to all educational levels, there are more females than males, who do not benefit from these. This gender discrepancy increases over the education levels, being more at the tertiary level and particularly in mathematics and its related fields. While both males and females attain relatively same number of bachelor's degrees, females do not attain degree at equal rates in fields where mathematics is highly applied such as Science, Technology, and Engineering (National Science Foundation [NSF], 2009). The question that comes in mind is why these phenomena?

The aim of the Mathematics Curriculum at Senior High School (SHS) in Ghana is to develop in students the following:

- Basic ideas of quantity and space.
- Use of basic Mathematics strategies for solving problems encountered in daily life.

- Communicate effectively using Mathematical terms and symbols.
- The ability and willingness to perform investigations using various Mathematical ideas and operations.
- Work co-operatively with other students to carryout activities and other projects in Mathematics and consequently develop the value of co-operation and diligence.
- Develop interest in studying Mathematics to a higher level in preparation for professions and careers in science, technology, commerce and a variety of work areas (Mathematics Syllabus for SHS, 2007.).

These aims are expected to be achieved by both males and females at the Senior High School level. It is against this background that this study would investigate on gender - based performance in mathematics of Senior High School students in selected schools in Sekondi-Takoradi Metropolis.

1.2 Statement of the problem

The question of gender difference in mathematics, achievement, and attitudes is of continuing concern. The greater concern is that girls in particular continue to perform poorly compared to boys in least developing countries. This problem seems to be most prevalent in mixed Senior High Schools in Ghana. Pamela (2000). Long research history in this area has shown that male advantage in mathematics achievement is a universal phenomenon Janson, Mullis et al. (2000).

Gallagher and Kauffman (2006) recognized that mathematics achievements and interest of boys are better than the girls. They go on however to explain that they do not know the main cause of these differences. These gender differences in mathematics and science achievements have implications on girl's future careers and have been a source of concern for educators everywhere. NELS (2004) shows that, learning experiences among females in Science, Technology, Engineering, and Mathematics (STEM) disciplines are impacted by a pattern of socialization that often differs from males, despite comparable ability. In 2001, women in the United States earned 48 percent of the Bachelors' degrees in Mathematics, according to the National Center for Education Statistics NCES, (2004). Girls tend to hold a higher internal locus control for their success and failures, and they tend to blame themselves more negatively than boys when they fail.

In Sekondi/Takoradi Metropolis there is a huge cry over the performance of Senior High School Students in Mathematics, and the prevailing notion is that female students underperform than their male counterparts. Oral evidence of subject teachers indicates that students, particularly female students do not perform satisfactorily in mathematics. Personal communication with the mathematics teachers in the metropolis further indicated that there seem to be gender differences in students' performance in mathematics, with girls performing poorly. The unsatisfactory performance of female students in mathematics in the metropolis is a pointer to their difficulty in learning and mastering the subject. The 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 performance among females in Senior High Schools. Even though several studies conducted over the years on gender differences in mathematics performance seem to produce conflicting reports (Hyde et al., 2008). It is against this background that this study sought to investigate on gender-based performance in mathematics of senior high school students in selected schools in Sekondi-Takoradi Metropolis.

1.3 Purpose of the Study

The purpose of the study was to investigate gender-based performance in mathematics of senior high School students in selected schools in Sekondi-Takoradi Metropolis.

1.4 Objectives of the study

The following objectives guided the study

1. To determine the overall mathematics performance of boys and girls in the selected schools in Sekondi-Takoradi Metropolis.

2. To identify factors that contribute to Gender-Based Performance (GBP) in mathematics among senior high school students.

3. To proffer a possible workable idea to enhance teaching and learning of mathematics to attain Gender-Based Performance (GBP) parity.

1.5 Research Questions

The following research questions guided the study:

1. What is the overall mathematics performance of boys and girls in the selected schools in Sekondi-Takoradi Metropolis?
2. What are the factors that contribute to Gender- Based Performance (GBP) in mathematics among senior high school students?
3. What workable ideas can be explored to enhance teaching and learning of mathematics to attain Gender- Based Performance (GBP) parity?

1.6 Hypothesis

The following hypothesis was formulated to guide the study:

H_o: There is no significant difference in mathematics performance of males and females in the selected Senior High schools in Sekondi-Takoradi Metropolis.

H_1: There is a significant difference in mathematics performance of males and females in the selected Senior High schools in Sekondi-Takoradi Metropolis.

1.7 Significance of the study

It is hoped that the study on gender- based performance in mathematics of Senior High School students in selected schools in Sekondi-Takoradi metropolis would serve as a baseline study for policy makers in mathematics education to carry out other research work in a similar area and contribute to clarifying the confusion and gap in understanding gender differences in students' academic achievement. It would also enable teachers to carry everybody along whether male or female, encouraging them to bring out their best performance. Finally, the study would also add to literature which can be adopted and used to compare other studies elsewhere.

1.8 Delimitations

The study involved only Mathematics teachers and students in four selected senior high schools in Sekondi-Takoradi metropolis although other students and teachers teaching mathematics in other senior high schools may face similar problems across the nation.

1.9 Limitation of the study

Among the senior high schools in Sekondi-Takoradi Metropolis, only five senior high schools were selected for this study and this has limited the scope of the research. The consequence of this was that, generalization of the research findings was limited. Also, a study of this kind should have covered a wide sampling of data, but due to time constraint and limited financial resources produce an obvious limitation.

1.10 Organisation of the Study

This study was organised into five chapters. The first is the introduction that provides a detail background and the problem to be addressed by the study. The various objectives and relevance of the study are also provided in this chapter. In chapter two, a detailed literature review of both theoretical and empirical research is provided. Chapter three outlines the methodology for the study. This includes a description of the study area, the sampling procedure, data collection and analysis. In chapter four, the empirical findings based on each objective are provided. Finally, chapter five gives the summary, conclusions, and recommendations from the study and suggestions for further studies

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

This chapter reviews the literature, discusses previous studies carried out which were related to this study. Thus, thorough search through available literature showed that a number of studies and articles on gender difference, particularly on mathematics performance had been carried out at various levels of education both local and foreign nation.

The literature was reviewed under the following themes: theoretical framework, the concepts of gender and gender gap in mathematics performance of students, factors responsible for gender differences in mathematics performance, how to improve Gender- based performance in mathematics in order to enhance effective teaching and learning of mathematics, empirical review, and summary of literature review.

2.1 Theoretical framework

This study is grounded in a social-cognitive framework and uses Bandura's (1986) theory of self-efficacy to understand the gender gap in mathematics achievement. In this theory, there is a triadic reciprocal relationship between a person's behavior, environment, and beliefs such that each bidirectional affect the others (Bandura, 2011). This is an appropriate framework because it incorporates not only individual factors but also larger social-structural factors such as gender that can operate through psychological mechanisms to influence behaviours. However, according to the deficit theory by Kaiser and Rogers (1995) differences in educational outcomes occur because of inherent deficiencies or weaknesses in girls' experiences, knowledge, and skills. Radical feminist researchers embraced differences between the genders and argued that patriarchal structure denied women the opportunity to use the deficit theory as a strengths for learning and achieving in mathematics.

Kaiser and Rogers (1995) argued for changes to curriculum and teaching approaches. The researchers argued that groups of learners were not homogenous, rather individuals have multiple and shifting identities and these are shaped by the context in which they are situated. Analyzing the relationships and the power within these relationships in mathematics classroom explained differences in learning behaviours and outcomes and the identities formed by learners in these classrooms. The researchers realized that boys and girls, in different environment, have things that encourage them to learn mathematics. The deficit theory brings out various powers within students and that made the researchers go for the deficit theory.

Bishop and Forgasz (2007) also supported the deficit theory in a different form as the theory of Equality or equity. They explained equity as a considered criterion for evaluating many aspects of education including outcomes, along with access, disposition and the quality of teaching. Bishop and Forgasz (2007) argued that boys and girls in the study of mathematics should be granted equal opportunities, equal treatment to ensure equal outcomes. The theory brings out the various ways that boys and girls should be treated to get an equal result. This made the researcher adapted to the theory. It also shows there are gender differences and can be easily be seen in their natural environment. Watt (2006) looked at the intended and actual participation of girls and boys, and the mathematics-relatedness of the students' intended careers. The results showed a "remarkably robust" and statistically significant tendency for boys to plan and take higher-level mathematics subjects than girls, and for boys to be more likely to plan mathematical careers than girls. These gender differences in the actions of girls and boys were mirrored by gender differences in their self-perceptions of mathematics talent and their expectations of success that also favoured boys. Despite similar success in mathematics, boys rated their talent more highly than did girls. Although prior success in mathematics was found to influence subject choice, students who rated the intrinsic value of mathematics, and their self-perception higher, took higher-level mathematics subjects.

Furthermore, boys who saw mathematics as moderately useful are likely to aspire to mathematics related careers, only girls who saw mathematics as highly useful are likely to do so. Watt (2006) further argued that, boys maintained higher intrinsic value for mathematics and higher mathematics related self-perceptions than girls throughout adolescence.

2.2 Concept of gender and sex

There are often misinterpretations of the words gender and sex. Gender is not the same as sex. Sex is biological in nature while gender is the sociological and cultural beliefs associated with a person biological status of being male or female (American Psychological Association & National Association of School Psychologists, 2015). This section looks at several definitions and adopts one as a working definition for the study.

"Gender refers to the array of socially constructed roles and relationships, personality traits, attitudes, behaviours, values, relative power and influence that society ascribes to the two sexes on a differential basis. Gender is an acquired identity that changes over time, and varies widely within and across cultures. Gender is relational and refers not simply to women or men but to the relationship between them" (INSTRAW as cited in Esplen & Jolly, 2006). Connell (2014) defines gender as a subject of social structure within which a person or group operates and not just a manifestation of biology in human life. Again, American Psychological Association and National Association of School Psychologists (2015) delineate gender as the attitudes, feelings, and behaviours that a particular culture or society associates with a person's biological sex. The Food and Agricultural Organisation also define "gender as the interactions between men and women, which are perceptual and material. Gender is a fundamental organizing principle of societies and often controls the processes of production and reproduction, consumption and distribution" (Food and Agriculture Organization, 1997). Lastly, the World Health Organisation (2001) defines gender as the economic, social and cultural attributes and opportunities connected with being male or a female at a particular point in time. All the definition connotes that gender is socially constructed.

2.2 Gender gap in mathematics performance

Gender gaps in mathematics achievement have been widely studied, particularly in USA and Europe (Fennema, Carpenter, Jacobs, Franke & Levi, 1998; Bevan, 2001; VanLeuvan, 2004, Gallagher & Kaufman, 2006; Zhu, 2007; Hyde, et al 2008; Azar, 2010; Else-Quest, Hyde & Linn, 2010).). But this literature is not conclusive and remains both controversial and debatable on whether gender gaps in mathematics achievement really exist and what sources of this difference are. It seems that results vary with context and analytical approach. For example, in USA, Hyde, et al (2008) dismissed the perceived gender gap in mathematics after finding no difference in average performance between girls and boys based on standardized mathematics assessment involving seven million students of grade two through eleven.

According to Hyde, et al. (2008) the notion that boys do better than girls in mathematics is simply a stereotype that has been around for decades. Other studies in the USA context by Else-Else-Quest, Hyde and Linn (2010), Vanleuvan (2004), Else-Quest, Hyde and Linn (2010), Vanleuvan (2004), Plante, Protzko and Aronson (2010), and Hyde and Mertz (2009) also found little or no difference in mathematics achievement between boys and girls and continue to conclude that female and male students have nearly equivalent mathematics achievement capacity and levels. Guiso, Monte, Sapienza and Zingales (2008) who, in a cross-national study, also found that the gender gap in mathematics performance in favour of boys disappears or is reversed as cultural-related gender differences diminish. This finding is also supported by Azar (2010), who argues that if gender difference in mathematics performance exists, they are small and only affect specific areas of mathematics skills at higher levels.

Gallager and Kaufman (2006) in their study on gender gaps in mathematics achievement concluded that girls score lower than boys on standardized tests of mathematics. They continue to argue that such gaps are real and very significant and cannot be trivialized as test scores determine entrance to higher training and by extension future success. This argument is supported by the work of Nelson and Brammer (2010) found that in mathematically intensive fields, women's progress is less dramatic. For example, in the top 100 U.S. universities, women occupy between 9% and 16% of tenure-track positions in mathematics intensive fields.

Contemporary research studies reflect scholars' maturing view of the complexity of causation of differences between males and females in mathematics education. Fennema (2000) rightly points out, from around 1970, 'sex differences' index was used to imply that any differences found were biologically, and thus, genetically determined, immutable and not changeable. During the 1970's and 1980's 'sex-related differences' criterion was often used to indicate that while the behaviour of concern was clearly related to the sex of the subjects, it was not necessarily genetically determined.

According to Leder (1996) there were probably more research studies published on gender and mathematics than any other area between 1970 and 1990. Fennema (1995, 2000) concluded that while many studies had been poorly analyzed and/or included sexist interpretations, there was evidence to support the existence of differences between girls' and boys' learning of mathematics, particularly in activities that required complex reasoning; that the differences increased at about the onset of adolescence and were recognized by many leading mathematics educators. Salmon (1998) concurred with the notion that gender differences increase at secondary school level, particularly in situations that require complex reasoning.

Studies by Fennema and Sherman (1977, 1978) documented sex-related differences in achievement and participation, and found gender differences in the selection of advanced level mathematics courses. They hypothesized that if females participated in advanced mathematics classes at the same rate that males did, gender differences would disappear.

Benbow and Stanley (1980) used interpretations of some of their studies as a refutation of this 'differential course-taking hypothesis'. They argued that gender differences in mathematics were genetic, a claim which was widely attacked and disapproved, but whose publication had unfortunate repercussions (Jacobs and Eccles, 1985).

Eleanor Maccoby (1966 and 1974) concluded that gender differences in mathematics performance were scientifically well established, with males scoring higher. She documented that boys and girls acquire early number concepts similarly in the pre-school years and that their performance throughout elementary school was similar; however, boys' skills in mathematics increased faster than girls' beginning around 12 or 13 years of age, creating a significant gender gap in performance by the time students reached high school.

