UNIVERSITY OF EDUCATION, WINNEBA

GENDER DIFFERENCES IN MATHEMATICS ACHIEVEMENT OF SENIOR HIGH SCHOOL STUDENTS IN SELECTED DISTRICTS IN THE CENTRAL REGION OF GHANA

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DECLARATION

STUDENTS' DECLARATION

I, Mavis Wiredu-Minta, 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 Dissertation as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: PROFESSOR DAMIAN KOFI MEREKU

SIGNATURE: ……

DATE: ……

DEDICATION

To God, the Almighty, for strengthening and uplifting me as I toiled. To my late father, Mr Francis Wiredu-Minta and to my family Anthony, Ryke, Darrel, Michelle and Estaban

TO GOD BE THE GLORY

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ABSTRACT

The purpose of this study was to investigate gender differences in mathematics achievement of senior high school students in selected districts in the Central Region of Ghana. The study was conducted in four districts in the Central Region of Ghana. The research questions/hypothesis addressed in the study were: The study sought to determine the overall mathematics achievement of senior high school boys and girls in the selected schools and to examine differences in the mathematics achievement of senior high school boys and girls from single-sex and mixed schools and finally to explore gender differences in single-sex and mixed senior high school students‟ perceived ability in, and attitude to, mathematics. The study included an extensive literature survey in order to identify related studies. The study employed both quantitative and qualitative research methods. A sample of 240 students was taken from four districts in the Central Region of Ghana for the study. The data instruments used in the study were test and questionnaire. Test was given to students to test ability and questionnaire also given after the test to help determine the opinions, attitudes, preferences and perceptions of persons of interest to a study. The data analysis procedure used included two main phases: the use of inferential statistics and the qualitative data analysis. The findings of this study revealed girls from the single-sex female schools and girls in mixed schools achieve better than boys in single-sex male school and boys in mixed schools. It also revealed that girls have reached parity with boys in mathematics. It was also in agreement with the narrow gender gap in achievement in other countries where similar studies were done. It was recommended that school authorities, teaching and learning of mathematics at the SHS level should be strengthened in mixed schools. Also in drawing school achievement plans, must endeavour to add exchange programmes internally to help increase the depth and quality of mathematics learning, since at the moment very little of this is seen at the SHS level in Ghana.

CHAPTER 1

INTRODUCTION

1.1 Background

Mathematics is one of the educational disciplines that have a universal attraction because of its unique nature. It cuts across all subject areas. This has made some countries, including Ghana, to study mathematics as a core subject so that it will form a basis for students to build their future academic pursuit. This is to help the students to develop interest in the use of mathematics and the ability to conduct investigations using mathematical ideas. It is widely recognized that mathematics is the driver and forerunner of a nation‟s socio-economic development. Mathematics plays a vital role of a precursor to the desired technological, scientific, engineering and national development required for the developing nations of the world. It is also a vital tool for the understanding and application of science and technology. Mathematics achievement has for some time now not seen good progress in various levels of examinations in Ghana. It has been established that most candidates‟ performance goes up and down in mathematics in examinations conducted by West African Examination Council (WAEC) (chief examiners‟ report, 2013, 2016, 2017 and 2018).

Currently, mathematics is studied as core and elective subjects in Ghana. It is a compulsory subject to be studied by pupils at the basic level (Primary and Junior High Schools). The rationale behind this policy is to help the pupils to 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 emphasise in the school system (CRDD, 2007). The subject is also

studied as a core subject in all Senior High Schools and it is intended to build on the knowledge and competencies developed at the Junior High School level.

Mathematics has become one of the requirements needed to enter any tertiary institution in the country. Without a credit in mathematics, the student cannot pursue most science and technology courses at institutions of higher learning in Ghana. It has therefore made mathematics one of the basic needs in one‟s educational life. Githua and Mwangi (2003) stated that life without mathematics is an almost impossibility and that it would be difficult to live a normal life in very many parts of the world without it. For this matter, it is only the teaching and learning of mathematics that can prepare the child adequately to fit into the society. A good foundation in mathematics helps in the success of the child‟s life. The Ghana mathematics syllabus for the primary and Junior High Schools issued by the Ministry of Education (MOE, 2010), outlines the rationale for teaching and learning of mathematics in schools. This has made the teaching of mathematics a core in the primary, Junior High and Senior High Schools; that is, the first and second cycle schools.

As mathematics involves multiple mental tasks, we would expect that gender differences in mathematics would be some kind of weighted average of the gender differences in the various mental tasks involved, and would vary somewhat from test to test depending on the composition. 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, 2007).

According to Amatobi and Amatobi (2013), mathematical methods are applied in most areas of human endeavour and as such mathematics learning plays a fundamental role in the economic development of a country.

However, gender inequality in education has remained a perennial problem of global scope (UNESCO, 2003). The full realization of the objective of mathematics education demands subject mastery and demonstrated achievement which should be evenly distributed across gender. Even though poor performance has been noticed in mathematics generally, there exists a controversy on gender and academic performance in the subject. Also Zembar and Blume (2011), think girls continue to exhibit higher verbal ability throughout high school, but they begin to lose grounds to boys after fourth grade on tests of both mathematical and scientific ability.

Sex differences in mathematics performance and ability remain a concern as scientists seek to address the underrepresentation of women at the highest levels of mathematics, the physical sciences, and engineering (Guisco, et al., 2008). In the United Kingdom for instance, 38% of students studying mathematics in higher education in 2008/9 were females (Higher Education Statistics Agency, 2011), but only 18% of UK-based mathematics academics and 3% of full professors were females (Hobbs & Kooman 2006). This study seeks to examine the gender difference in mathematics achievement of males in single sex male schools, females in single sex female schools and males and females in mixed schools in the Central Region of Ghana.

Over the past three decades, a considerable number of studies seeking to determine a relationship between gender and mathematics learning have been conducted in various countries. Oppong (2012), however, found that students with low mathematics abilities are likely to have a more negative attitude towards the subject. They do not have the inclination to improve their skills in mathematics. He observed that although the majority of studies indicate that poor attitudes towards mathematics

are related to lower levels of achievement in the subject, it has not always been found to be so. He also stated that girls' negative attitudes towards mathematics and limited academic confidence may influence their later career choices and steer them away from mathematic related fields.

Asante (2010) attributed poor achievement in mathematics to parental attitude, interrupted teaching, poor teaching and dyscalculia. Karue and Amukowa (2013) pointed out that lack of meaningful library and laboratory, qualified teachers, home environmental factors and family backgrounds as well as participation of parents in the education of their children as the main causes of any achievement in mathematics.

One of the priorities of the international community is to ensure gender equity in the provision of quality education to all persons irrespective of socio-cultural and economic background. With the current world trend and research emphasis on gender issues following the United Nations millennium declaration of September 2000, which has as its goal, the promotion of 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, it is believed that bridging gender gap in mathematics achievement is one major way of achieving equal opportunity and enhancing human development.

The issue of the disparity between female and male performance has been of prime concern to most researchers in mathematics education. While some researchers argue that males perform better than their female counterparts, others insist that females can actually prove their mettle and achieve at par with the males. Over the past decades, a considerable number of studies seeking to determine a relationship between gender and mathematics learning have been conducted in various countries. The controversy

is deepened when researchers discovered differences in gender and mathematics performance in single sex and co-educational institutions. The issue is "Does gender gap exists in mathematics achievement in Ghana?" "Do girls in single sex Senior High Schools achieve better in mathematics than those in mixed Senior High Schools?"