The fact that less attention is paid to the gender gap in the upper tail is unfortunate for a couple of reasons. First, upper tail outcomes are potentially relevant to various important topics including the under representation of women in mathematics and science careers. Second, and more importantly, the gender gap in mean scores is sufficiently small so as to be of little practical importance, whereas the gender gap in the upper tail can be quite large. (Ellison & Ashley, 2009).

The debate on gender in Africa is less intense on achievement compared with the literature and debate in the USA. The literature in Africa is mainly concentrated on analysis of gender parity in terms of enrolment, but not in terms of achievement gaps. However, the few studies done so far seem to support the view that gender gaps in mathematics achievement exist. According to South African consortium for monitoring educational quality (SACMEQ) data for the 15 countries participating in the study, Saito (2010) found that the set of countries where boys performed significantly better than girls in mathematics in 2000 (Tanzania, Kenya, Malawi and Mozambique) were also countries where boys performed better than girls in 2007. Furthermore, Saito asserts that between 2000 and 2007, the directions in gender differences in mathematics achievement were consistent.

Unlike the USA, the UK, Australia and other advanced countries where gender and mathematics literature are widely reported, is not a highly heterogeneous society. This is not to claim homogeneity, but that the layers, divisions and cultures are fewer and hence, the pattern of female differences in mathematics varies across fewer layers. That means variables such as socioeconomic status and ethnicity need to be viewed differently by evaluating the prevailing social types.

2.2.1 Gender differences in mathematics in relation to content and cognitive process

Cockcroft (1982) indicated that different attitudes could be as a result of genetic factors or hormonal influences or even differences in brain lateralization. Despite the report being credible, this assertion may not exactly be verified as to how a student, either a girl or a boy may be pre-disposed to like something or dislike it. Cognitive psychologists emphasise on the role of thinking process. Psychologists assumed that there are developmental changes in the child's brain that allow it to process information in more sophisticated ways. Bryden (1979) notes that brain lateralization has been used to explain cognitive differences which are in favour of boy's achievement in mathematics. The explanation given has been that the right hemisphere which controls spatial related activities develops earlier in boys than girls. Spatial skills or spatial visualization is the ability to move geometric figures in ones' mind. Hence, a person with greater competence in spatial related activities is likely to perform well in science and mathematics. This explains why boys are more likely to be good in science and mathematics compared to girls. Twoli (1986) agrees that there is no clear-cut evidence that a learner is pre-disposed genetically. But Twoli (1986) cites cases of documented differences in cognitive ability between girls and boys which in one way or another, the learner may form attitudes towards learning a particular subject.

Reilly, Neumann and Andrews (2016) conducted a study on gender differences in spatial ability: Implications for STEM (Science, Technology, Engineering, and Mathematics) education and approaches to reducing the gender gap for parents and educators. The study indicated that boys and girls do not differ in levels of general intelligence; gender differences do exist for more specific cognitive abilities. The study also indicated that gender difference in spatial ability is reviewed, including the role that educators and parents can play in encouraging these skills using formal instructional at home through play. They observed that the development of spatial ability lays the foundation for quantitative reasoning, a collective term for mathematical and science skills. For this reason, some educational psychologist has claimed that they contribute to the under representation of women in STEM related fields. However, a growing number of educational psychologists have argued that early education of spatial intelligence is necessary and as a matter of equity for all students, and that it may offer substantial benefits for the later development of mathematical and scientific skills across all ability levels. Miller and Halpern (2013) observed that cognitive sex differences are changing, decreasing for some tasks whereas remaining stable or increasing for other tasks. (Wai et al.2009) proposed that spatial ability provides a foundation for the development of quantitative reasoning such as science and mathematics. Factor analyses of cognitive ability tests show high loadings for mathematical performance against a spatial factor (Halpern,2000). Furthermore, measures of spatial ability have predictive validity, in that they can predict future performance in quantitative fields (Williams and Ceci 2007). For example, (Shea et al. 2001) followed a large group of intellectually talented boys and girls over a 20-year longitudinal study, from seventh grade until age 33. They found that individual differences in spatial, verbal, and quantitative reasoning in adolescence predicted educational and vocational outcomes two decades later. Further, spatial ability made a significant unique contribution even after controlling for verbal and mathematical ability (Shea, et al. 2001). Spatial ability is also predictive of college mathematical entrance scores (Casey et al. 1997), which important prerequisite for entry to further education in science and mathematics disciplines (Ceci et al. 2009). Factors that influence spatial ability during development hold promise for educational interventions that seek to reduce the gender gap in science and mathematics in adulthood (Halpern 2007). Hyde and Lindberg (2007) asserted that even mild improvement in spatial ability may have "multiplier effects in girls' mathematical and science performance. Additionally, higher levels of spatial ability are associated with attitudinal changes towards mathematics and self-confidence in mathematical ability from elementary school (Eccles et al.1993) to high school and tertiary (Eccles et al. 1990). Thus, the contribution of spatial ability to later cognitive development may be in part social as well as intellectual (Crawford et al 1995) According to Barmao (2003), majority of the girls perceive information concretely and process it reflectively. They learn best by personal involvement, listening and sharing ideas. Boys on the other hand, perceive information abstractive and process it actively. They learn best through hands-on activities and self-discovery. How much gender role is influenced by biology and how much by environment is still a matter of conjecture, but it is evident that both influences are involved. With the new information about cognitive differences, girls should know that there are many reasons why they can do well in mathematics and science.

Lakin (2013) conducted a study on sex differences in cognitive abilities and reviewed some important implications for the participation of men and women in highly valued and technical career fields. He observed that although negligible mean differences have been found in many domains, differences in variability and high ratios of males to females in the tails of the ability distribution have been found in a number of studies and across domains. He noted that studies have observed trends over time, with some noting the decreasing ratios of boys to girls in the highest levels of mathematics test Performance. In his study, Lakin evaluated sex differences in performance in verbal, quantitative, and figural reasoning domains as measured by the Cognitive Abilities Test. Samples included US students in grades 3–11. He reported that the results were consistent with previous research, showing small mean differences in the three domains, but considerably greater variability for males. He however observed that, contrary to related research, the ratio of males to females in higher quantitative reasoning distribution seemed to increase over time.

Reilly (2012) study on gender, culture, and sex-typed cognitive abilities. His study results revealed that cross-national variation in gender differences provides useful information about the environmental conditions that foster, or inhibit, gender differences in domains such as mathematics. He observed that whiles gender differences in mathematics are frequently found at a national level, they are not found across all nations. Social roles for women vary greatly from culture to culture, with some cultures promoting higher standards of gender equality and access to education than others. Even those nations that have progressive attitudes towards women may still have strongly-held cultural stereotypes that constrain them. Cultural stereotypes that girls and women are less able than boys and men in mathematics and science still endure and these stereotypes have damaging consequences for the self-efficacy of young girls.

Bal (2014) argued that attitude is an important predictor in the context of success in geometry and gender is an important factor affecting success due to the fact that cultural factors are dominant over the biological factors. He explained that gender differences in mathematics are varied at middle school levels. Alex and Mammen (2014) conducted a study on gender differences in geometrical thinking levels of South African grade 10 learners. The study revealed that both male and female showed similar thinking levels in geometry from Van Hiele geometry test. The results also revealed that the levels of thinking were lower than what was expected of the learners who participated in the study. They observed that the phenomenon of low geometry knowledge might be due to the inadequate geometrical experiences from the lower grades. Furthermore, the study found that although the mean score of female learners' Van Hiele levels was higher than that of males, this difference was not statistically significant.

Halpern et al. (2007) conducted a study on the science of sex differences in science and mathematics due to public speculation about the reasons for sex differences in careers in science and mathematics. The researchers observed that males outperformed females on most measures of visuo-spatial abilities, which have been attributed to as a contributory factor to sex differences in mathematics and science achievement. They opined that although sex differences in math and science performance have not directly evolved, but could be indirectly related to differences in interests and specific brain and cognitive systems. They reviewed the brain basis for sex differences in science and mathematics and identified several possible correlates. They observed that experience alters brain structures and functioning, so causal statements about brain differences and success in math and science are possible. They also explained that there is a wide range of sociocultural factors that contribute to sex differences in mathematics and science achievement and ability, which include the effects of family, neighborhood, peer, and school influences; training and experience; and cultural practices. They concluded that early experience, biological factors, educational policy, and cultural context affect the number of women and men who pursue advanced study in science and math and that these effects add and interact in complex ways.

Halpern (2000) stated that it has long been accepted that females are more verbal than males. He explained that very young girls can say more words clearly than young boys and more girls are ready to read at time of school entrance than boys. By the time students get to, secondary school differences are no longer as extreme. Girls have less confidence in mathematics ability than boys even when no gender differences are measured in mathematic (Watt, 2006). Self-confidence usually brings changes in learning achievements. There is difference in confidence level between male and female students

2.3 Factors responsible for gender differences in mathematics achievement

If gender gap in mathematics achievement does indeed exist, what are the factors that explain it?

Zhu (2007) assert that gender differences in Mathematics are not substantially biologically determined but result from a combination of factors including, psychological and environmental. This means that instructional practices can play a role in shaping problem solving abilities among boys and girls. Internationally researchers such as (Abiam & Odok, 2006; Mahlomaholo & Sematle, 2005) have argued that the differences emerge as a result of attitude, influence of role model, stereotyping, teaching and learning styles and spatial ability are the main factors that contribute to gender differences in mathematics. Academic achievement is the end product of all educational endeavours. Academic achievement means the achievements of students in academic subject in relation to their knowledge attaining ability of competence in school task usually measured by standardized test and expressed in grades based on student's performance. Academic achievement is of paramount importance to the current study because it has been indicated that a good number of variables such as: personality characteristics of the learners, the organizational climate of the school, curriculum planning, teaching learning setup, variables arising out of home, determine students' performance in different degrees (Sharmistha, 2008). A study by Weerakkody and Ediriweera (2008) cited that some of the factors that lead to differences in performance were English language proficiency, family background and academic efforts made by the students, perceptions of learning, attitudes of students and teachers towards education, teaching aids and method and environmental factors are the key factors that determines the academic performance of students at all levels.

Other important factors that indicated on gender and mathematics are cultural, family influences, socio-economic status of parents, as well as cultural and traditional influences (Kaino & Salani, 2004). Asante (2010) citing Collins, Kenway and McLeod (2000) argued that schools establish symbolic oppositions between male and female students through gendering of knowledge and defining of certain subjects as masculine. In contrast, female students are conditioned in the society to have perception that mathematics is a male subject, and it is widely acceptable for them to drop it. Studies conducted in Botswana by Finn (1980), and Duncan (1989), cited in Kaino (2001) indicated that cultural expectations of society could result in differences in performance between girls and boys in mathematics. In Nigeria, it has been argued that nurture entrenches male dominance over the female gender (Bassey, Joshua & Asim, 2007).

The above review suggests that many factors may be associated with the gender gap, including issues such as classroom interactions, students' attitudes, students' interest and self-esteem, teachers' gendered attitudes, curricular materials, beliefs, social and cultural norms. These differences put together have implications for the kind of instructional procedures that are to be adopted for setting up an appropriate teaching and learning environment for mathematics instruction that is suitable for both genders. This is why this current study is seeking to provide empirical evidence as to whether gender differences in mathematics performance exist in senior High schools in Sekondi/Takoradi Metropolis.

Gender differences in mathematics performance have been a contentious issue in educational domain and research documents show great discrepancies among boys and girls in school mathematics (Sprigler and Alsup 2003). Male advantage in mathematics performance is a universal phenomenon, while early research (Fennema and Sherman, 1977) indicated that males out performed females in mathematics achievement at the junior high and senior high school levels. These earlier studies added that there were also significant differences in achievement towards mathematics between the boys and girls. Gallagher and Kaufman (2006) recognized that the achievement and interest of boys are higher than the girls. They however explained that they do not know the main cause of these differences. O'Connor-Petruso & Miranda's study (as cited in Campbell 2005) have shown that gender differences in mathematics achievement become apparent at the secondary level when female students begin to exhibit less confidence in their mathematics ability and perform lower than the males on problem solving and higher-level tasks. In Ghana, Eshun (1999, 2004) also observed a higher achievement of males than females in mathematics at the secondary school level. Wilmot (2008) even showed that in Ghana, the difference in mathematics achievement between boys and girls begins or becomes apparent at the sixth grade.

Internationally, researchers have undertaken studies in various contexts to examine factors that influence gendered achievement in mathematics. Many of such studies have focused on factors related to differences in the performance of boys and girls in mathematics (Abiam & Odok, 2006; Mahlomaholo & Sematle, 2005; Opolot-Okurut, 2005). Students' performance in mathematics are due to factors such as attitude towards mathematics (Hammouri, 2004), schools climate and culture (Fullan, 2001), educational resources (Mullis et al. 2000), socioeconomic status of the family (Marjoribanks, 2002), home language versus language of test (Howie, 2005) and providing quality homework assistance by parents (Engheta, 2004) are among factors that can explain variance in academic achievement. Although many factors inside and outside of school influence students' level of achievement, the quality of teaching is important for improving students' learning (Hammouri, 2004,) According to Butty (2001) instructional practices has impact on mathematics' achievement as well as attitude towards mathematics. Some research findings indicated that instructional practices have positive effect on students' mathematics achievement and attitude toward mathematics (Butty, 2001). Attitude towards mathematics has significant direct negative effects on math achievement for the girls' and boys' model and the effects for girls' model is more than the boys. This finding is similar to the finding of Papanastasius (2002). However, gender issues on mathematics achievement are studied most frequently by researchers. A study through a meta-analysis reveals that males tend to do better on mathematics tests that involve problem-solving (Hyde, Fennema & Lamon, 1990). Females tend to do better in computation, and there is no significant gender difference in understanding mathematics concepts. Another study shows that females tend to earn better grades than males in mathematics (Kimball, 1989). These differences put together have implications for the kind of instructional procedures that are to be adopted for setting up an appropriate teaching and learning environment for mathematics instruction that is suitable for both genders. Hence, it is crucial for educators and researchers to pay attention to gender differences in the design of mathematics instruction.

2.3.1 Gender differences in mathematics in relation to biological make-up

Gender differences in cognitive abilities is attributed to the influence of sex hormones. According to Geschwind's theory of prenatal hormonal effects (Halpern, 2000, Halpern, Wai and Saw, 2005) assumed that higher levels of prenatal testosterone in males would result in a greater level of right brain dominance, with which males would develop cognitive ability patterns that were more closely associated with right hemisphere Therefore because both mathematical reasoning and spatial abilities were under greater control by the right hemisphere, males outperformed females on mathematical reasoning and spatial tasks.

A line of researchers such as (Skandries, Reik and Kunze, 1999), came up with similar findings that male-female difference in mathematics were due to biological differences in girls' and boys'. 'Females consistently showed larger global field power for arithmetical processing in electroencephalogram (EEG) studies than males, and they also displayed different scalp field topography of enrolled brain areas during mental arithmetic brain. (Battista, 1990) reported that sex differences in brain lateralization function emphasises the different brain organisations of females and males and considers their relationships with gender differences in spatial and verbal abilities. He assumed that the left and right hemispheres of females are more symmetrically (bilateral) organised for speech and spatial functions and males are more asymmetrically (lateralized) organised. He also hypothesises that "greater lateralization of function may be essential for high spatial performance and less lateralization more important for verbal performance; therefore, males are superior in spatial tasks and females in verbal tasks as perceived by the observation that girls in general are better with language and writing and that boys are better at mathematics due to better spatial abilities. This implies that gender differences in mathematics may not be challengeable.

2.3.2 Gender differences in mathematics in relation to environment

Marcus and Joakim (2016) investigated on whether there were gender differences with respect to students' perceptions of the classroom setting, their relationship to mathematics and how perceptions of the classroom setting were related to performance in mathematics. Researchers described classroom environment as the relationships between teacher and students, which include academic support, teaching goals, teaching methods, instructional materials, teacher beliefs and teaching practices (Church, Elliot, and Gable 2001; Wetzel et al. 2010). Empirical evidence indicated that, in general, teacher and peers support are positively related to learning motivation, academic attitudes, self-efficacy, emotions and achievement (Danielsen et al., 2010).

Researchers found that mathematics performance significantly depends on teaching practices. Specifically, the behaviour, such as being responsive, helpful and supportive (Ahmed et al. 2010), and having many years of teaching (Bagakas 2011), positively impact on the students' self-competence and mathematics grades in secondary school. Several Studies conducted by researchers found out that teacher's instructional abilities and achievement goals influence academic performance, students progressed faster if they worked with highly skilled teachers (Taylor, Pressley, and Pearson 2000). Ahmed et al. 2010; Bagakas 2011) Showed that in early adolescence both classroom support and achievement goals are related to academic performance, and these relationships are gender-moderated. According to the classroom setting, they found that boys feel that they use group work more than the girls do. Boys also feel that they have an influence over the content and are more involved during the lesson than girls. Gherasim, Butnaru, and Mairean (2013) found gender effects in such variables as achievement goals, classroom environments and performance in mathematics among young adolescents showing that girls obtained higher grades in mathematics than boys in a highly classroom support with lower performance-avoidance goals. Considering the patterns of relationships between classroom environment and goal orientations, and their effects on achievement, in a study to examine the effect of the teacher and peers support on goal orientations and achievement. The results indicated that supportive and mastery-orientated teachers influence the adoption of mastery goals within the classroom and the enhancement of mathematics performance (Church, Elliot and Gable2001; Puklek

Levpuscek 2004). Also, peer's acceptance and cooperation increase the level of achievement (Wentzel et al. 2010)

In a second study to examine how achievement goals influence the perception of classroom environment, the results indicated that the students' motivational profiles determined differences in their preferences for the classroom environment (Ahmed et al. 2010). The third study analyzed if academic motivation mediated the links between classroom environment and achievement. Some studies revealed that competence beliefs mediated the relationship between classroom support and achievement (Ahmed et al. 2010), many studies on mathematics achievement also analyzed the gender differences. The researchers endorse that the differences in the perceptions of classroom environment or achievement goals could explain the gender gap in mathematics performances. Because neither environmental, nor motivational factors alone could fully explain the gender differences in mathematics achievement, further research is needed to explore gender differences in the relationship between environmental and motivational factors. Boaler (1997) is of the view that the different learning goals of girls and boys leave girls at a disadvantage in competitive environments. Boys and girls preferred a mathematics curriculum that enabled them to work at their own pace as their reasoning was different. Girls value experiences that allow them to think and develop their own ideas, as their aim is to gain understanding. Boys, on the other hand, emphasize speed and accuracy and see these as indicators of success. Boys are able to function well in a competitive environment of textbook based mathematics learning.

Whereas parental homework helps positively predict students' mathematics achievement, parents' child-school discussion negatively predicted students' performance in mathematics. This findings about child-help negatively predicting students' achievement is in line with the literature (Desimone, 1999).

(DeWit, Karioja, and Rye 2010) asserted that there are no gender differences in the perception of classroom support While (Oelsner, Lippold, and Greenberg 2011) reported that girls perceived more classroom support while others found that boys reported more approval, encouragement and corrective feedback especially in mathematics and science (Meece, Glienke, and Burg 2006). (Wentzel et al. 2010) endorsed that boys and girls received support from different types of activity; boys receive more opportunities to succeed in science, engineering, computing and mathematics, while girls have more learning opportunities in literacy, arts and to socially interact with their peers This current study established the patterns of relationship between school environment and also identify classroom practices that contribute to gender differences in mathematics performance.

The support from academically-oriented peers and female friends who are successful in mathematics (Crosnoe et al. 2004; Riegle- Crumb, Farkas, and Muller 2006), and learning in friendly classroom environments (Shapka and Keating 2003) enhance girls' performance in mathematics.

2.3.3 Societal influence on students' performance

According to Orton (1987) attributed a noticeable difference in learning among boys and girls to "societal attitudes and expectations". He asserted that influences of society and from the environment affect mathematical development of students at various levels between boys and girls. Boys and girls are socialized differently while playing children games. Boys engaged themselves in vigorous activities while girls involve themselves in passive roles. These major activities are practiced in the classroom while learning. If no procedural steps are undertaken to counter this mind-set, students may form unfavourable attitudes towards any learning activity and this may lead to variation in what is learned in a subject. A study conducted by (Halpern 2000) asserted that when talented students take advanced test in mathematics with a negative stereotype that male will outperform female, male students did score higher than female students. When these students take the same test with a positive stereotype that female and male will score equally, no overall gender difference is found in test scores. Such an occurrence is referred to as “stereotype threat”. Steele (1999) also found that among the talented, the fear of being associated with a negative stereotype impaired intellectual functioning and disrupted test performance regardless of preparation, ability, self-confidence, or motivation. This is confirmed by (Orton, 1994) that differences in parental expectations, desires and pressure that they exert at home on their sons and daughters has been attributed for attainment variations among the sexes. Parent’s presumption about mathematics ability predicts children’s self-conception about mathematics. Ying and Ching (1991) did a study comparing 894 students from 26 schools in Hong Kong. They undertook a study to identify correlations between mathematics achievement and expectations from parents and of students themselves. After conducting multiple regression analyses, they revealed that parental expectations and student’s achievement in mathematics had a strong correlation. Whether societal and parental expectations influence performance amongst secondary school students became the contention of the study. Costello (1991) confirmed that when parents react and reinforce daughters and sons differently. When their children do something mathematical, daughters are told “you’ve really tried” meaning nothing much is expected from the female child. But to their sons, they are told “you can do far much better” (Costello, 1991). Meaning male children are expected to do a lot more in mathematics. Such comments said by parents consciously or without much thought are registered in the sub-conscience of a child and may influence how he/she perceives mathematics. Hence formation of attitudes among students may have been unconsciously registered from parents particularly and from the society in general.

2.3.4 Teachers perception towards gender differences in mathematics performance

According to (Fennema,1990) teachers have theories and belief systems that influence their perceptions, plans and actions in the classroom which affect and shape classroom dynamics. Since behaviour is guided by a personally held system of beliefs, values and principles (Peterson and Barger, 1985), there are signs that teachers' sex-related beliefs about children might influence their classroom behaviour (Good and Findley, 1985). This suggests that teachers' beliefs or expectations might directly influence their classroom behaviour and thus need to continually question how their belief systems affect learners.

In mixed schools, teachers interact more with boys, praise and scold boys more, and call on boys more than girls. However, the impact of this differential treatment is unclear and difficult to ascertain. There was no evidence that all differential teacher treatment of boys and girls is very closely related to gender differences in mathematics (Koehler, 1990). However, Fennema and Peterson (1985) found that small differences in teacher behaviour combined with the organization of instruction, made up a pattern of classroom organization that appeared to favour males. For instance, competitive activities encouraged boys' learning and had a negative influence on girls' learning, while the opposite was true of cooperative learning. Since competitive activities were much more prevalent than cooperative activities, it appeared that classrooms were more often favourable to boys' than to girls' learning. Fennema and Peterson (1985) proposed the Autonomous Learning Behaviours model, which suggested that because of societal influences of which teachers and classrooms were the main components and personal belief systems which include loweredconfidence, attributional style, and belief in usefulness. Females did not participate in learning activities that enabled them to become independent learners of mathematics.

Since teachers' thoughts from their beliefs and knowledge about girls and boys influence their instructional decisions (Fennema, 2000), an understanding of these concepts from an African perspective is necessary for African research. The differing socioeconomic status and ethnic compositions are important points of contrast between Western and African contexts whose consideration is paramount to social research. Carr and Jessup (1999), explored why girls are less confident in their mathematics abilities than boys, she found out that girls use different strategies and have different motivations to do mathematics.

One broad Hypothesis is that male and female teachers have unique biases with respect to how they engage boys and girls in the classroom. For example, there is controversial evidence based on classroom observations that teachers are more likely to offer praise and remediation in response to comments by boys but mere acknowledgement in response to comments by girls (AAUW1992). Similarly, cognitive process theories suggest that teachers may subtly communicate that they have different academic expectations of boys and girls. The biased expectations of teachers may then become self-fulfilling when students respond to them (Jones and Dindia, 2004).

2.3.5 Students' mathematics anxiety, interest and self-confidence

Mathematics anxiety is commonly defined as a feeling of tension, apprehension, or fear that interferes with math performance (Ashcraft, 2002,). Those powerful feelings begin at different stages in a child's educational journey. "Mathematics anxiety can begin as early as the fourth grade and peaks in middle school and high school. It can be caused by past classroom experiences, parental influences, and remembrance of poor past mathematics performance" (Scarpello, 2007). According to Scarpello, high school students' career options are often determined by the number of math classes they complete. If a student does not take algebra in high school, then access to higher level mathematics classes is not an option. The result is that high school students graduate with a lack of confidence in mathematics and may feel uneasy when doing simple mathematical tasks. Hidi and Renninger (2006) proposed a four-phase model of interest development and made a distinction between individual and situational interest. Interest is defined as a psychological state that can also develop into a tendency to reengage content.

Situational interest is the initial psychological state of focused attention and affect in response to some environmental stimuli. Individual interest refers to the relatively stable tendency to reengage content over time. The first phase of the model is "triggered situational interest" which may evolve into the second phase, recognized as "maintained situational interest". The third phase, an "emerging individual interest" may then develop, which if sustained, can progress into a "well-developed individual" interest.

Interest can greatly impact students' learning (Hidi & Renninger, 2006). Interest has been shown to be positively related to achievement on related tasks (Evans, Schweingruber, & Stevenson, 2002). Individual interest can positively affect persistence and effort and academic motivation (Hidi & Renninger, 2006). Interest also predicts many choices, both educational and vocational (Su, Rounds, & Armstrong, 2009). Interest is also domain specific (Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005). A small number of studies have been conducted with a specific

focus on mathematics interest. High interest in mathematics was shown to correlate with mathematics achievement in Taiwan, Japan, and the United States (Evans et al., 2002). Interest in mathematics has been shown to decline across the developmental period (Frenzel, Goetz, Pekrun, & Watt, 2010) Ahmed et al. (2012) conducted a study on gender differences in mathematics anxiety (MA) and its relation to mathematics performance. They observed that there are no gender differences in mathematics performance but the levels of Mathematics Anxiety (MA) and Test Anxiety (TA) were higher for girls than for boys. They revealed that girls and boys showed a positive correlation between MA and TA and a negative correlation between Mathematics Anxiety (MA) and mathematics performance.

According to an empirical study conducted in the United States of America by Fryer and Levitt (2010), there was no statistical difference in the gender gap in mathematics at the entry level in school, but girls lost focus more as compared to boys in the first six years of schooling. Preliminarily analysis of the PISA (2001) data suggests that what matters to gender differences in learning outcomes appears to be the learning environment that is established through education efforts and social context (OECD, 2001). The school environment is an equally important influence in the gender difference in mathematics. Changes in mathematical attitudes are correlated with developmental changes in gender identity (Gallagher & Kaufman, 2006). During this stage, girls begin to firmly establish their feminine identity and so become susceptible to social and environmental pressures that undermine their confidence and performance in male dominated subjects like mathematics. The problem is that by the time some students seek a post-secondary education, they are convinced that they cannot do mathematics (James, 2007).

International, researchers have undertaken studies in diverse contexts to examine factors that influence gendered achievement in mathematics. Many of such studies have focused on factors related to differences in the performance of boys and girls in mathematics (Abiam & Odok, 2006; Mahlomaholo & Sematle, 2005). Feminist researchers have tried to make meaning of the experiences of girls and boys in the mathematics classrooms, and to interpret male-female power relations (Jungwirth, 1991; Waiden & Walkerdine, 1985). Their findings revealed that girls are often marginalized and given subordinate status in the mathematics class. The findings suggest that perceptions of teachers are that girls' performances in mathematics are dependent on rote learning, hard work and perseverance rather than natural talent, flexibility and risk taking which are the learning styles of boys. Mutemeri and Mygweni (2005) argue that the idea that mathematics is for boys may result in low motivation in girls and could widen the gender gap in mathematics achievement in favor of boys.