Whenever a female is asked of the subject being pursued at any level, when the subject mathematics is mentioned, a certain surprise look is drawn on the face of the individual. When a female in any senior high school is offering elective mathematics, most people tend to see the student to be "intelligent". So there is need to examine whether really there exists gender differences in mathematics achievement of senior high schools students in the various categories.

1.2 Statement of the Problem

Large-scale comparative international and national surveys continue to show poor performance of students in mathematics. In Ghana, recent students‟ performance in mathematics at the Senior High School has not been encouraging. Candidates are reported to exhibit poor understanding of mathematical concepts and are unable to form the appropriate mathematical models which could be tackled with the requisite skills (Chief Examiner‟s Report, 2016, 2017 and 2018). Ghana‟s scores in mathematics test conducted at the junior high level, were also among the lowest behind Algeria, Botswana, Egypt, and Tunisia as well as, falling short of the scores of countries at similar income levels in other regions, as well as the upper and middle income countries that participated (Mitchell, 2009).

Gender differences in mathematical achievement has been a great contentious issue in educational domain and research documents show great discrepancies among girls and boys performance in school mathematics (Sprigler & Alsup, 2003). Long research history in this area has shown that male advantage in mathematics achievement is a universal phenomenon (Janson, 1996, Mullis et al., 2000). While early research (Fennema & Sherman, 1977) indicated that males outperformed females in mathematics achievement at the Junior High and Senior High School levels, there were also significant differences in attitudes toward mathematics between the two groups. Gallagher and Kauffman (2006) recognized that the mathematics achievement 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 achievement have implications for girls‟ future careers and have been a source of concern for educators everywhere. The Senior Secondary School, currently known as Senior High School, of the educational system in Ghana is a crucial one because it is at this level that some specialisation begins. Also, it is from this level that specialised training colleges and tertiary institutions admit their students.

When one enters an elective mathematics class in a mixed sex school, there is one thing that is usually obvious, that the class is dominated by boys. But there is no evidence that the subject is gender sensitive. There is another school of thought about careers that require mathematics as a basic requirement and what we see is that, such departments will be dominated by men. In the mathematics department of the University of Education, Winneba, there are only two women lecturers. 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. Related to this are a number of behaviours girls exhibit in comparison to boys, two of which are that they drop their expectations more after failure, and are quicker to change their main courses when their grades slip (Wigfield, 2002).

1.3 Purpose and Objectives of the Study

The purpose of the study is to investigate gender differences in mathematics achievement of senior high school students in four selected districts in the Central Region. Also to examine gender differences in single-sex and mixed senior high school students‟ perceived ability in, and attitude to, mathematics.

The study sought to achieve the following objectives:

- determine the overall mathematics achievement of senior high school boys and girls in the selected schools in the Central region.
- examine differences in the mathematics achievement of senior high school boys and girls from single-sex and mixed schools.
- explore gender differences in single-sex and mixed senior high school students‟ perceived ability in, and attitude to, mathematics.

1.4 Research Questions

It is a methodological requirement for any research to formulate questions to guide the study. Sarandakos (1995) argues that the researcher‟s personal expertise and interest as well as the need of the community should be incorporated in the questionnaire.

The following research questions therefore were posed to guide the study:

1. What is the overall mathematics achievement of senior high school boys and girls in the selected schools?
2. What are the differences in the mathematics achievement of senior high school boys and girls from single-sex and mixed schools?
3. Are there any differences in single-sex and mixed senior high school students‟ perceived ability in, and attitude to, mathematics?

1.5 Significance of the Study

The study is to contribute to the discussion on issues concerning gender. Since it is alleged that some students and parents have a wrong perception when it comes to the learning of mathematics, the study will help students as well as parents to develop the idea that mathematics is in everything that we do in life such as in the kitchen; various degrees of measurement takes place unaware, even the menstrual cycle for which all females go through involves some calculations. For some of these reasons, it could be seen that mathematics ought to be female dominated rather than male as females use mathematics a lot than males who have taken over the study of the subject. The research was also undertaken for the purpose of seeking additional information to augment the already data on factors that influence students‟ achievement in mathematics. It is hoped that this study, even though limited in scope, will add to the body of knowledge on gender differences in mathematical achievement of senior high school students in the Central Region in particular and in Ghana generally. The study was also expected to contribute to the discussion on issues concerning gender, specifically female and mathematics.

It will also provide information needed by policy makers, particularly those of the Ghana Education Service and Ministry of Education and other groups interested in the education of students.

Finally, future researchers into gender issues in mathematics would consider this research as an essential data base for referencing.

1.6 Delimitations of the Study

It would have been better to cover all Senior High Schools in the Central Region to have a larger sample size for the study so that meaningful generalization could be drawn to cover the entire Region. This was not possible since a large data cases increase reliability of the information that would be gathered. Therefore, However, in view of constraints such as time, finance, materials and the number of single-sex schools available, the researcher chose schools that have proximity advantages and convenience in one district and municipal in the region, down-sizing the population and the sample of the study. The researcher is hopeful, however, that the study of the gender differences in mathematics achievement of senior high school students in Central Region will bring to light problems and solutions to help improve mathematics achievement of students in the country as a whole.

1.7 Limitation

The limitations on which the present study was based were as follows:

- The number of single-sex schools in the region made choosing of the school for the research a bit difficult in the research exercise.

- Trying to convince the various heads of department of the selected schools to start the test at the same time was very challenging. As well as getting the students ready to sit for the test.

- Lastly, from the research, it was found that there was no male private single sex school in the region but fortunately, the only one known which was absorbed by the government had their second and third year students being private.

1.8 Organization of the Study

The study is presented in five chapters. Following this chapter, Chapter Two contains review of related literature. Chapter Three describes the research methodology applied in the study, explaining the research design, the population, the sample and sampling procedure, the instruments used in data collection and their validity and reliability. Chapter Four presents the methods used in analyzing the data and the findings of the study. Chapter Five presents the discussion, summary of the findings, conclusions, recommendations, and suggestions for further studies.

CHAPTER 2

LITERATURE REVIEW

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 achievement on mathematics had been carried out at various levels of education both local and foreign. For this study, gender was considered as male and female.

There are so many scholars who have researched into gender and found out interesting things that benefits the society that we live in. Santos, Ursini, et al, (2006), gave a distinction on sex and gender and went on further to explain that sex is for boys and girls and gender as masculine, feminine, male and female. This shows that gender has different interpretations.

The OfSTED (2003) report found that boys progress more than girls in mathematics throughout schools. Research indicated that in mathematics the gap between boys and girls attaining level 4 and above at the end of Key Stage 2 was only one percentage point, with boys at 73% and girls at 72%; however, 32% of boys achieved level 5 and above whilst only 26% girls did (OfSTED, 2003:13).

Hudson (1966), sends the researcher back in history where interest in or dislike for a subject depends on the child‟s perceptions of the usefulness of the subject, his or her desire for the subject and the relationship between the learner and his or her environment,. A revelation from Cesternell (1980) is that, the need to achieve is mostly perceived as a one unitary construct possessed by some and not by others and

for that matter an early investigation into the achievement levels, achievement training strategies and the way and manner teachers would go a long way to improve effective teaching and learning of the subject mathematics.