2.3.6 Stereotypes about Gender and Mathematics

Mathematics and Science are stereotyped as male domains (Fennema & Sherman, 1977). Stereotypes about female inferiority in mathematics are prominent among children and adolescents, parents, and teachers. Although children may view boys and girls as being equal in mathematical ability, they nonetheless view adult men as being better at mathematics than adult women (Steele, 2003).

These stereotypes are of concern for several reasons. First, in the language of cognitive social learning theory, stereotypes can influence competency beliefs or self-efficacy; correlational research does indeed show that parents' and teachers' stereotypes about gender and mathematics predict children's perceptions of their own abilities, even with actual mathematics performance controlled (Bouchey & Harter, 2005).

A second concern is that stereotypes can have a deleterious effect on actual performance. Stereotype threat effects (Steele & Aronson, 1995) have been found for women in mathematics. In the standard paradigm, half the participants (talented college students) are told that the mathematics test they are about to take typically shows gender differences (threat condition), and the other half is told that the mathematics test is gender fair and does not show gender differences (control). Studies find that college women underperform compared with men in the threat condition but perform equal to men in the control condition, indicating that priming for gender differences in mathematics indeed impairs girls' mathematics performance (e.g., Janet Hyde, a psychology professor at UW-Madison, noted that, despite the fact that girls now take just as many advanced high school mathematics courses as boys, and women earn 48 percent of all mathematics bachelor's degrees, the stereotype that, girls struggle with mathematics persists. Linn and Hyde have long collaborated on studies of gender differences in mathematics and science learning, including an analysis that appeared in Science in 2006 that showed that differences in mathematics performance were far greater between different cultures than between men and women. For example, Japanese and Taiwanese children perform far better on mathematics tests than American children, irrespective of gender. Some critics argue, however, that even when average performance is equal, gender discrepancies may still exist at the highest levels of mathematical ability.

2.4 How to improve Gender based performance in mathematics in order to enhance effective teaching and learning of mathematics

According to Pechman (1991), the effects of implementing effective mathematics instruction can be observed in the mathematics classroom. Specifically, students will be engaged in a learning environment designed to encourage inquiry and analysis. More distinct indicators of best practice include changes in physical facilities, classroom climate, student voice and involvement, instruction and activities, classroom communication, time allocations, student assessment, and teacher attitude and initiative

(Hyde et al, 2008.) While these indicators encompass all aspects of the classroom experience, all are student centered. The purpose is to create a classroom whose main focus is student achievement and success, modes of communication and activities that promote success, and a physical environment depicting and encouraging student success. To achieve this goal of best practice, teachers need to build a classroom structure that supports more student-directed activity, and make teacher-guided activities both less prevalent and more successful.

An important component of effective teaching is knowing what kind of assessment that will provide the best picture about students' performance: that is using the most appropriate method to get the information (Mehrens & Lehmann, 1991). Educators are therefore interested in students' performance because "so often what a person knows is not a good predictor of what a person can or will do" (Mehrens & Lehmann, 1991). The student's ability to do something or make something is, therefore, an important instructional objective. It important that mathematical lessons are linked to the type of performance students are expected to exhibit after a period of study. This therefore, calls for the use of performance assessment in the teaching and learning of mathematics in the classroom. Similarly, Oppendekker and Van Damme (2006) stress that good teaching involves communication and building relationships with students. Boaler (1999, 2002) reports that practices such as working through textbook exercises or discussing and using mathematical ideas were important vehicles for the development of flexible mathematical knowledge. One outcome of Boaler's research was that students who had worked in textbooks performed well in similar textbook situations. However, these students found it difficult to use mathematics in open, applied or discussion-based situations. The students who had learned mathematics through group-based projects were more able to apply their knowledge in a range of situations.

Boaler's research gives evidence for the theory that context constructs the knowledge that is produced.

According to UNESCO advocacy brief (UNESCO 2006) argues in favour of hiring more female teachers in developing countries, and states that doing so will have two positive outcomes. Their presence will lead to an improvement in both girls' enrolment and girls' learning achievement. The literature on the relationship between teacher gender and student outcomes offers almost every possible conclusion. Dee (2006) investigated the effect of teachers' gender using National Education Longitudinal Survey (NELS) data on 8th graders from the US and found that same-gender teachers had a positive effect, i.e. girls do better in school when taught by women and boys do better when taught by men. It also found that the effect of teacher gender varies depending on the subject; for girls the benefits of being assigned to a female teacher are concentrated in history. A study by Michaelowa (2001) using data from Francophone sub-Saharan African similarly finds support for the same-gender effect.

In the Netherlands, for instance, Driessen (2007) found that teacher gender has no effect on student achievement, attitudes, or behaviour, regardless of student gender, ethnic background, or socioeconomic status. Thus, the evidence that increasing the presence of female teachers will improve girls' learning outcomes is at best limited. With respect to the positive relationship between the presence of female teachers and improved school participation for girls the argument is that the presence of a female teacher may help alleviate parental concerns about the safety and well-being of their daughters in traditional, gender-segregated societies and encourage them to send their daughters to school (Velkoff, 1998; UNESCO, 2000).

Some researchers such as (Laird, Garver, and Niskode, 2007). have found evidence that male and female teachers have different teaching styles. Research on gender differences in teaching practice has been primarily qualitative. While reviewing this literature it is also important to keep in mind that these studies are often based on university-level faculty members and a lot of these studies are conducted in the developed world. This research shows that male and female teachers do have different styles in terms of the time they spend on lecturing and classroom activities. Female faculty members tend to use a more student-oriented style of teaching that emphasises relating to the student (Grasha, 1994). Compared with their male counterparts, women faculty also tend to have more liberal views about letting the students define and identify their own learning experiences and learning styles (Lacey, Saleh, and Gorman, 1998) Singer (1996) argued that female faculty members are more likely than males to utilise motivation or process paradigms. Moreover, women faculty members are more likely to spend time planning and designing and assessing learning activities. (Singer, 1996). More specifically in the developing country context, a UNESCO-sponsored study of four countries (Bangladesh, Nepal, India and Pakistan) on female teachers in rural primary schools found that female teachers were perceived as more effective in earlier grades by the administrators; children also saw them as more open and more comfortable to interact with than male teachers (UNESCO 2000). It is essential to keep in mind that gender dynamics of the classroom are difficult to assess using surveys, interviews and discussions as they are often unable to take into account the broader context within which the interactions between students and teachers take place. In a traditional rural setting for instance, where teaching itself accords a certain authority to the teacher regardless of their gender, a male and female teacher may look very similar inside the classroom in their teaching practices.

In a detailed ethnographic study of rural schooling in India, Sarangapani (2003) provides an excellent analysis of teaching and learning in the rural classrooms. Her analysis shows no differences between male and female teachers in their exercise of authority and their use of teaching practices that ignored, for instance, the students' contributions completely. In fact, in her

Study the female teachers came from towns further away and they perceived themselves as 'more urban and socially superior to the children' compared with the male teachers who were local. She thus remarks that, 'contrary to the myth that children are happier with women teachers, the children were free. with the two male teachers from their village. This research provides an important illustration of the dangers of viewing gender as a one dimensional variable devoid of the social contexts. Specifically focusing on teachers, Reddy (2004) review notes that studies have found a positive relationship between teacher qualification and student achievement, but not between student learning and teacher experience. One study quoted in the report found a negative correlation between teacher experience and student learning. Reddy notes that research has also found that teaching practices such as giving more homework and providing more feedback have a positive relationship with student learning but found no consistent effect for class size. It is important to note that while the extensive literature review by Reddy (2004) may perhaps provide the most authoritative and comprehensive summation of the major findings in achievement research in India, it does not elaborate on the methods employed by most of the studies cited in the report. Also, from the perspective of the present study her literature review does not speak to the relationship between teacher gender and student achievement

2.5 Empirical review

Kyei, Apam, and Nokoe (2011) conducted a research on gender differences in performance in senior high school mathematics examination in mixed high schools in Ghana. The results of the study indicated that there is gender difference in the outcome of mathematics examinations in mixed senior high schools in Ghana. The study showed that there is gender difference in mathematics performance with males performing better than females. Asante (2010) indicated a clear-cut sex differences in attitude towards mathematics between boys and girls in mixed high schools in Ghana

In a study conducted by the Female Education in Mathematics and Science in Africa (FEMSA, 1997) projected, issues on resources and facilities for teaching and learning of mathematics and science subjects were highlighted. The objective of FEMSA study was geared towards supporting materials available for teaching and learning of mathematics and science, project set out from the heads of primary and secondary schools selected for the study, the number of each kind of facility or resources that one would normally expect to find in a school, which include: classrooms, offices, libraries, laboratories, workshops, bookstores, staff room, percentage of students with textbooks (disaggregated by gender), furniture, overhead, film and slide projectors; calculators, television sets, display board and duplicating machines. The study found great modification in the resources and facilities available for the teaching and learning of all subjects. Although all schools in the study were government schools, sitting for the same national examinations within a country; and rely on their governments because majority of their finances are catered by the government, some of these schools were so destitute, they did not have the basic necessities, such as sufficient classrooms, offices, desks, textbooks, not to mention facilities like laboratories, libraries, workshops, chemicals, science equipment or apparatus. The negative impact created by this inadequacy or total lack of resources/facilities on participation and performance in SMT subjects, particularly by girls; and recommendations given to ease these problems were based on the findings and some recommendations.

The study also found out that there is a great shortage of mathematics and science teachers at the secondary school level, and the few they are, have to be shared by a large number of students which puts a heavy workload on teachers. At the same time, the study revealed that most mathematics and science teachers are male. The study further revealed that most teachers at both primary and secondary schools are inadequately trained and most never participated in any in-service training. Most teachers lack creativity and initiative and will not improvise where there are no ready-made visual aid tools available. Many teachers complain that science syllabuses, mainly at the secondary level, are inordinately long and that there is no sufficient time to cover the syllabus adequately. This is often the pretext for skipping practical work, even where equipment is available, on the basis that practical work takes up too much class time. The unwillingness to engage in practical work is bolstered by examinations which test learned knowledge and not practical skills, as in the case of Tanzania where there are no practical examinations at the end of Form 4 (FEMSA, 1997).

2.6 Summary of literature review

This chapter reviews the relevant literature to the study. Essentially, the review encompasses the theoretical framework that focused on gender-based performance in mathematics. There is a range of theories which account for gender differences and mathematics performance. The current study is rooted in the equality or equity, deficit, feminist and implicit theory of achievement. The theory therefore suggests that examining male and female performance at different ability levels gives a clear picture of the relationship between the gender of the student and academic performance than what is achieved by merely considering group averages. This is upon realization that a lot of weight has been put in the subject as far as the senior high school curriculum is concerned. Studies from other parts of country on gender difference in mathematics performance have been reviewed in order to identify and evaluate the impact of these researches on mathematics education.

It is of this view that mathematics has been seen as a subject favouring male student worldwide. However, despite many research evidences for male's superiority in mathematics performance, some research findings do not support the difference between these two genders in the performance of mathematics. In this regard, the current review points to mixed opinions on gender differences in mathematics performance.

The review also indicated that the school variables which influence gender differences in the performance of mathematics includes the organizational climate of the school, curriculum planning, curricular materials, teaching learning setup, school's climate and culture, school connectedness or engagement and classroom interactions. These differences put together have implications for the kind of instructional procedures that are to be adopted for setting up an appropriate teaching and learning environment for mathematics instruction that is suitable for both genders.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter outlines the research methodology that was used in the study. It is discussed under the following sub-topics; research design, the population, the sample and sampling procedure, instrumentation, validity and reliability of the instruments, data collection procedure, data analysis,

3.1 Research Design

Burns and Grove (2009) explained research design as an outline for conducting a study with control over factors that may influence the validity of the findings. Also, Polit and Beck (2012 understand research design as the complete plan of finding answers to research questions. Therefore, in order to find answers to the research questions, the researcher adopted a cross sectional survey design to draw both quantitative and qualitative data for the analyses. A cross-sectional survey according to Alhassan (2012) comprises of collecting data at one point and over a short period to provide a 'snapshot' of the outcome and the characteristics associated with a population at a specific time. The rationale for embracing this design is that it depends on large-scale data from a representative sample of a population with the goal of describing the nature of existing conditions. Vogt (2007) stressed that using cross sectional design offers advantages in terms of economy and the probability to sample from a large population. The cross-sectional survey was employed to investigate gender- based performance in mathematics of Senior High School students in selected schools in Sekondi- Takoradi metropolis. A mixed method approach specifically concurrent method was employed where both qualitative and quantitative data were collected together. Creswell (2010) explained mixed methods as a research method whereby the researcher combines both elements of quantitative and qualitative approaches that is aimed at getting breadth and depth of understanding and corroboration.

3.2 Population of the study

Orodho (2002) defined population as a group of people from which a sample can be drawn. Population is the total collection of elements about which we wish to make some inferences. The target population for this study comprises of Senior high school students preparing for their final examination and mathematics teachers in Sekondi-Takoradi Metropolis. The targeted population was estimated as 500 students of which the accessible population was 200 comprising of 107 male and 93 female final year students, as well as 5 mathematics teachers. However only five schools were selected from the metropolis because of time and the cost implication. The researcher selected thirty students from each of the senior high schools in the metropolis for the mathematics test and a mathematics teacher from each school for the interview. The first year and the second-year students were excluded from the study because they did not have much exposure to senior high school mathematics. This means that they were not taught many mathematical concepts because they have not covered many topics in the mathematics curriculum or syllabus.

3.3 Sample and Sampling Technique

Sampling is the procedure or the activity of choosing samples from a group or population to become the basis for estimating, exploring, describing or predicting the outcome of the population as well as to find an unknown piece of information (Boateng, 2014). The sampling procedure used for this study were convenient, stratified and simple random. Convenient sampling method was used to select five Senior high schools for the study. Convenient sampling was used because the researcher could easily reach out to these mixed Senior high school. Stratified sampling was also used to obtain gender balance, because the researcher aimed at targeting mixed senior high school students. The students were first stratified into categories or strata: by gender or sex group (male and female. Lastly simple random sampling technique was used to select a sample of two hundred final year senior high school students of which 107 (54%) were males and 93 (46%), females were selected for the study. The same procedure was also used to select five mathematics teachers from different senior high schools, because they have equal chance of being selected (DePersio, 2015). Also, a simple random sample gives an accurate representation of the larger population. (DePersio, 2015). In the first phase of the study, 200 respondents making the sample size took part in the quantitative data collection whilst in the second phase 5 selected respondents who were mathematics teachers, agreed to be interviewed took part in the qualitative data collection.

3.4 Research Instruments

Three tools were developed and used. These were Mathematics Test (MT) for students, a Mathematics Questionnaire for Students (MQS) as well as an interview guide for Mathematics Teachers.

3.4.1 Mathematics test items

A test was conducted for the students on some of the topics they were taught in first and second year which includes topics such as real numbers, algebra, geometry percentages and statistics. The duration for the test was thirty minutes. Students were asked to give short answers to the objective and answer any one question from subjective. Each objective question was worth 2 marks and 20 marks for the subjective.

3.4.2 Questionnaire design

The questionnaire, which had close-ended items, consisted of background information, factors contributing to gender- based performance in mathematics and how to proffer a possible solution to enhance effective teaching and learning in order to attain parity in gender- based performance in mathematics. The questionnaire items are on a Likert-type scale with five response choices, including “1= strongly agree”, “2 = agree”, “3 = neutral”, “4 = strongly disagree” and “5 = disagree” for sections A, B and C. The items were built to reflect on the key themes raised in the research questions. It consisted of sections: A, B, and C. Section ‘A’, which had 3 closed ended questions and 2 open ended questions on background information with respect to section ‘B’ with 7 closed ended items on the factors relating to gender- based performance in mathematics. The last part section ‘C’, had 5 items on possible solutions to improve gender-based performance in mathematics in order to enhance effective teaching and learning of mathematics in all, the questionnaire had 17 items. The questionnaire request straightforward, concise, brief and short answers. The respondents used 25-30 minutes to answer the question. Questionnaire is widely used as a very useful instrument for collecting survey information, providing structured outline and it is being able to be administered without the presence of the researcher if respondents can read and write. Again, it is often being comparatively straightforward to analyse (Cohen, Manion, & Morrison, 2007).

3.4.3 Interview Schedule

Mugenda and Mugenda (1999) defines interview schedule as a set of questions that the interviewer asks when interviewing. Data from the teachers were collected using phenomenological face to face interview. The interview created a context where the participant spoke freely and openly by utilizing communication techniques such as clarification, paraphrasing, and summarizing, probing and minimal verbal as well as non-verbal responses. During the interview the researcher used bracketing (putting preconceived ideas aside) and intuiting. The interview was conducted until data was saturated as determined by the interview guide.

3.5 Nature of the Research Instruments

Fraenkel and Wallen (2003) indicate that; a pre-test of the questionnaire can reveal ambiguities, poorly worded questions, questions that are not understood and unclear choices, and can also indicate whether the instructions to the respondents are clear. It became necessary to pre-test the instrument for collecting data. The basis for the pre-testing was to analyse the reliability and validity of the questionnaire. The participants for the pre-testing exercise were students of Shama Senior High School in the Sekondi-Takoradi Metropolis. The reason for the choice of this school had to do with closeness and accessibility to the researcher. In all, the total number of respondents for the pre-test were 10 students. A total of 10 questionnaires and test were used for the pre-testing. All the questionnaires and test were returned giving a response rate of 100%. The students asked for clarity from the questionnaire and the test, such comments, statements that were unclear, misleading and /or repeated were revised, deleted, reconstructed or broken down into simpler forms.

3.6 Validity and Reliability

In order to ascertain the content validity of the instrument, my supervisor was consulted to review the items. He helped to evaluate the questionnaires whether the items were relevant to the research questions and his suggestions helped to establish the items. Reliability on the other hand is the degree of dependability or consistency of a measuring instrument (Babbie & Mouton, 2003). A high degree of stability indicates a high degree of reliability, which means the results are repeatable. Validity of an instrument is the extent to which the items in an instrument measure what they are set out to measure, while reliability on the other hand, is the extent to which items in an instrument generate consistent responses over several trials with different respondents in the same setting or circumstance (Cohen et al., 2007; Fraenkel & Wallen, 2003; Gall, Gall, & Borg, 2003). Mouton and Marais (1996) argued that validation is not a necessity with qualitative research instrument as concepts already reflect the world of the object of study. One way to guarantee that reliabilty is achieved in any research is to conduct a pilot study of research instruments (Dikko, 2016). Reliability and validity in educational researches help in achieving triangulation of data collection methods (Patton, 1990, cited in Owen & Demb, 2004).

3.7 Data collection procedure

In conducting a study, Creswell (2003) 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 of 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 Head of mathematics department in the selected Schools. An approval letter was then given to the researcher to open the gate for data collection. After permission was granted, the researcher first met the participants to inform them of the impending administration of the questionnaire test. Printed survey instruments were distributed to the students. All students were to complete and return the survey instruments on the same day except for one school which the researcher went on a different day to collect the answered data. The respondents were told that the exercise was for academic purpose only and that confidentiality was assured in order to encourage them to give their responses without suspicion. This was done to ensure high coverage, completion, and return rate. The completion and return rate were 100%

3.8 Data Analysis Procedures

The data analysis procedure included two main phases: the use of descriptive and inferential statistics. Regarding the inferential statistics, version 21.0 of the Statistical Package for Social Sciences (SPSS) computer software programme was used for data storage, calculation of central tendencies, frequencies and percentages. The researcher also used the SPSS to run independent samples t-test to find significant gender differences in mathematics performance. This was done at a significance level of $p \leq .05$. The interpretation of the t-test results made it possible to make appropriate inferences. The assumptions for the independent sample t-test are as follows:

The t-test was used to determine the significance of the difference between the male and female group means.

The t-test was used to analyze the interval data.

The t-test was also used because the sample size was more than 30.The t-test was also used because the sample was picked from a normally distributed population with homogenous or equal variance.

This assumption can be tested using Levene's test for homogeneity of variance.

3.9 Ethical Considerations

Shamoo and Resnik (2009) defined 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. The researcher consulted all Heads of each of the selected schools and made her research intentions branded to them. In addition, an official letter addressed from the Head of Mathematics Department in UEW that intend to seek permission was submitted to the schools. The Heads of Department of the schools in turn briefed their students of the upcoming exercise that is the test and questionnaire. Additionally, participants were assured of confidentiality which means that no names were necessary on the test and questionnaire or used during the write up of the study. A letter of appreciation was later sent to the schools for their dedication and commitment during the exercise.

CHAPTER 4

DATA ANALYSIS AND DISCUSSION

4.0 Overview

This chapter focuses on the results from the analyses of the data obtained and discussion on the findings that have emerged from the data collected by means of questionnaire, test and interview. The purpose of the study was to investigate gender- based performance in mathematics of Senior High School students in selected schools in Sekondi-Takoradi metropolis. Data have been organized, presented and discussed under the following themes based on the research questions in the sections that follows:

- demographic characteristics of the students
- Overall mathematics performance of males and females in the selected Senior High Schools in Sekondi-Takoradi Metropolis.
- Factors that contribute to Gender-Based Performance (GBP) in mathematics among Senior High School students.
- To proffer a possible workable idea to enhance teaching and learning of mathematics to attain Gender-Based Performance (GBP) parity

4.1 Analysis of Data

4.1. Research Question 1:

What is the overall mathematics performance of males and females in the selected Senior High Schools in Sekondi-Takoradi Metropolis?

In order to address research question one, the students were given a thirty minutes test, five written mathematics test items were given to students to solve. Table 4.1 shows the descriptive statistics of the test results.

Table 4.1: Descriptive statistics of mathematics test score

	Range	Female	Male	Total
Unsatisfactory	0-5	33	37	70
Satisfactory	6-10	35	49	84
Good	11-15	23	20	43
Very good	16-20	2	1	3
Total		93	107	200
M ± SD		7.11 ± 4.643	7.20 ± 4.090	

Field Data 2021. M=Mean, SD=Standard Deviation

Table 4.1 presents the descriptive mathematics test scores of both male and female students. The data is categorized based on scoring ranges, ranging from unsatisfactory to very good. The results indicate that out of a total of 70 students who scored between 0 and 5(unsatisfactory), 37 of them were males whiles 33 were females. Similarly among 84 students who scored between 6 and 10(satisfactory), 49 were males whereas 35 were females. In contrast, 43 students scored 11 and 15(good), with 23 of them being females and 20 being males. Only 3 students achieved a score between 16 and 20(very good), and 2 of them were females and 1 was a male. The calculated mean score for the female students were found to be M=7.11 with a standard deviation of S.D=4.643.For the male students the mean score was slightly higher at M=7.20 with a standard deviation of SD=4.090

Table 4.2: Results of independent sample t-test on scores obtained in mathematics

H_o: There is no difference in mathematics performance of males and females in the selected Senior High schools in Sekondi-Takoradi Metropolis.

Levene's Test for Equality of Variances					
F	p	t	df	p	Mean Difference
2.689	0.103	-.0144	198	0.886	-.089

The result presented in table 4.2 indicates that Levene's Test of Equality of Variances. The null hypothesis of Levene's test of equality of variance states that there is no significant difference in the variances of the groups being compared. In other words, it assumes that the variances of the different groups are equal or homogenous, because the test was not significant (p=0.103>0.05), hence we fail to reject the null hypothesis of equal variance between the groups. The null hypothesis of a two –sample t-test state that there is no significant difference between the means of two independent groups being compared. It assumes that the population means of the two groups are equal, because the test was not significant (p=0.886>0.05) we fail to reject the null hypothesis of equal means between the two groups. We can therefore conclude that there is no significant difference (mean and variance) between the two groups at 5% level of significance.

4.1.2 Research Question 2

What are the factors that contribute to Gender- Based Performance (GBP) in mathematics among Senior High School Students?

One of the core issues that was explored by the researcher was the factors which contribute to gender –based performance in mathematics. The data were presented and analysed under this theme which sought to answer research question 2 which states,

"What factors contribute to gender based- performance in mathematics among Senior High School students?" The data for this research question was obtained from responses of items from 1 to 16 in the questionnaire. Furthermore, a descriptive data analysis were further used to find out whether the respondent's perception was either positive or negative.

Table 4.3: Descriptive statistics of respondents' perception

S/No	FACTORS	GENDER	SD F (%)	D F (%)	N F (%)	A F (%)	SA F (%)
	The school environment						
1.	The school environment has positively influenced my performance in mathematics.	FEMALES	45 (22.5)	27 (13.5)	2 (1.0)	5 (2.5)	14 (7.0)
		MALES	46 (23)	38 (19)	3 (1.5)	6 (3)	14 (7.0)
2.	Teaching methodology employed in teaching mathematics has greatly improved my performance in mathematics	FEMALES	28 (14)	39 (19.5)	9 (4.5)	5 (2.5)	12 (6.0)
		MALES	48 (24)	26 (13)	2 (1.0)	13 (6.5)	18 (9)
3.	Availability of teaching and learning materials has positively influenced my performance in mathematics	FEMALES	27 (13.5)	50 (25)	4 (2)	3 (1.5)	9 (4.5)
		MALES	31 (15.5)	40 (20)	9 (4.5)	15 (7.5)	12 (6)
4.	Leadership style employed in my school has greatly improved my performance in mathematics.	FEMALES	34 (17)	45 (22.5)	3 (1.5)	5 (2.5)	6 (3)
		MALES	40 (20)	23 (11.5)	5 (2.5)	27 (13.5)	12 (6)
	Students' mathematics anxiety, interest and self-confidence						
5.	I am comfortable expressing my own ideas on how to look for solution to a difficult problem in Mathematics	FEMALES	30 (15)	37 (18.5)	8 (4)	11 (5.5)	7 (3.5)
		MALES	15 (7.5)	20 (10)	5 (2.5)	42 (21)	25 (12.5)

6.	I have a lot of self-confidence when it comes to studying mathematics.	FEMALES	13 (6.5)	27 (13.5)	9 (4.5)	10 (5.0)	34 (17)
		MALES	23 (11.5)	18 (9)	5 (2.5)	35 (10)	26 (13)
7.	Knowing mathematical concepts will help me earn a living.	FEMALES	36 (18)	22 (11)	8 (4)	14 (7)	13 (6.5)
		MALES	2 (1)	3 (1.5)	5 (2.5)	38 (14)	59 (29.5)
8.	My mathematics teacher holds higher expectation for boys when learning mathematics concepts	FEMALES	53 (26.5)	18 (9)	6 (3)	6 (3.0)	10 (5)
		MALES	36 (18)	27 (13.5)	4 (2)	25 (12.5)	15 (7.5)
	Teachers perception						
9.	I enjoy learning mathematics regardless of the gender of my teacher	FEMALES	29 (14.5)	34 (17)	10 (5)	14 (7)	6 (3)
		MALES	46 (23)	40 (20)	12 (6)	4 (2)	5 (2.5)
10.	Mathematics teachers teaching experience in my school has relatively improved my performance in mathematics	FEMALES	30 (15)	46 (23)	4 (2.0)	8 (4)	5 (2.5)
		MALES	42 (21)	50 (25)	5 (2.5)	4 (2)	6 (3.0)
	Societal factors						
11.	Society predominantly views of mathematics as a male domain.	FEMALES	21 (10.5)	10 (5)	11 (5.5)	31 (15.5)	20 (10)
		MALES	22 (11)	30 (15)	5 (2.5)	23 (11.5)	27 (13.5)
12.	Societal expectations towards boys and girls presents a positive challenge in their mathematical task.	FEMALES	38 (19)	18 (9.0)	5 (2.5)	12 (6.0)	20 (10)
		MALES	34 (17)	37 (18.5)	2 (1.0)	22 (11)	12 (6)

	Content and cognitive factors						
13.	Boys have higher cognitive abilities and higher average IQs in mathematics.	FEMALES	15 (7.5)	8 (4.0)	6 (3.0)	24 (12)	40 (20)
		MALES	10 (5.0)	15 (7.5)	5 (2.5)	16 (8.0)	61 (30.5)
	Home related factors						
14.	Engagement in household chores and duties do not affect my performance in mathematics	FEMALES	37 (18.5)	23 (11.5)	8 (4)	10 (5.0)	15 (7.5)
		MALES	41 (20.5)	18 (9.0)	7 (3.5)	10 (5.0)	31 (15.5)
15.	My parents and siblings encourage me to learn mathematics and perform well in the subjects	FEMALES	35 (17.5)	28 (14)	8 (4.0)	14 (7)	8 (4.0)
		MALES	48 (24)	21 (10.5)	3 (1.5)	12 (6.0)	23 (11.5)
	Motivational factors						
16.	My teacher praise boys and girls during mathematical instructional time.	FEMALES	33 (16.5)	48 (24)	2 (1.0)	6 (3.0)	4 (2.0)
		MALES	2 (1.0)	7 (3.5)	5 (2.5)	50 (25)	43 (21.5)

***F= Frequency**

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

Table 4.3, depicts factors that contribute to Gender-Based Performance (GBP) in mathematics among Senior High School Students in Sekondi- Takoradi metropolis.