Achievement has been defined by many scholars. For instance Pitman (1974) defined achievement as the execution to an act by courage, skill or perseverance. Meaning, it is the success of knowledge, understanding and skills as a result of specific mathematical experiences. He continued to state that achievement is measured by a set of tasks, which an individual can successfully accomplish at a point in time, as a result of a specific course of instruction.

2.1 Theoretical Framework

The deficit theory of Kaiser and Rogers (1995) guided the framework of this study. It states that: *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 these differences as strengths for learning and achieving in mathematics.

Kaiser and Rogers (1995) argued for changes to curriculum and teaching approaches. They 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. Analysing 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 researcher realised that boys and girls, in different environment, have things that encourage them to learn

mathematics. The theory brings out various powers within students and that made the researcher go for the theory.

Bishop and Forgasz (2007) also supported the deficit theory in a different form; 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. They 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 The Mathematics Achievement of Males in Single-Sex Male Senior High Schools.

Aedín, Donal and Sweetman (2012) pointed out that in recent years; single-sex schooling has received increased attention. This, they found, is partly because schools in several countries have been experimenting with single-sex classes within mixed schools in an attempt to raise overall achievement. Although recent trends suggest that general female educational attainment has surpassed male attainment in many industrialised countries (Pekkarinen 2012), empirical evidence indicate that boys continue to outperform girls in mathematics in most countries. There is also a belief that boys and girls learn differently and educational instruction is more effective when it is tailored to these differences.

However, previous studies have documented that single-sex schools do not yield better outcomes than mixed-schools. For example, Bosire, Mondoh and Barmao (2008) discovered that boys in some single-sex schools did not perform better than their counterparts in co-educational schools. Tully and Jacobs (2008) also observed that male students from single-gender schools underperformed in comparison to male students from a co-educational environment. It could be inferred from these findings that boys outperform girls in the presence of girls. Therefore, when boys are separated from girls, their (boys) performance shrinks. Based on this evidence, it could be concluded that the policy of segregation which intends to maximize performance across genders and ensure equity is counterproductive.

2.3 The Mathematics Achievement of Females in Single-Sex Female Senior High Schools

Diermayer (2005) with the increasing number of women in the workforce, gender gaps in math skills and pursuits in math-related fields continue to be a main concern. Extant studies have investigated the influence of single-sex schools for female on their mathematics achievement.

Diermayer (2005) established that many girls do better in single-sex schools where they often attain higher levels of academic performance and career aspirations than girls in coeducational settings. He went on to say for girls, they could increase the amount of hands-on experience and problem solving opportunities. The view of that, Diermayer suggests that the presence of boys in mathematic classes deprive girls the opportunity to learn and practice concepts, and results in poor attainment. To increase opportunities for girls in learning mathematics, girls only should be taught in a class. There is this myth that females do not do so well in mathematics and cannot achieve much when it comes to careers that are mathematics related.

Again, Diermayer (2005) researched and came out with a mixed finding that suggests that many girls do better in single-sex schools, where they often attain higher levels of academic performance and career aspirations than girls in coeducational settings.

Campbell and Evans (1997) found that females in a single-sex class had statistically significant lower mathematics anxiety than did the females in a coeducational class ($t(15) = -3.37$, $p<.005$). Lower anxiety levels appear to have positive impact on self-concept. Females in the single-sex classes are more likely to enroll in advanced math classes in high school, thus keeping the window of opportunity open for potentially

higher paying and more prestigious careers. Studies have shown that, on average, girls do not score as high as boys do on mathematics tests, especially if those tests involve higher level cognitive tasks (Leder, 1990).

Stereotype threat represents the experience of anxiety or concern in a situation where a female student faces the risk of confirming the negative stereotype about females‟ inferior mathematics ability (Steele, 1997).

More specifically, it was found that some of the studies concentrated on students‟ achievement in a single-sex school and for that matter a female school. Eisenkopf et al (2012) found the situation where gender gap in mathematics has recently attracted a great deal of attention in education economics. Their study further revealed that when a female class is taught by a male teacher, the performances of such students are high. It also revealed that single-sex schooling also strengthens female students‟ self-confidence and renders the self-assessment of their mathematics skills more level-headed.

Eisenkopf et al (2012) analysed the impact of female-only classes on mathematical achievement, exploiting random assignment of girls into single-sex and co-educational classes in a Swiss secondary school. They found that single-sex classes improve the performance of female students in mathematics and that this positive effect increases if the single-sex class is taught by a male teacher. However, the paper does not examine the impact of single-sex education on the gender mathematics gap; moreover, it focuses on girls in a single school that caters for students who intend to become teachers, making the results hard to generalize.

Eisenkopf et al. (2012) have shown the existence of a significant gender gap in mathematical achievement at the top of the test distribution. Again, Eisenkopf et al., find no evidence that single sex schools reduce this gap; if anything the gender gap is wider among students attending single-sex schools than among those in co-educational schools. Given the nature of the Irish educational system they believe that their results on single-sex schools are less likely to be affected by self-selection bias than would be the case in other countries. In the final part of this section they examine the strength of our findings to this erogeneity assumption. They find that having a mother with a mathematics-related occupation has a significant positive effect on mathematics scores. This may be a causal effect, reflecting inherited innate ability or a more positive disposition to the subject. On the other hand, the variable may be picking up some measure of social class not captured by income or education.

However, it is interesting that results from a separate analysis not included here indicate that the mother‟s mathematics occupation is insignificant when included as a control in a model of reading scores. This is not what they would expect if the mother‟s mathematics occupation was simply almost for social class.

Another study by ACER (2008) found that girls attending single sex schools produced higher tertiary entrance scores than those in coeducational schools. Besides, Saidin and Brahim (2011) in a study carried out in single-sex schools in Malaysia found out that girls‟ performance in Maths and science improved in a single gender settings. The study reports the experience of 30 secondary students enrolled in single gender schools. It revealed that in gender separate classroom, students have higher motivation and higher confidence levels which offer them better educational opportunities. Consistent with this finding, Malcove (2007) validates that females

frequently expressed having more confidence in the single-gender setting which made them behave more competitively than do girls in coeducational schools.

Eliot (2009) argues that single sex schools automatically expand the leadership opportunities available to both boys and girls, and they increase the odds that each sex will enter non-traditional disciplines. Girls were also found to do better in certain subject areas such as Mathematics and Science when boys are not in the class. A study by Sullivan, Joshi and Leonard (2010) in British schools examining the impact of single-sex schooling found out that single sex schooling is linked to the attainment of gender stereotyped subject areas for both sexes, not just during the school years, but also later in life. Riordan (2008) in a research commissioned by the US department of Education found out that in single-sex high schools, students exhibited high levels of engagement in academic activities and homework completion than students in coeducational schools.

Based on the findings of Hurst and Johansen (2006), the arguments for single-sex schools and classrooms fall into two categories. The first category is pedagogical where advocates argue that teaching methods that take into account the social or biological differences between girls and boys can be more effective. The second category of arguments in favour of separate education for boys and girls centres on the perceived negative impact on learning resulting from social interactions between girls and boys. Some advocates of single-sex education like Hurst and Johansen (2006) are apprehensive that both girls and boys may suppress themselves intellectually to impress the opposite sex.