Out of the 200 respondents (36%, n=72) representing females and (42%, n=84) representing males disagreed to the facts that the school environment has positively influenced their performance in mathematics, but (9.5%, n=19) representing females and (10%, n=20) of males agreed whiles (1%, n=2) representing females and (1.5%, n=3) representing males were indecisive to the fact that the school environment has positively influenced their performance in mathematics.

Besides, majority of the respondents (33.5%, n=67) representing females and (37%, n=74) representing males disagreed to the facts that teaching methodology employed in teaching mathematics has greatly improved their performance in mathematics, whiles (8.5%, n=17) representing females and (15.5%, n=31) representing males agreed whereas (4.5%, n=9) representing females and (1%, n=2) representing males were irresolute.

Nevertheless (38.5%, n=77) representing females and (35.5%, n=71) representing males disagreed that availability of teaching and learning materials has positively influenced their performance in mathematics, whereas (6%, n=12) representing females and (13.5%, n=27) representing males agreed (2%, n=4) representing females and (4.5%, n=9) neither agree or disagree that availability of teaching and learning materials has positively influenced their performance in mathematics

Furthermore, (39.5%, n=79) representing females and (31.5%, n=63) representing males disagreed to the perception that leadership style employed in their school has greatly improved their performance in mathematics, whiles (5.5%, n=11) representing females and (19.5%, n=39) representing males agreed whereas (1.5%, n=3) representing females and (2.5%, n=5) representing males were indecisive.

Besides, (33.5%,n=67) representing females and (17.5%, n=35) representing males disagreed to the fact that they have a lot of self-confidence when it comes to studying mathematics, whereas majority of the respondents (9%,n=18) representing females and (33.5%, n=67) representing males were of the view that they have a lot of self-confidence when it comes to studying mathematics, whiles (4.5%,n=9) representing females and (2.5%, n=5) representing males were neutral.

Majority of the respondents (20%, n=40) representing females and (20.5%, n=41) representing males disagreed to the fact that they feel comfortable to express their own ideas on how to look for solution to a difficult problem in mathematics, whiles (22%, n=44) representing females and (22%, n=44) representing males agreed to the perception that they feel comfortable to express their own ideas on how to look for solution to a difficult problem in mathematics, whiles (4.5%,n=9) representing females and (2.5%, n=5) representing males were irresolute.

Out of the 200 respondent's (29%,n=58) representing females and (31.5%, n=63) representing males were totally not convinced that knowing mathematical concepts will help them earn a living, whiles (13.5%,n=27) representing females and (48.5%, n=97) representing males agreed to it that knowing mathematical concepts will help them earn a living, but (4%,n=8) representing females and (2.5%, n=5) representing males neither agree nor disagree.

Additionally, (35.5%, n=71) representing females and (31.5%, n=63) representing males disagreed to the fact that their mathematics teacher holds higher expectation for boys when learning mathematics concepts, whiles (20%, n=40) representing females and (20%, n= 40) representing males agreed, whereas (3%, n=6) representing females and (2%, n=4) representing males were irresolute.

On the contrary, (31.5%, n=63) representing females while (43%, n=86) representing males had a negative perception on the view that mathematics teachers teaching experience in their school has relatively improved their performance in mathematics, whereas (10%, n=20) of females and (4.5%, n=9) representing males were of the positive view that mathematics teachers teaching experience in their school has relatively improved their performance in mathematics, while (5%,n=10) of females and (6%,n=12) of males neither agree nor disagree.

Similarly, (38%, n=76) of females and also (46%, n=92) of males disagreed to it that society predominantly view mathematics as a male domain, whereas (6.5%, n=13) of females and (5%, n=10) of males agreed, but (5.5%, n=11) of females and (2.5%, n=5) of males were irresolute.

On the other hand, (15.5%, n=31) of females and (35.5%, n=71) of males were of the negative view that societal expectations towards boys and girls present a positive challenge in their mathematical task, whereas (25.5%, n=51) of females and (25%, n=50) of males had a positive perception on the view that societal expectations towards boys and girls present a positive challenge in their mathematical task, but (5.5%, n=11) of females and (2.5%, n=5) of males were neutral.

Alternatively, (28%, n=56) of females and (35.5%, n=71) of males disagreed to it that boys have cognitive abilities and higher average IQs in mathematics, whiles (16%, n=32) of females and (17%, n=34) agreed that boys have cognitive abilities and higher average IQs in mathematics, whereas (2.5%, n=5) of females and (1.0%, n=2) of males were neutral

However, (11.5%, n=23) corresponding to females and (12.5%, n=25) likewise males disagreed to it that engagement in household chores and duties affect their performance in mathematics, in the same way (12.5%, n=25) of females and (38%, n=77) of males were of the positive view that engagement in household chores and duties affect their, performance in mathematics, whereas (3%, n=6) of females and (2.5%, n=5) of males were neutral.

On the other hand, (30%, n=60) corresponding to females and (39%, n=78) corresponding to males disagreed that their parents and siblings encourage them to learn mathematics and perform well in the subjects, while (36.5%, n=73) of females and (29.5%, n=59) of males were with the positive view that their parents and siblings encourage them to learn mathematics and perform well in the subject whereas (12.5%, n=25) of females and (1.5%, n=3) of males were indecisive.

Finally, (31.5%, n=63) of females and (4.5%, n=9) of males disagreed to the view that their mathematics teacher praise boys and girls during mathematical instructional time, on the other hand (5%, n=10) of females and (46.5%, n=93) of males were of the positive that their mathematics teacher praises boys and girls during mathematical instruction time, while (1%, n=2) of females and (2.5%, n=5) were neutral.

4.1.3 Research Question 3

What workable ideas can be explored to enhance teaching and learning of mathematics to attain Gender- Based Performance (GBP) parity?

Research Question 3 sought to identify workable ideas that can be explored to enhance teaching and learning of mathematics to attain Gender- Based Performance (GBP) parity. The students were given questionnaires to rate their perception. The data for this research question were obtained from responses of items from 17 to 20 in the questionnaire. Furthermore, a descriptive data analysis was further used to find out whether the respondent's perception was either positive or negative.

Table 4.4: Descriptive statistics of respondents' perception

SOLUTIONS	GENDER	SD	D	N	A	SA
		F (%)	F (%)	F (%)	F (%)	F (%)
17. Using gender-based assessment at the end of Mathematics lesson can help improve both gender-based performance in mathematics.	FEMALES	18 (9.0)	13 (6.5)	9 (4.5)	30 (15)	23 (11.5)
	MALES	13 (6.5)	10 (5.0)	11 (5.5)	22 (11)	51 (25.5)
18. Applying classroom mathematics to the real world situation can enhance effective teaching and learning of mathematics.	FEMALES	3 (1.5)	6 (3.0)	13 (6.5)	32 (16)	39 (19.5)
	MALES	2 (1.0)	4 (2.0)	9 (4.5)	48 (24)	44 (22)
19 Creating equal opportunities for feedback can help improve the performance of both genders in mathematics	FEMALES	7 (3.5)	3 (1.5)	11 (5.5)	35 (17.5)	37 (18.5)
	MALES	4 (2)	1 (0.5)	10 (5)	45 (22.5)	47 (23.5)
20.Given practical and interacting classwork can help improve the performance of both genders in mathematics	FEMALES	2 (1.0)	3 (1.5)	5 (2.5)	59 (29.5)	24 (12)
	MALES	6 (3.0)	1 (0.5)	8 (4.0)	35 (17.5)	57 (28.5)

***F=Frequency**

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

Table 4.9 depicts workable ideas that can be explored to enhance effective teaching and learning of mathematics in order to attain parity in Gender- Based Performance (GBP) in mathematics.

Out of the 200 respondents, (15.5%,n=31) representing females and (11.5%,n=23) of males disagreed to the fact that using gender based assessment at the end of Mathematics lesson can help improve gender-based performance in mathematics, whiles (26.5%,n=53) of females and (36.5%,n=73) of males agreed to the fact that using gender- based assessment at the end of Mathematics lesson will not help improve gender-based performance in mathematics, whereas (4.5%, n=9) of females and (5.5%,n=11) of males did not agree nor disagree.

Besides, majority of the respondents (4.5%, n=9) of females and (3.0%, n=6) of males disagreed to the fact that applying classroom mathematics to real world situation can enhance effective teaching and learning of mathematics, whiles (35.5%, n=71) of females and (46%, n=92) representing males agreed to the fact that applying classroom mathematics to real world situation cannot enhance effective teaching and learning of mathematics, whereas (6.5%, n=13) representing females whereas (4.5%, n=9) of males were irresolute.

Similarly, (5%, n=10) corresponding females and (2.5%, n=5) corresponding males disagreed to the fact that, creating equal opportunities for feedback can help improve the performance of both genders in mathematics whiles (36%, n=72) representing females and (46%, n=92) representing males had a positive affirmation to the fact that creating equal opportunities for feedback can enhance effective teaching and learning of mathematics, whiles (5.5%,n=11) of females and (5%,n=10) of males were neutral.

Finally, out of the 200 respondents, (2.5%,n=5) representing females whiles (3.5%, n=7) of males disagreed to the fact that given practical and interacting classwork can help improve the performance of both genders in mathematics, whiles (41.5%,n=83) of females and (46%, n=92) of males disagreed to the claim that given practical and interacting classwork can help improve the performance both genders in mathematics whereas (2.5%, n=5) of females and (4.0%, n=8) of males were indecisive. This implies that the student gave out positive perception towards workable ideas that can be explored to enhance teaching and learning of mathematics to attain gender-based performance in mathematics.

4.1.4 Qualitative Analysis

Creswell (2009) explained qualitative research as a process of comprehending a social or human problem through building a complex, holistic picture, fashioned with words, reporting de tailed views of informants and conducted in a natural setting.

Mathematics teachers from the selected five senior high schools in Sekondi-Takoradi Metropolis were interviewed in detail about their responses to the questionnaire data. The five mathematics teachers were giving the following codes. A, B, C, D and E

1. How many years have you been teaching mathematics?

Interviewee	Responses
TEACHER A	*4 years*
TEACHER B	*5years*
TEACHER C	*5 years*
TEACHER D	*12 years*
TEACHER E	*13 years*

Research Question 1

What is the overall mathematics performance of boys and girls in the selected schools in Sekondi-Takoradi Metropolis?

1. With regards to mathematics as a subject, tell me your opinion on gender base performance in mathematics in your school?

Interviewee	*Responses*
TEACHER A	*Gender based performance in mathematics in my school is actually male biased, that is to say majority of students who perform well in mathematics are boys.*
TEACHER B	*Generally, boys perform better in mathematics than girls. This has become possible because of the misconception the girls themselves have in mind.*
TEACHER C	*In my five years of teaching mathematics males have been performing more creditably than the female students. This is not to say that the female students are not academically good in mathematics but weighing their performance the males are ahead. Although there are certain female students who are giving their male counterparts a run for their monies.*
TEACHER D	*With regards to mathematics as a subject, I can say that the male students perform better than the females.*

TEACHER E	*Males generally perform better in mathematics than the females.*

RESEARCH QUESTION 2

2. What are the factors that contribute to Gender- Based Performance (GBP) in mathematics among Senior High School students?

Interviewee	Responses
TEACHER A	*One of the key factors is, the classification of students during admission periods.*
TEACHER B	*Inappropriate classification of students based on what they want to do in future.*
TEACHER C	*Financial constraints.*
TEACHER D	*Less confidence.*
TEACHER E	*Parental influence.*

3. Could you please give your comment on the factors that influence gender-based performance in your school?

Interviewee	Responses
TEACHER A	*During admission time, courses like general science, business accounting etc. are given the first attention in the sense that the students who performed excellently are mostly classified into those classes while those with poor grades in mathematics are classified into home economics, visual arts and etc. next is the comment the teachers or some school officials pass on the students. you may have a teacher who has already conditioned his mind that once a student is found in those classes it means you are not good academically precisely mathematics.*
TEACHER B	*Classification of students should be based on what the students want to do in future. Girls in the home economics class should be assigned to female mathematics teachers which will serve as a form of motivation to the girls.*
TEACHER C	*Financial constraints in purchasing school Item Students who are less privilege cannot purchase items such as calculator and textbooks which makes learning very difficult for them.*
TEACHER D	*Most female students have less confidence in themselves when it comes to mathematics even to the highest level.*
TEACHER E	*Some parents do not encourage their children especially females to learn mathematics because they perceive it to be for the males than the females. They perceive males are good in calculating whiles females are good in reading.*

RESEARCH QUESTION 3

What workable ideas can be explored to enhance teaching and learning of mathematics to attain Gender- Based Performance (GBP) parity?

4. How do we bridge the gap and encouraged female students to attain gender parity in mathematics?

Interviewee	Responses
TEACHER A	*We must motivate them through giving them relatively simple mathematical activities to handle and appreciate their little efforts afterwards. This will go a long way to build a very strong interest in them. More female mathematics teachers should be assigned to the Arts and Home Economics classes to serve as role models to the female students.*
TEACHER B	*Motivation*
TEACHER C	*Teaching and learning of mathematics should be made more practical, interesting and above all geared towards problem solving. This can be made possible if relevant teaching and learning materials are incorporated into the teaching and learning process.*

TEACHER D *Teaching of mathematics should be activity oriented with more females being leaders in the group which will enable them see mathematics as any other subjects*

TEACHER E *Special incentives should be given to females who study mathematics*

4.2 Discussion of Results and Findings

Research question 1 sought to find out the overall mathematics performance of males and females in the selected Senior High schools. Results from research question 1 indicated that female students outperformed their male counterparts in the mathematics test score, although the difference is no statistically significant. The theoretical frame work which support this framework is the deficit theory which state that differences in educational outcomes occur because of inherent deficiencies or weaknesses in girls' experiences, knowledge, and skills. Liberal feminist researchers argued, however, that these deficiencies were due to socialization and that by attending to these deficiencies through particular educational programs equality of outcomes could be achieved. The findings of this study are consistent with the one in the United States of America by Hydea and Mertzb (2009) which says girls have reached parity with boys in mathematics. This finding is also in agreement with the narrow gender gap in achievement in U.S.A (Perie, Moran & Luktus, 2005) and in Australia (Forgasz, Leder & Vale, 2000). It however contradicts with the findings of Ogunkunle (2007), in Nigeria, where part of the findings established significant difference in favor of males and another part in favor of the females. It also disagrees with earlier studies of Fennema (2000) and Asante (2010) which showed significant gender differences.

The reason for the equal performance of male and female students may not be unconnected with the fact that both see themselves as equals and capable of competing and collaborating in classroom activities. This affirmation is opposed to the views of Fennema and Leder (1990) that gender difference in mathematics is based on gender differences in cognition and brain lateralization.

From the qualitative analysis, mathematics teacher's perception towards gender -based performance was that boys outperformed girls in mathematics. Their perception is in agreement with the earlier studies of Fennema (2000) and Asante (2010) which showed significant gender differences in mathematics.

Research question 2 sought to find out factors that contribute to gender- based performance in mathematics among senior high school students in Sekondi-Takoradi Metropolis. Findings from the result above showed most of the students had a negative perception towards factors that contribute to gender–based performance in mathematics. It is not surprising that majority of the students' responses indicated that the school environment has negative influence on gender differences in mathematics performance. This finding is in agreement with (Ahmed et al. 2010), which reported that differences in the perceptions of classroom environment or achievement goals could explain the gender gap in mathematics performances because, neither environmental, nor motivational factors alone could fully explain the gender differences in mathematics achievement, further research is needed to explore gender differences in the relationship between environmental and motivational factors. The authors also argue that positive school environment positively influence learners' achievement while negative school environment negatively affect learners' academic performance in mathematics. Similarly, the students' responses on teaching methodology employed in their school reveal that, (34%) representing females and (36.5%) representing males were of the view that it had a moderate improvement in their mathematics performance whereas, (9%) representing females and (15.5%) representing males mentioned that it has greatly improved their performance in mathematics. This finding is in agreement with Fennema and Peterson (1986) statement which reported that, small differences in teacher behaviour combined with the organization of instruction, made up a pattern of classroom organization appear to favour males. For instance, competitive activities encouraged boys learning and had a negative influence on girls' learning, while the opposite was true of cooperative learning. Majority of the students (60%) of the students disagreed to the fact that availability of teaching and learning materials has positively influenced their performance in mathematics. It is clear from the result that the role of the teacher in learning mathematics cannot be downplayed. This finding is in agreements with UNESCO (2009) findings which reveal that textbooks at the school library are motivators for students to engage in personal study and hence improved outcomes in the subjects such as mathematics. Due to a large number of students in secondary schools as a result of subsidized secondary education, schools are over-stretched in terms of resources. This has left a very little resources to go towards equipping the libraries, which has left students with nowhere to turn to as they are forced to share one book among 10 students against the recommended one book per one student. Also, the results of the findings are in agreements with that of Mutai (2006) who asserts that learning is strengthened when there are enough reference materials such as textbooks, teaching aids, exercise books, classrooms and the academic achievements illustrates per excellence the correct use of these materials. This implies that provision of conducive classrooms, laboratories and other teaching/learning resources can positively change teachers' attitude to the teaching of mathematics and make the subject to be very interesting, meaningful and exciting to the students and hence will encourage mathematical exploration and manipulation by students which will keep them alive and thinking and will also help them realize the applications of mathematics.

Majority of the students (71%) were not in agreement towards the leadership style employed in in their school in relation to their performance in mathematics. This is opposite to the direct findings of Ahmad et al. (2010) and Bagakas (2011) study who also lend weight to the current study outcome as the authors established that teacher's behavior, such as being responsive, helpful and supportive, positively impact students' mathematics grades in Senior High School.

Also, almost half (65%) of the total number of females as compared to males (21%)gave negative response that they were not comfortable to express their own ideas on how to look for solution to a difficult problem in mathematics as compared to males. This is in assertion to the findings of Jungwirth (1991), Waiden & Walkerdine (1985), study who tried to make meaning of the experiences of boys and girls in mathematics classrooms to interpret male-female power relations. Their findings revealed that girls are often marginalized and given subordinate status in mathematics class. Their findings suggest that the perceptions of teachers towards girls'performance in mathematics are dependent on rote learning, hard work and perseverance rather than natural talent, flexibility and risk taking which are the learning style of boys. This result is also in agreement with Mutemeri and Mygweni (2005) study which argue that the idea that mathematics is for boys may result in low motivation in girls and could widen gender gap in mathematics performance.

Majority (61%) of the females also declined that they do not have self-confidence when it comes to studying mathematics. This is also similar to Kyei et al. **(**2011) which found that lack of self-confidence in females was a causal factor of the difference in the female performance in mathematics. Confidence is very significant in learning mathematics because it enables students to be sure of themselves when solving non routine problems on their own especially studying new concepts. Confidence affects students' enjoyment, interest and involvement in mathematics.

Majority of females (71%) further declined that knowing mathematical concepts will not help them earn a living in future, for the males, (51%) of them revealed that knowing mathematical concepts will help them earn a living in future, This assertion tallies with (Guiso, Monte, Sapienza, & Zingales, 2008; Else-Quest, Hyde and Linn, 2010) research which they found, gender gap in academic performance especially in mathematics which continue to be observed worldwide and discouraging women from pursuing a career in high paying occupation field such as engineering. It is conceivable that low performance of females in Mathematics contributes to the gender wage gap which in itself is an economic issue

On the contrary, majority (60%) of the students revealed that mathematics teachers hold higher expectation for boys when learning mathematics concepts, this assertion is in line with (Koehler,1990) study who reported that in mixed schools, teachers interact more with boys ,praise and scold boys more, and call on boys more than girls. Similarly, majority of the students gave a negative response to the statements that they enjoy mathematics regardless of the gender of the teacher, only a few gave a positive response to the statement. Gender seems to be an issue when it comes to mathematics performance especially if the discipline is handled with discrimination on the basis of gender as the issues cited by the respondents cut across all the gender with no significant differences in any of the school studied in this research. The teacher's gender affects a very larger number of respondents. This result is reflected in all the categories of school in this research. This is in opposite direction to the report made by UNESCO (2004) which indicates that teachers' gender has an impact on learning and achievement in mathematics. The fewer female mathematics teachers in the sample imply that girls have few role models and it also reinforces the stigma that mathematics is a male domain. At any rate, all the students care about is an instructor who will deliver the lessons in an organized manner in such a way that it is easier to understand the complex concepts in mathematics. Conversely, most of the respondents disagreed that mathematics teachers teaching experience has not relatively improve their performance in mathematics This is also in disagreement to the study of Bagakas (2011) who revealed that teacher's teaching experience positively influenced students' self-competence and mathematics grades in Senior High School.

On the other hand, more than half (61%) of females as compared to (21%) of males had a negative view that societal expectations towards boys and girls presents a positive challenge in their mathematical task. This study conforms to the assertion of Costello (1991) which confirmed that parents react and reinforce their daughters and sons differently. When their children do something mathematical, daughters are told you have really tried meaning nothing much is expected from the female child. But to their sons, they are told you can do far much better meaning, male children are expected to do a lot more in mathematics. Such comments said by parents consciously or without much thought are registered in the sub-conscience of a child and may influence how he/she perceive mathematics. Hence formation of attitudes among students may have been unconsciously registered from parents particularly and from the society in general.

Similarly, (65%) of the students denied the fact that their parents and siblings encourage them to learn mathematics and perform well in the subject. This finding is also in consistence with the result of Ying and Ching (1991) who revealed that parental expectations and students' achievement in mathematics had a strong correlation. This result implies that the role parent's play in developing strong attitude in mathematics has been ignored. Students are not constantly encouraged and given support in terms of adequate time at home to revise and complete the assignments. Books are not provided which has led to laxity on the part of students.

Finally, half of the total number of females (50%) as compared to boys (4.5%) totally disagreed that mathematics teachers praise boys and girls during mathematical instructional time. This result is in consistence with the findings of (AAUW,1992) which states that male and female mathematics teachers have unique biases with respect to how they engage boys and girls in classroom. They stated that there is controversial evidence based on classroom observations that teachers are more likely to offer praise and remediation in response to boys but mere acknowledgement in response to comment by girls.

From the qualitative analysis it, was also observed that most teachers had various views on the factors that contribute to gender-based performance in mathematics which were classification of students during admission periods, inappropriate classification of students based on what they want to do in future, financial constraints, less confidence and parental influence. Also, the results of the teachers' findings is in agreements with that of Mutai (2006) who asserts that learning is strengthened when there are enough reference materials such as textbooks, teaching aids, exercise books, classrooms and academic achievements illustrates per excellence the correct use of these materials.

Research question 3 sought to find out possible solutions that can be explored to enhance effective teaching and learning to attain parity in gender-based performance in mathematics. Findings from the study shows most of the students had positive perception, possible solutions that can be explored to enhance effective teaching and learning of mathematics to attain gender –based performance parity. Thus, majority of the respondents agreed that using gender- based assessment at the end of mathematics lesson can help improve both gender performance in mathematics. This is in agreement with the findings of Meherens and Lehmann, (1991) which reported that effective teaching is knowing what kind of assessment that will provide the best picture about students' performance that is using the most appropriate method to get information from students. The findings further revealed that majority of the students were of the view that applying classroom mathematics to the real-world situation can enhance effective teaching and learning of mathematics. This support previous findings that mathematics teachers should engage students in a variety of learning experiences designed to promote mathematical exploration and reasoning. Pechman, (1991). Pechman (1991) noted that these experiences should engage students actively in mathematics, help them discover meaning through manipulations with concrete materials, which will enable them to learn individually and in groups, and lead them to construct meaning using a variety of resources and instructional materials. Additionally, majority of the students revealed that creating equal opportunities for feedback can help improve the performance of both genders in mathematics. This finding is in consistent with Oppendekker and Van Damme (2006) who states that settings where students were allowed and encouraged to cooperate with classmates enable teachers to give students more opportunities to understand and succeed. Similarly, they stressed that good teaching involves communication and building relationships with students. Similarly, it is not surprising that most of the students were of the view that practical and interactive classwork can help improve the performance of both genders in mathematics. According to Boaler (1999, 2002) mathematics is open, applied or discussion-based situations. The students who had learned mathematics through group-based projects were more able to apply their knowledge in a range of situations. Boaler (1999,2002) research provided evidence for theory that context constructs the knowledge that is produced. The findings from the results conclusively indicated that most of the students bear positive perception on workable ideas that can be explored to enhance effective teaching and learning of mathematics to attain Gender-Based Performance (GBP) parity.

Finally, the teachers were able to explore workable solutions that can bridge the gap and encouraged female students to attain gender parity in mathematics which include motivation, practical-oriented activities and student-centered. This support previous findings that mathematics teachers should engage students in a variety of learning experiences designed to promote mathematical exploration and reasoning. Pechman, (1991).

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter provides the summary of the study and findings. It highlights the conclusion of the study and also outlines some recommendations and areas for future research.

5.1 Summary of the Study

This study was aimed at determining the overall mathematics performance of senior high school boys and girls in the selected senior high schools in Sekondi–Takoradi Metropolis. It further investigated on factors that contribute to Gender-Based Performance (GBP) in mathematics among senior high school students and proffer a possible workable idea to enhance effective teaching and learning of mathematics in order to attain Gender-Based Performance (GBP) parity.

This study was guided by the following research questions:

1. What is the overall mathematics performance of boys and girls in the selected schools in Sekondi-Takoradi Metropolis?
2. What are the factors that contribute to Gender- Based Performance (GBP) in mathematics among Senior High School students?
3. What workable ideas can be explored to enhance teaching and learning of mathematics to attain Gender- Based Performance (GBP) parity?

In answering the first research question, the hypotheses below were formulated for the study;

H_o: There is no significant difference in mathematics performance of males and females in the selected Senior High schools in Sekondi-Takoradi Metropolis.

H_1: There is a significant difference in mathematics performance of males and females in the selected Senior High schools in Sekondi-Takoradi Metropolis.

The study adopted the Mixed Method Approach with cross-sectional survey as a design. The targeted population was made up of 200 students comprising of 107 male and 93 female final year students, as well as 5 mathematics teachers. Convenient sampling was used to select five senior Senior high school students in Sekondi-Takoradi Metropolis. Secondly stratified sampling was also used to select both males and females. Lastly simple random sampling technique was used to select a sample of two hundred final year Senior High School Students of which 107 (54%) were males and 93 (46%), females were selected for this study as well as 5 mathematics teachers were selected from each school. Basically, the main instruments used for this study were questionnaire, test items and interview. The responses from the questionnaire were analysed with the aid of SPSS version 23. Descriptive data analysis such as frequency distribution, and percentages, were used to analyse, describe and compare the quantitative data in this study. Mathematics teachers were interviewed and it was transcribed. Inferential data analysis such as Levene's Test for Equality of Variances was employed to find out if there is statistically significant difference in mathematics performance of boys and girls in the selected schools in Sekondi-Takoradi Metropolis. In particular, each research question was looked at from all relevant data sources.