Even though some proponents of single-sex education view improved achievement of girls in single-sex schools as evidence that coeducation schools are detrimental to

female students, Hurst and Johansen (2006) contend that the actual causes of the enhanced performance are hard to pinpoint. Supporters of single-sex schooling in low-income areas believe that their students should have a right to opportunities that are generally only available to upper and middle class students. Many would agree that single-sex education in private or religious schools has promoted students achievements more than hindered them, but the question is whether students at these schools have succeeded because of the specific structure of single-sex schooling or because of other factors such as the socioeconomic status of the students (Cable & Spradlin, 2008). Some researchers posit that single-sex schools would actually benefit boys the most, specifically; boys from minority groups and poor families who may need more direct guidance (Guarisco, 2010). In public school single-sex environments, student achievement improves, especially for minority students or students in poverty because of improved behaviours and teacher focus on learning-style differences (Guarisco, 2010).

Other scholars oppose single-sex schools on various grounds. According to Smyth (2010), single-sex education for girls-only are unnatural social settings which isolate girls from boys. He further asserts that in well-managed co-educational environments boys and girls learn to respect and value each other's ideas. They learn to listen and communicate with each other. Isolating girls and boys in single-sex schools is considered a barrier to them developing the effective interpersonal skills they will need to function as grown-ups in their society. Some scholars also believe that single-sex schools are drawbacks to male performance.

Sax (2008) reports that “in the coeducational classroom so many of the choices we make are to the advantage of girls, but disadvantage boys” (p. 1), and that schooling

boys and girls separately is the best way to accommodate boys‟ needs without disadvantaging girls. The perspective of Sax (2008) re-echoes the view that single sex schools for girls do not benefit girls but boys.

In pursuant of the argument that single-sex schooling dose not benefit girls, Chouinard, Vezeau and Bouffard (2008) indicated that in a less competitive context, like public schools, where there is probably more inter individual differences, girls did not seem to be hampered by the presence of boys in mathematics classes. The argument that is often brought up in opposition to single-sex schools is that such schools cannot adequately prepare students for the real world (Guarisco, 2010). Feminist researchers also oppose single-sex schools for girls. According to Vail (2002), the National Organization for Women (NOW) and the American Association of University Women (AAUW) worry that separating students by sex is similar to separating them by race. The NOW opposes single-sex education in the belief that "so-called separate but equal" policies rarely treat girls equally, often relying on outdated sex-stereotypes about girls and boys interests and abilities (Guarisco, 2010). Now also fears that "all-boys schools increase sexism and exacerbate feelings of superiority toward women" (Guarisco, 2010, p.8), and that the best way to achieve workplace equality in the future is to enhance, not eliminate, interaction between boys and girls in the classroom.

Societal factors were emphasized as the cause of the gap by another group of researchers. Here, societal explanations focused on how girls were socialized into believing that mathematics is not important, useful, achievable, or part of the identity of a girl, Wilder and Powell (1989). A test was conducted and it was found out that, although teachers tend to rate girls more favourably than test scores would predict,

girls lose nearly as much ground on subjective teacher ratings of mathematics ability as they do on standardized tests, suggesting that the poor relative performance by girls is not simply a manufactured article of standardized testing. They further went on to attempt to test socialization hypotheses in a number of ways.

In conclusion, the review of literature has shown that there is disagreement among researchers on whether girls in single-sex schools do better than their colleagues in mixed schools. Whiles other are certain that single-sex schooling benefit girls, others observe that it perpetuates male dominance in mathematics. Other scholars also noticed that single-sex schooling divorces girls from boys and hinders their interaction in the natural social setting. In Ghana, single-sex schools for girls exist, so the issue is "Do girls in single-sex senior high schools perform better than those in mixed schools?"

2.4 The Mathematics Achievement of Males and Females in Mixed Senior High Schools

In general, background education and teaching process are the two main influential factors for the boys‟ mathematics achievement. Also, school climate, mathematics self -concept and attitude towards mathematics (negative effects) are the three main influential factors for the girls‟ mathematics achievement.

Alkhateeb (2001) tends to portray how mathematical achievement appears to be related to gender differences, with boys typically performing better than girls from adolescence on. He went on to do a study to examine gender differences in mathematics achievement of Arab students. He goes on to state how it is important to provide a longitudinal look at gender differences in a cultural context and provides

implications as to what influences achievement in females. In his study he explored gender differences in mathematics achievement of students in the last grade of high school and changes in these differences over a 10-year period in United Arab Emirates.

The findings of his study indicated a decline of gender difference in high school final mathematics achievement; more precisely, the gender gap on achievement test scores appears to be closing. Some researchers believe that there are genetic reasons for the differences between males and females in mathematics achievement (Alkhateeb, 2001). However, if gender differences in mathematics achievement are due to biological factors, they should remain relatively constant among different cultures. Findings in Alkhateeb‟s study, he supported the claim of Fennema and Sherman (1977) that the difference in mathematics achievement is due to societal influence and not genetic (Benbow & Stanley, 1980; Halpern, 1997; Scarr, 1993).

From Alkhateeb (2001), for a better understanding of gender differences, it is recommended that further studies be conducted to carefully investigate the individual contribution of each of these conjectures or combinations of these on gender differences, using standardized achievement tests to explain the way these factors affect the mathematics achievement level. Also, it would be interesting to investigate the effect of the socioeconomic status on sex differences in mathematics achievement in the United Arab Emirates. According to Kyriakides and Panayiotis (2009), gender interaction has also been investigated in relation to the content of the items. For instance, researchers classified the items into those measuring arithmetic knowledge and those measuring geometric knowledge Engelhard, (1994). Cognitive complexity and empirical difficulty were also taken into account. The results seem to reveal that

boys do better on multiple-choice items, items with Algebraic content, and items classified at a higher cognitive level of complexity according to Bloom‟s taxonomy. On the other hand, girls seem to outperform boys on free-response items and on abstract or textbook-like items. (Engelhard,1994)

However, these results emerged from studies conducted mainly in the United States of America and the United Kindom. It was found that the phenomenon was country specific. This finding is also supported by the results of secondary analyses of comparative studies in mathematics such as the Trends in International Mathematics and Science Study, TIMSS. Finally, it has been shown that for each social class, there was a correlation between the item difficulty differences estimated on girls and boys separately and the difficulty of the item estimated on the whole sample. However, the correlation was much weaker for girls from professional families

Goldin, Katz, and Kuziemko (2006) noted that in 2003 there were 1.35 females graduating from four-year colleges for every male. In stark contrast, in 1960 there were 1.6 males graduating from 4-year colleges for each female. In 1970, women made up only 9% of combined Medicine, Dentistry, and Law degree recipients. This shows how the study of mathematics is making a lot of women to be counted less in some careers. Thirty years later, the situation saw a slight difference as women accounted for 47% of full time and 44% of part-time students pursuing such degrees, Freeman (2004). Women made up 45% of all doctorate degrees, Freeman (2004).

Mohammadpour and Shekarchizadeh (2013) did a study aimed at identifying the amount of variance in mathematics achievement of students from high- and low-achieving schools that can be explained by school-level factors, while controlling for student-level factors. The students and the schools, in which they are enrolled, are

generally conceptualized as a hierarchical or multilevel structured system (Hoxby, 2009). In Hoxby‟s findings it was indicated that there is a clear-cut sex differences in attitudes towards mathematics between boys and girls in high schools in Ghana. It has given way for people in our society to clear certain doubts about who to study what.

Lamb (1997) on the other hand made an observation in Australia and came out that there was a gap between the number of boys who study mathematics and the number of girls who study mathematics. The boys outnumber the girls, so if the same number can come into this field of study, then the number of girls in the engineering, science and technology fields would go up and help in many form in the society.