5.2 Findings from the Study

The findings from the study are presented as follows:

1. It was emerged from this study that, there is no significant difference in the mathematics performance of males and females in the selected Senior High schools in Sekondi-Takoradi Metropolis.
2. The study revealed that the school environment has an influence on gender differences in mathematics performance, which includes, non-availability of mathematics teaching and learning resources, teaching methodology used, teacher quality, teaching experience and even leadership styles employed in schools have a negative effect on students' performance in mathematics.
3. A sizeable gender differences were detected across the five attitude scales examined towards students' mathematics anxiety, interest and self-confidence. It was the boys who voiced out a stronger confidence and interest in mathematics, and found learning mathematics related tasks easier, showed more pronounced interest in starting a career in mathematics, and rated mathematics to be more beneficial as compared to their female counterparts.
4. The girls voiced out that their mathematics teachers make them feel uncomfortable, restless, irritable and impatient during mathematical instruction. However, the boys confirmed that their mathematics teachers hold higher expectation towards their contributions when learning a mathematics concepts.
5. It was also revealed that societal perception towards girls present a negative challenge in their mathematical task as compared to boys.
6. On the contrary majority of the girls agreed that boys have higher cognitive abilities and higher average IQs in mathematics. Moreover, it was revealed that engagement

in household chores and duties affect girl's performance in mathematics as well as having a positive influence on boy's performance in mathematics. Conversely, mathematics teacher's motivation during mathematics instruction had a negative effect on girls and influenced boys positively.

4. Finally, findings from the study indicated that using gender-based assessment at the end of mathematics lesson can help improve both gender-based performance in mathematics. The students perceived that, when teachers apply classroom mathematics to the real-world situation, it can enhance effective teaching and learning of mathematics. It also reveals that creating equal opportunities for feedback can help improve the performance of both genders in mathematics as well as given practical and interacting classwork can also help improve the performance of both genders in mathematics. These are the possible solutions that can help to enhance effective teaching and learning of mathematics in order to attain gender-based performance parity in mathematics.

5.3 Conclusion

Based on the findings, the researcher draws various conclusion

1. It was revealed that there is no statistically significance difference in mathematics performance of boys and girls in Sekondi-Takoradi Metropolis.
2. The student perceived that the school administration has not prioritized learning of mathematics by purchasing the relevant resources to equip teaching of mathematics, unconducive school environment as well as their teachers teaching experience have an influence in their performance in mathematics. It also provided sufficient evidence that girls had formed negative attitudes towards the subject and they did not have any interest for it. Boys have a positive attitude towards learning of mathematics. While there are differences among individuals in learning

mathematics, little is based on gender as most differences cut across all gender. It is, therefore, possible to lift the performance of girls and reduce the gap by moderating the few areas responsible. They also establish that stereotypical factors affect their performance in mathematics as compared to boys. Parental influence was also an important factor influencing the participation of girls in mathematics. However, they do not play their roles effectively since they are not conversant with school programmes. Finally, society still perceives mathematics to be a male domain and hence does not strongly encourage girls' participation in mathematics.

3. Majority (90%) of the students gave out positive perceptions on measures that can be explored to enhance effective teaching and learning in order to attain parity in gender-based performance in mathematics.

5.4 Recommendations

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

1. Since evidence from the analysis indicates that there is no gender differences in mathematics, educational stakeholders should initiate remedial activities which focus on differences in mathematics performance needs must be enhanced. Mathematics teaching and evaluation strategies should be gender bias free. This will make males and females see themselves as equal, capable of competing and collaborating in school activities.
2. Mathematics teachers should use appropriate teaching and learning materials and teaching approaches that can make mathematics learning grounded in learner centered pedagogies. This would encourage active learning of the subject with application to real life situations outside the classroom. This could

offer opportunities for students to construct and discover their knowledge in learning mathematics.

3. Teachers and stakeholders in the educational sector should organize seminars and workshops for students, parents and teachers to enhance and promote positive attitudes towards mathematics.

5.5 Suggestions for Further Research

The following are suggested for further research:

The study was carried out on gender-based performance in mathematics among some selected senior high school students in Sekondi-Takoradi metropolis. Hence, the findings may not be representative of all senior high schools in Sekondi-Takoradi metropolis.

Finally, this study needs to be replicated in other parts of the metropolis in Ghana to enable greater generalization.

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APPENDICES

APPENDIX A
QUESTIONNAIRE FOR STUDENTS

Introduction:

I am a student of the University of Education, Winneba. I am Carrying out a study to investigate gender-based performance in Mathematics of Senior High School Students in Selected Schools in Sekondi – Takoradi Metropolis. The information that you will provide in this questionnaire is anonymous and will only be accessed by one researcher. You will not be identified anywhere in this research study and you are not required to provide your name in the questionnaire. All information provided here shall be kept confidential and shall be used for research purpose only. Thank You.

SECTION A

BACKGROUND INFORMATION

Please Tick (✓) in the box where appropriate

1. Sex Female [ ] Male [ ]

2. Father's highest level of education

BECE/O Level	[ ]	SSCE/A Level	[ ]	HND/Diploma	[ ]
First Degree	[ ]	Masters	[ ]	PHD	[ ]

No formal education [ ]

3. Mother's highest level of education

BECE/O Level [ ] SSCE/A Level [ ] HND/Diploma [ ]

First Degree [ ] Masters [ ] PHD [ ]

No formal education [ ]

4. Occupation of father. ……………………

5. Occupation of mother ……………………

SECTION B: FACTORS RELATING TO GENDER BASED PERFORMANCE IN MATHEMATICS.

Please indicate your level of agreement or disagreement on the statements below. They have been rated in the form **Disagree (D), Strongly Disgree (SD) Neutral (N), Strongly Agree (SA) and Agree (A).**Please Tick (✓) in the box where appropriate.

S/N	ITEMS	D	SD	N	SA	A
The school environment						
1	The school environment has positively influenced my performance in mathematics.					
2	Teaching methodology employed in teaching mathematics has greatly improved my performance					
3	Availability of teaching and learning materials has positively influenced my performance in mathematics.					
4	Leadership styles employed in my school has greatly improved my performance in mathematics					

Students' mathematics anxiety, interest and self-confidence						
5	When I can figure out a mathematical problem, I feel as though I am lost and cannot find my way out.					
6	I am comfortable expressing my own ideas on how to look for solution to a difficult problem in Mathematics					
7	I have a lot of self-confidence when it comes to studying mathematics.					
8	Knowing mathematical concepts will help me earn a living.					
Stereotypical factors						
9	My mathematics teacher makes me feel comfortable, restless, irritable and impatient during mathematical instruction.					
10	My mathematics teacher hold higher expectation for boys and girls when learning a mathematics concepts					
Teachers' perception						
11	I enjoy learning mathematics regardless of the gender of my teacher					
12	Mathematics teachers teaching experience in my school has relatively improved my performance in mathematics					
Societal factors						
13	society predominantly view of mathematics as a male domain influence girls' attitude towards the subject					
14	Societal expectations towards boys and girls presents a positive challenge in their mathematical task.					
	Content and Cognitive factors					
16	Boys and girls have higher cognitive abilities and higher average IQs in mathematics.					

17	Boys and girls have the brain size, skills and cognitive abilities in mathematics than females					
Home related factors						
18	Engagement in household chores and duties affect my performance in mathematics					
19	My parents and siblings encourage me to learn mathematics and perform well in the subjects					
Motivational factors						
20	My teacher praises boys more than girls during mathematical instructional time.					

SECTION C: HOW DO WE IMPROVE GENDER BASED PERFORMANCE IN MATHEMATICS IN ORDER TO ENHANCE EFFECTIVE TEACHING AND LEARNING OF MATHEMATICS

Please indicate your level of agreement or disagreement on the statements below. They have been rated in the form **Disagree (D), Strongly Disagree (SD) Neutral (N), Strongly Agree (SA) and Agree (A).**Please Tick (✓) in the box where appropriate.

S/N	ITEMS	D	SD	N	SA	A
21	Using gender-based assessment at the end of mathematics lesson can help improve both gender performance in mathematics					
22	Applying classroom mathematics to the real-world situation can enhance effective teaching and learning of mathematics.					
23	Classroom management g can help improve gender-based performance in mathematics.					
24	Creating equal opportunities for feedback can help improve the performance of both genders in mathematics.					
25	Given practical and interacting classwork can help improve the performance of girls in mathematics.					

APPENDIX B

TEST FOR STUDENTS

PROVIDE SHORT ANSWERS TO THE QUESTION

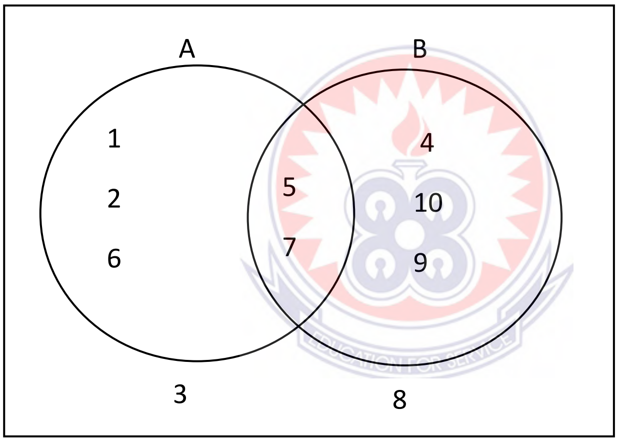
Duration 30 minutes

Gender

Male ☐

Female ☐

1.Use the Venn diagram below to answer question 1 and 2



1. From the Venn diagram, what is A∩B[1]

2. How many elements are in the set A∩B[1]

3. If the intersection of two sets gives a null set, the set is said to be

4. The set {1, 2, 3, 4, 5, 6, 7................} can be describe as the set of

5. The set {0, 1, 2, 3, 4, 5, 6,} is described as the set of

6. The sum of two consecutive odd numbers is 32, Find the first number

7. Find the mode of the following set of data, 2, 4, 3, 5, 3, 3, 1, 4, 6, 3

8. Make d the subject if the relation 3r+dk=c

9. Express 4^{-2} as a fraction

10. The Notation of a/b is a fraction, what name is given to b.

Part II

Answer any one in this part.

1a .A man invested a certain amount of money in a bank at a simple interest rate of 5% per annum. At the end of the year, his total amount in the bank was GH¢840, 000. How much did he invest at the bank?

1b. If 10 men can weed a piece of land using 9 days, how long will 15 men weed the same piece of land, if they work at the same rate.

2. The lines 3x+y=12 and x-2y=11 at P, the equation of the line through P and Q (1, 1) is of the form ax + by + c= 0

Find

(i) the value of a, b and c

(ii) / PQ/, leave your answer in surd form.

APPENDIX C

QUESTIONNAIRE FOR MATHEMATICS TEACHERS

PART II

Thank you for agreeing to participate in this interview which is part of my MPHIL work at the University of Education, Winneba. This study aims to investigate Gender based performance in mathematics of Senior High School students in some selected schools in Sekondi-Takoradi Metropolis. Your school is one of the few that have been selected for this study. Your candid expression of opinion in this Semi-structured interview would be helpful in analyzing this issue. Be assured that your honest responses would be treated with utmost confidentiality and your identity won't be revealed in anyway. Thank You.

1. How many years have you been teaching mathematics?
2. With regards to mathematics as a subject, tell me your opinion on gender base performance in
3. What are the factors that influence gender-based performance in mathematics in your school?
4. Could you please give your comments on the factors that influence gender-based performance in your school?
5. How do these factors affect gender-based performance in your school?
6. How do we bridge the gap and encouraged female students to attain gender parity in mathematics?
7. What workable ideas do you think can enhance effective teaching and learning of mathematics to attain gender-based performance in mathematics?

Thank You

APPENDIX D

MARKING SCHEME

PART 1

QUESTION	DETAILS	MARKS
1	{1,2,3,5,6}	B1
2.	5 elements	B1
3.	Disjoint Set	B1
4.	Set of counting numbers	B1
5.	Set of whole numbers	B1
6.	Let the first number be x and the second number be (x + 2) => x + (x + 2) = 32 x + x = 30 2x = 30 x = 15 ∴ The first number is 15	M1 for the equation M1 for solving A1 for the answer.
7.	The mode is 3	B1
8.	3r + dk dk = c – 3r $d=\frac{c-3r}{k}$	M1 A1
9.	$\frac{1}{4^2}$ $=\frac{1}{16}$	M1
10.	b is a natural number because b ≠ 0	B1

PART 2

Question	Details	Marks
1.	P = I×100/R×T I= ₵840000 R= 5% T=1 year ₵840000×$\frac{100}{5}$ =₵16,800,000	M1 M2 for simplifying A2 for final answer
1b.	10men =9days 15 men =? 10×9 =15X 90/15 =15X/15 X=6 days.	M1 for bringing out the expression. M2 M2 for final answer.
2.	3x + y = 12 --------(1) ×1 x – 2y = 11 -------(2) × 3 = > 3x + y = 12 -----(1) 3x – 6y = 33 -----(3) 7y = -21 y = -3 put y = -3 into eqn (2) 3x – 3 = 12 3x = 15 x = 5	B1 for (eq3) M1 for solving A1 for y =3 A1 for substituting M1 for simplifying A1 for x= 5.

	P(x, y) →(5, -3) $y + 3 = \frac{3-1}{5-1}(x-5)$ y + 3 = -1 (x – 5) x + y – 3 = 0 Comparing the two equations ax + by + c ≡ x + y - 3 = 0 a = 1, b = 1 and c = -3 (ii) $\lvert PQ\rvert = \sqrt{(1-5)^2 + (1+3)^2}$ $\sqrt{4^2 + 4^2}$ $\sqrt{32}$ $4\sqrt{2}$	A1, A1, A1 for a=1, b=1, c=-3 each M1 for substitution any term correct A1 for all correct M1 for simplifying A1 for M1 for substitution any term correct A1 for all correct M1 for simplifying A1 for 4 √2

APPENDIX E

LETTER OF INTRODUCTION