Hall (2013) found out that there is an obvious gender imbalance in the mathematical sciences, which begins at high school and is most pronounced at universities in the Professor and Associate Professor ranks. This gender imbalance shows that many talented women do not achieve their potential in the mathematical sciences, Hall (2013). This creates the surprises people get when they realise a female is trying to go higher on the mathematical education ladder.

Nyala, (2005) states that boys and girls probably had different encouragement levels to study the mathematics. Females who do elective mathematics receive more attention from their parents and for this matter parents play a very important role in choosing the subjects their wards should do at the senior high school. For that matter, parents should attend career guidance seminar to help their wards choose the best subject that can reflect in their future career and for this case, elective mathematics.

Fryer and Levitt (2009) showed that there is a bulk of the evidence in the past 50 years which suggests that the gender gap in mathematics does not exist before

children enter school, but is large and significant in the middle school years and beyond. (Fryer and Levitt, 2009). Fryer and Levitt (2009) again saw that parental expectations regarding mathematics are lower for girls than boys even after accounting for test scores, but controlling for these expectations does nothing to reduce the gender gap. They also find that girls with mothers working in mathematics-related occupations lose just as much ground as those whose mothers are not in mathematics -related occupations, making it unlikely that low domestic expectations for girls in mathematics lie at the root of the issue. Parents report spending equal amounts of time with boys and girls doing mathematics - related activities. As a result, including these variables has no effect on the gender gap. They investigate the relationship between the gender mathematics gap and societal level female socialization as measured by the World Economic Forum"s (WEF) gender gap index which reflects economic and political opportunities, education and well-being for women.

Hoxby (2009) Lavy and Schlosser (2011) report that the achievement of both boys and girls is increasing in the fraction of females than boys in their peer group. Schools who have more female peers report a lower level of classroom violence and better relationships with other students and teachers than those with male peers. In addition, their findings suggests that teacher fatigue and burnout are inversely related to the proportion of girls in a class, in which case, single-sex schooling will increase the performance of girls, but at the cost of poorer achievement by boys.

Fryer and Levitt (2009) went on to compare gender equity from country to country and surprisingly, although Middle Eastern countries have a high degree of gender inequality, there is no gender gap in mathematics on average in these places. Girls

appear to fall further behind in private schools than in public schools, more when the mother is highly educated and more when the mother is out of the labour force over the years the child goes from kindergarten to fifth grade. It does not appear to matter whether the mother is in a mathematics -related occupation (engineer, architect, scientist, etc.) or whether the mother is more highly educated than the father. Interestingly Fryer and Levitt, further saw that parents have lower mathematics expectations for their daughters, which could adversely affect female mathematics course. Different test were used to test for validity and saw that although they are not successful at isolating the root causes of the gap in the ECLS-K data, they are able to test a number of potentially important prior explanations, finding scant support for any of these. For instance, their evidence suggests that the gender mathematics gap is especially large among children who attend private schools, have highly-educated mothers and have mothers working in mathematics-related occupations - all factors that one might think under some theories would be conducive to girls‟ success in mathematics.

Some factors that influence students‟ attitude towards mathematics can be categorised into three distinctive groups. Firstly, factors associated with the students themselves. Some of these factors include students‟ mathematical achievement score (Köğce et al, 2009), anxiety towards mathematics, students‟ self-efficacy and self-concept, extrinsic motivation, Tahar et al (2010) and experiences at high school (Klein, 2004; Bobis & Cusworth, 1994).

Secondly, the factors that is associated with the school, teacher and teaching. Some of these factors that influence attitudes are teaching materials used by teacher, teachers‟ classroom management, teachers‟ content knowledge and personality, teaching topics

with real life enriched examples, other students‟ opinions about mathematics courses (Yilmaz, Altun & Olkun, 2010), teaching methods, reinforcement (Papanastasiou, 2000), receiving private tuition (Köğce et al, 2009), teachers‟ beliefs towards mathematics (Cater & Norwood, 1997) and teachers‟ attitude toward mathematics (Ford, 1994, Karp, 1991).

Thirdly, factors from the home environment and society also affect students‟ attitude towards mathematics. Factors such as educational background of parents, occupation of parents (Köğce et al, 2009) and parental expectations (Tobias, 1993) play a crucial role in influencing students‟ attitude towards mathematics.

Coleman et al., (1966) revealed that school has little effect on students‟ academic achievement; however, the methodology used had not adequately accounted for the hierarchical nature of the data. Following the Coleman Report, many studies have been carried out to address three key questions:

1. Do schools make a difference in students‟ academic achievement?;
2. If so, to what extent do schools contribute to the differences?; and
3. What are the sources of the differences?

Academic achievement differs from one student to another due to individual and family background differences. Consequently, the achievement average varies across schools due to the student body‟s socioeconomic status (SES), expectations for students‟ success and school climate. The results revealed that between-school differences accounted for about 28% of the total variance in mathematics achievement of students from the high-achieving schools, while only about 7% of the total variance

in achievement of students from the low-achieving schools accounted for between-school differences.

Gender differences in mathematics achievement have important implications for the underrepresentation of women in science. Typically, gender differences in mathematics achievement are thought to emerge at the end of middle school and beginning of high school, yet some studies find differences among younger children. The consensus in the existing literature is that gender differences in mathematics achievement typically arise at a fairly late stage in students‟ careers. Penner and Paret (2008)

Muller (1998) and Leahey and Guo (2001) find that there are no differences among middle school students, and that differences emerge as students‟ progress through high school. Gender differences in mathematics are generally assumed to result from differences in curricular choice, so that the male advantage in mathematics is largely a function of their greater preparation (e.g., Pallas and Alexander, 1983). Together, the idea that gender differences in mathematics achievement originate later in students‟ educational careers, and the notion that they are created by differences in curricular choice serve as the foundation to many of the policies addressing the underrepresentation of women in mathematics and the sciences.

Recent findings, however, provide evidence that gender differences might emerge at an earlier age. For example, studies of gender differences in spatial abilities show a male advantage on mental rotation tasks at the age of 4 years 6 months (Levine et al., 1999).

Even if early gender differences are small relative to those found in later stages of students‟ educational careers, the mere presence of such differences is important because early achievement gaps lead to larger disparities later in the education system. Early academic achievement is associated with cognitive skills and social-psychological factors, both of which are likely to have lasting effects on educational success. These findings suggest that if early gender differences in mathematics achievement do exist, they need to be considered seriously. If gender differences occur before curricular choices are made, then other explanations are needed.

2.5 Students' Attitude and Mathematics

Wasiche (2006) defines attitude as a feeling towards something or somebody which is sometimes reflected in a person‟s behaviour. Attitudes formed by an individual mostly depends on his/her experience in the learning environment. Attitudes are further enhanced by interpersonal interaction. Attitude is a central part of human identity. Everyday people love, hate, like, dislike, favour, oppose, agree, disagree, argue, persuade etc. All these are evaluative responses to an object. Hence attitudes can be defined as "a summary evaluation of an object of thought" (Bohner & Wänke, 2002).

Njue (2005) explain that attitude is either positive or negative depending on whether a person likes or dislikes something or someone. The question which comes to mind was what would be the likely sort of such attitudes among students in secondary schools and what could be the reinforcing factors? Sources of negative or positive attitudes may not be pin-pointed. Their source may overlap depending on an individual‟s learning environment.

However there are many studies that suggest that there is no significant difference between attitude towards mathematics among male and female students (Mohd et al, 2011; Köğce et al., 2009; Nicolaidou & Philippou, 2003). There are some other studies which suggest that the attitude of students of their study towards mathematics was more positive in the third year than the first year (Grootenber & Lowrie, 2002) and there is a difference between attitude in the grades 6, 7 and 8 (Köğce et al, 2009). Hence it can be said that students‟ attitude towards mathematics are very subjective and varies among the students.name of some of those studies Several studies had been conducted to find out the relationship between attitude towards mathematics and academic achievement of the students. Most of these studies showed that there is a positive correlation between students attitude towards mathematics and academic achievement of students (Mohd et al, 2011; Bramlett & Herron, 2009; Papanastasiou, 2000; Ma & Kishor, 1997) and also achievement in problem solving (Nicolaidou & Philippou, 2003), The studies have also shown that students attitude towards problem solving in terms of patience, confidence and willingness has a positive relation with students‟ mathematics achievement (Mohd et al, 2011).

Some previous studies also supported the present study‟s results of Sinnes (2005), it is agree that females in principle will produce exactly the same scientific knowledge as males provided that sufficient rigour is undertaken in scientific inquiry. Abiam and Odok (2006) found no significant relationship between gender and achievement in number and numeration, algebraic and statistics. On the contrary, Opolot-Okurut (2005) found that for all the attitudinal variables (anxiety, confidence and motivation), males had higher mean scores than females. That is, the differences in student attitude towards mathematics based on gender were confirmed. A lot need to be done to fill

this gender gap in mathematics achievement. Male and female students should make the competitive environment, coordinate and exchange their knowledge from one another in mathematics teaching and learning. Female students should be informed the importance of mathematics and it is the basic tool for further education.

Mathematics teaching and evaluation strategies should be bias-free. This way, males and females will tend to see themselves as equals, capable of competing and collaborating in classroom activities.

2.6 Summary

Review of related literature has revealed that a gender difference in mathematics achievement is a contentious issue. Conflicting results exist on the effects of the type of school (single-sex, mixed) on the mathematics achievement in different contexts. Proponents of single-sex schools argue that these schools allow girls to flourish in a way that coeducational schools may not. Some studies indicate that girls in schools with single-sex programs achieve higher learning, display more self-confidence and leadership skills, and enter male-dominated fields at a higher rate (Ferrara, 2005: Smyth, 2010). Studies have also shown that girls in single-sex classes are actually more likely to act outside of traditional gender roles. Boys might also feel freer to engage in pursuits they may not have considered at a coeducational school. When girls are around, they are the ones expected to take part in such „non-macho pursuits".

The positive effects of single-sex schools remain substantial, even after taking into account various school-level variables such as teacher quality, the student-teacher ratio, the proportion of students receiving lunch support, and whether the schools are public or private(Park, Behrman & Choi, 2012).

Such findings have important implications for single-sex schooling, since single-sex environments can actually reduce the tendency of students to behave according to gender-typical stereotypes or norms (Sullivan et al., 2010). It is on this basis – the reduction of the detrimental effects of stereotypes – that single-sex education is often advocated (Thom, 2006). Smithers and Robinson (2006) add to the contention. They conducted a review of studies that examined educating girls and boys together and separately, either in different schools or in different classes. They looked at studies from Australia, the United States, Canada, New Zealand, Ireland, and the United Kingdom and concluded that there were no consistent findings and that single-sex education is either advantageous or disadvantageous.

Smithers and Robinson (2006) also noted that the influences of gender are far outweighed by ability, social background and race. Overall, they concluded that there are excellent coeducational schools and excellent single-sex schools, and they are excellent for reasons other than that they separate, or bring together, the sexes for their education. Findings revealed there are robust differences in how girls from single-sex schools behaved, in comparison with those from coeducational schools. Not only did they behave more competitively than their female counterparts did, but their competitive behaviour was also found to be very similar to boys".

Yusuf and Adigun (2010) observed that some parents believe that their children cannot perform very well academically in co-educational schools (mixed). To this end, many of them would prefer to register their children in single sexed schools for Senior School Certificate Examination to enhance better academic performance. This corroborates the UNESCO (2007) report especially for students in mathematics and science.

On the contrary, Bosire, Mondoh and Barmao (2008) argued that the debates on single-sexed schools have hinged their arguments on disciplinary issues rather than academic. Therefore, research on single-gender education and the impact on mathematics achievement is contradictory and inconclusive (Bosire, Mondoh and Barmao, 2008; Tully and Jacobs, 2008).

Consequently, the questions emerged again; "what is the overall mathematics achievement of senior high school boys and girls in the selected schools in the Central Region."

This study tends to investigate gender differences in mathematics achievement of senior high school students in four selected districts in the Central Region.

In conclusion, there are literatures indicating that there are gender differences in mathematics achievement of senior high school students and that it is the same in all the countries under studied.

2.7 Gabs found in literature reviewed

The various literatures reviewed talked about the gender differences in mathematics achievement of senior high school students in four selected districts in the Central Region. Most of them did not compare the difference in gender together. There were situations where some of the researchers tried to differentiate but could not come out so clearly.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discusses the methodology that was used in carrying out the study where, the gender differences in mathematics achievement of senior high school students in the Central Region, have been examined. It discusses the research design that was adopted for the study, the population, the sample and the sampling procedures and the instrument that was used for data collection. The procedures for the data collection and the method of analysis of data for the research was also explained in this chapter.

3.2 Research Design

According to Babbie and Mouton (2001), a research design is a set of guidelines and instructions that are followed in conducting research. In this study, a multiple research method was employed and this has permitted the researcher to make use of both quantitative and qualitative data collection techniques and data analysis procedures.

A survey is defined as a brief interview or discussion with individuals about a specific topic. Surveys represent data collection method that is very useful in descriptive and co-relational studies because it is versatile, efficient and generalize.

This study is a non-experimental survey. According to www.goggle.gh .com retrieved on the 24th of June 2015, non-experimental research is the label given to a study when a researcher cannot control, manipulate or alter the predictor variable or subjects, but instead, relies on interpretation, observation or interactions to come to a conclusion. This is so because the variables studied are already there in the students and the researcher will not in any attempt to manipulate the variables. Non-

experimental research tends to have a high level of external validity, meaning it can be generalized to a larger population.

The type of non-experimental survey used was cross sectional designs - information is collected from one or more groups at the same time. Form one and two students from different schools were used.

The variables were independent and dependent variables. The independent variable is the gender and the dependent variable also is the achievement in mathematics.

Multiple methods are useful if they provide better opportunities for a researcher to answer research questions and where the methods allow a researcher to better evaluate the extent to which the research findings can be trusted and inferences to be made from them. Though, the two approaches have distinct procedures in terms of research directions, any single approach would be excessively one-dimensional for this study. The choice of the approaches had also depended on what the researcher sought to achieve, thus, the stated objectives of this research and the research questions (Tashakkori and Teddlie, 2003).

The quantitative aspect of this work deals with the quantitative techniques that were used in collecting the data and the follow up statistical tools for the analysis. Quantitative research design is all about quantifying relationships between variables. It aims at determining the relationship between one thing (an independent variable) and another (a dependent or outcome variable) in a population (Hopkins, 2000). The researcher used questionnaire to collect data from the students. They were made to write a test as well. A questionnaire constitutes series of written questions a

participant is confronted with to supply answers. This method gathers responses to questions that are essay or Likert scale.

Using a questionnaire allows a researcher to utilize several strengths. For example:

- It allows for minimal contact between researcher and participant.
- Multiple avenues, such as handing them out in person, using snail mail, email, and online survey engines, can be used.
- Participant's answers are readily recorded on the forms.

Moreover, descriptive statistics, regression and correlation; all quantitative tools, have been employed for analysis and testing of hypothesis. The quantitative design was employed to test the research hypothesis because of the advantages outlined by Hopkins (2000).

- Quantitative research design is an excellent way of finalising results and proving or disproving a hypothesis.
- Quantitative techniques are useful for testing the results gained by a series of qualitative experiments, leading to a final answer, and a narrowing down of possible directions for follow up research to be taken.

The non-experimental survey design was used to sample views of 240 students. 120 of which were males 120 were female students from six Senior High Schools in the Central Region.

The primary aim was to explore gender differences in the mathematics achievement of students in the Central Region; an ideal approach was to conduct regional surveys. The researcher used the mathematics achievement scores collected from high schools

in Central Region. The data collected for this research were test and a questionnaire to seek a representative sample of senior high school in the Central Region of Ghana.

3.3 Population, Sample and Sampling Techniques

The population of this study was all students in senior high schools in the Central Region of Ghana during the period of the study. Sampling is the process of selecting a portion of the population to represent the entire population (Alhassan, 2006).

In all, 240 students from private and public senior secondary school, during the 2014/15 academic year, formed the sample for the study. There were 80(33.3%) students from mixed school (MF), 80(33.3%) from single-sex male school (SM) and 80(33.3%) from single-sex female school (SF). The schools were in Cape Coast north municipal, Cape Coast south, Cape Coast municipal, Abura-Asebu-Kwamankese district and Agona West Municipal. Convenience sampling was used to select the municipals and district.

Convenience sampling was used to sample the particular school to be used for the research. Convenience sampling, according to Harris (2002), also called haphazard sampling refers to a sampling process in which the researcher selects a sample mostly because it is reachable and reasonably representative of the population of interest to the researcher.

Further, random sampling was used to select the targeted students for the research in all the schools. There were only two (2) different forms in each school. These were form one (F1) and form two (F2). These classes were chosen due to the timing of the research. The final years were by then preparing to write their final West African Secondary School Examination (WASSCE). Only the junior classes were available.

The random sampling method was then used to select students to do the test. A total number of about 40 students (20 from each of the two classes) were selected from school.

3.4 Data Collection Instrument

Two instruments, test and questionnaire were used for the study.

3.4.1 The Questionnaire

In order to answer the various research questions, it became necessary to choose correct data collection devices. Survey research typically employs the questionnaire and interview methods to determine the opinions, attitudes, preferences and perceptions of persons of interest to a study and since this research is on assessing perceptions, experiences, thought and attitudes of parents, teachers and students in connection with Mathematics, it was appropriate to use questionnaire and interviews. Borg et al. (1993).

Questionnaires were also considered due to the secrecy of its nature which made it a preferred option. From Munn & Drever (1990) they see the general benefits of a questionnaire which were thought to make it appropriate were: consistency of presentation of questions to the respondents, a greater perception of doubt for the respondents and less time-consuming to administer (Lewis & Munn 1987)

The first part contains items that brought out personal information on the background of the students and their views on gender differences in mathematics achievement. The background component of the questionnaire basically brought out information on variables like gender, school type, performance in mathematics and likeness of the

subject, mathematics. This was in line with the research since these variables helped the researcher to make conclusions from views of students.

The second and third part of the questionnaire was to bring out the effort students put in their mathematics work with explanation as well as their views about mathematics. Seven questionnaire items were used. Six provided for respondents to cross given a five (5) Likert scale depending on the question asked (excellent, very good, good, weak, very weak; very much, much, average, dislike, highly dislike among others). One opened-ended question was asked for students to express their personal views regarding their point in the previous question. The purpose of these questionnaire items was to bring out views from students on what they think about gender differences in mathematics achievement. Also to prevent the oversight of any possible points that would enrich the results of the research that might have been limited in the case of the close ended questionnaire.

Item 7 concern students own views about mathematics. Here, a five point performance ranking scale (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree) were given students to cross. This part also consisted of six questions for students to express their views.

In all, a total number of 240 questionnaires were administered to 240 students.

3.4.2 Test

A test was conducted in all the schools. 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.

3.4.3 Piloting of instruments

Fraenkel and Wallen (2000) 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 the correctness of the instrument for collecting data to be determined. 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 a Senior High Technical School in the Agona West municipal. 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 was 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, re-constructed or broken down into simpler forms. For example, question 6 of the questionnaire which should have been “Briefly explain your response in question 5” was rather “Briefly explain your response in question 6”. It was observed that in the Likert scale (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree) strongly disagree was typed strongly, disagree was omitted.

The pilot exercise proved very useful since it helped to restructure and to reduce the number of items on the questionnaire and decrease the test duration by 10 minutes. More importantly, it helped to improve the quality of the questionnaire and the test for the study.

3.4.4 Validity and Reliability

In order to ascertain the content validity of the instrument, my supervisor as well as some lecturers in the Department of Mathematics Education at the University of Education, Winneba were consulted to review the items. They helped to evaluate whether the items were relevant to the research questions and their suggestions helped to establish the items‟ features and content validity.

Joppe (2000) defines reliability as: The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable. A high degree of stability indicates a high degree of reliability, which means the results are repeatable. Joppe (2000) again provides the following explanation of what validity is in quantitative research: Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull‟s eye" of your research object?

Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others. Wainer and Braun (1998) describe the validity in quantitative research as “construct validity”. The construct is the initial concept, notion, question or hypothesis that determines which data is to be gathered and how it is to be gathered. They also assert that quantitative researchers actively cause or affect the interplay between construct and data in order to validate their investigation, usually by the application of a test or other process. In this sense, the involvement of the researchers in the research process would greatly reduce the

validity of a test. In so far as the definitions of reliability and validity in quantitative research reveal two strands: Firstly, with regards to reliability, whether the result is replicable. Secondly, with regards to validity, whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure. For the suitability of the instrument for collecting data to be determined, the instrument was pre-tested which is also known in research manner of speaking as piloting.

According to Wilson and MacLean (1994), piloting is able to help in establishing the reliability, validity and practicability of the questionnaire because it serves among other things: to check the clarity of the questions, give feedback on validity of test items and also to make sure that the data required answered the research questions.

The rationale for the piloting in this research was to examine the reliability and validity of the questionnaire. A caution was given by Awanta and Asiedu-Addo (2008) on how possible it is to design a questionnaire that is reliable because the responses are consistent, but may be invalid because it fails to measure the concept it intend to measure. With the above concern in mind and to establish the content validity of the instrument, the researcher‟s supervisor and other experts who are senior lecturers in the Department of Mathematics Education, University of Education, Winneba, evaluated the questionnaire for content and construct as well as features validity.

This exercise also helped to correct any ambiguities that were detected and other items that were not relevant to the research were deleted.

3.5 Data Collection Procedure

Prior to embarking on the data collection exercise, the researcher made first contact to the school with a letter of consent. The data collection instrument was organized and pilot-tested to obtain reliability. Course calendar as well as the time table were considered to identify the most appropriate date and time of participants for the subjects‟ retrieve. Prospective participants were reached through casual visits to classes at a mathematics department of a secondary school. All students in these mathematics classes volunteered to participate in the study but the researcher used 20 students from the class. The researcher was now handed over to the Heads of Mathematics Departments in the selected schools. The purpose of the study was explained to mathematics students, and their voluntary participation was requested. Printed survey instruments were distributed to the students. All students were to complete and return survey 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. After preparing the research instruments, an introductory letter and a letter of consent were obtained from the researcher‟s department. Copies of these letters were sent to the heads of the sampled schools. The letter of consent were signed and a date given to the researcher to come and administer the instruments. On getting to the school, the researcher was introduced to the class and the test were given to student to answer then followed by the questionnaire. With the exception of one school where the head to the department collected the items and gave a date for collection, the

researcher administered the items herself. The researcher got involved in the data collection procedure in order to ensure a maximum response rate.

As the researcher announced to conduct a test before answering the questionnaire, some of the students got scared and opted out. Upon explanation from both the researcher and the teacher involved, some came back to fill up the number of participant to twenty and then write the test whilst others still stood back. In the process of collecting the answer sheets and questionnaires, some students reluctantly decided not to submit claiming they were not given but it was later realised that they wanted to keep them but the researcher did a follow up to get everything.

3.6 Data Analysis Procedures

The data analysis procedure included two main phases: the use of inferential statistics and the qualitative data analysis. Regarding the inferential statistics, version 16.0 of the Statistical Package for Social Sciences (SPSS) computer software programme was used for data storage, calculation of central tendencies, frequencies and percentages. Also the regression and correlation analysis models were employed for the data analysis. The test statistic of SPSS for significant testing comes with its degree of freedom (df), correlation coefficient or F-value and probability (P-value) of the test result. A P-value=0.05 was used for this study, meaning 5% significance level or 95% confidence interval.

Collected data were reviewed for any missing data entry or errors. There were missing data or error. Then the collected data were imported to the statistical analysis package (SPSS 16) for later analysis. Descriptive analysis, ANOVA and Post Hoc Multiple

Comparison LSD test were used to answer the research questions. All statistical analyses were conducted with a significant level of 0.05.

For computations into the SPSS, the coded questionnaires were fed into the computer. In scoring the Likert-type scale items the positive statements were scored in descending order thus:

Table 3.1: Coding of Likert scale of views about mathematics

SA	A	U	D	SD
5	4	3	2	1

Table 3.2: Coding of Likert scale of how much effort usually put in mathematics work

Not at all	Just enough	Average effort	Try very hard	Practice frequently
1	2	3	4	5

Table 3.3: Coding of Likert scale of how they like mathematics

VM	M	A	D	HD
5	4	3	2	1

The performance scale was scored in descending order thus:

Table 3.4: Coding of performance scale

E	VG	G	W	VW
5	4	3	2	1

The abbreviations used for the Likert-type scale are as follows:

SA	Strongly Agreed
A	Agreed
N	Neutral
D	Disagreed
SD	Strongly Disagree

E	Excellent	VG	Very Good
G	Good	W	Weak
VW	Very Weak	VM	Very Much
M	Much	A	Average
D	Dislike	HD	Highly Dislike

The outcome of participants views were found by summing the scores for the items and dividing them by the number of items on the Likert-type scale. This formed the mean scores for each respondent. The Mean is one of the simplest models used in statistics. Some people have problem thinking of the mean as a model, but in fact it is because it represents a summary of data.

According to Field (2005), the mean is a hypothetical value that can be calculated for any data set, it does not have to be a value that is actually observed in the data set. As such, the mean is a model created to summarise a data. We can determine whether the mean is an accurate model by looking how observed values have deviated from the expected values. The standard deviation, according to Field (2005), measures how well the mean represents the data. Small standard deviations relative to the value of the mean indicates that the data points are close to the mean. A large standard deviation indicates that the mean is not an accurate representation of the data.

The declarative statements were coded with male (1) and female (2) and the open-ended questionnaire was scanned through carefully and constructs were formed for the commonly provided responses. These constructs were tallied and also coded. Frequencies for the items were computed and converted into percentages. The results were organised in tabular forms. The analyses were used to answer the research questions.

The data entries were done by the researcher in order to check the accuracy of the data. Data was accurate by numbering each datum for corrections before running any analysis. Cleaning the data helped the researcher to get rid of errors that could result from coding, recording, missing information, influential cases or outliers. The data was analyzed and presented largely using descriptive statistics (i.e. frequency

distribution, percentages, charts, mean, median, and mode) and inferential statistics (i.e. one-way between subjects ANOVA). The one-way between subjects ANOVA was used because participants in each group are independent from one another. The one-way between subjects ANOVA was used to answer research questions (2) which determines the differences in the mathematics achievement of senior secondary school male and female from single-sex and mixed schools, whether or not there is a statistically significant difference in the means of the sexes. The ANOVA was used in analyzing the test and the questionnaire because it met all the assumptions ANOVA. See Table 3.5 showing the homogeneity of variance for the test.

In statistics, Levene‟s test is an inferential statistic used to assess the equality of variances for a variable calculated for two or more groups. Some common statistical procedures assume that variances of the populations from which different samples are drawn are equal. A post-hoc analysis was also used to compare means of each of the treatments used. ANOVA is an omnibus and cannot determine exactly which group differs from the other therefore post-hoc analysis was used.

Table 3.5: Levene Statistic- Homogeneity of Variances of post test

	Levene Statistic	**df1**	**df2**	**Sig.**
Achievement	2.463	3	236	0.16
Perceived ability	2.71	2	105	0.47
Attitude	1.14	2	121	0.32

The Levene‟s test is designed to test the null hypothesis that the variances of the groups are the same. The mean achievement of students by gender and school type of public and private schools were used for the test. The mean differences (df1 and df2) were calculated and the significant value (sig) was also brought out from the input. That is variances of the scores of public school students are the same as the Mathematics Achievement of private school students. Since the significance value of the Levene‟s test is 0.063 and is greater than 0.05, it can therefore be said that assumption of equal variance between the two groups is met.

3.7 Ethical Principles

The researcher consulted all Heads of each 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 coming 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 of the findings that have emerged from the data collected by means of questionnaires and test. The purpose of the study is to investigate gender differences in mathematics achievement of senior high school students in four selected districts in the Central Region. In order to meet this purpose and also answer the research questions, data were gathered from students. The data obtained were organized and presented using descriptive statistics and inferential statistics including T-test, One-way-Anova and Post hoc analysis. The results of the study are discussed under themes based on the research questions in the sections that follow:

- demographic characteristics of respondents.
- overall mathematics achievement of senior high school boys and girls in the selected schools.
- differences in the mathematics achievement of senior high school boys and girls from single-sex and mixed schools.
- differences in single-sex and mixed senior high school students‟ perceived ability in, and attitude to, mathematics.

4.1 Demographic Characteristics of Respondents

The presentation starts with the demographic data of the respondents from the various categories of schools. Table 4.1 shows the gender distribution of students involved in the study.

Table 4.1: Gender distribution of students involved in the study

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Boys	120	50	50	50
Girls	120	50	50	100
Total	240	100	100	

Table 4.1 shows the total number of respondents for the whole research. It can be seen that there was an equal number of respondents with respect to gender. The respondents for this study were 240 and they were made up of 120 boys and 120 girls constituting 50% for each.

Table 4.2: Distribution students by type of school

Students by school-type	Number of students	Percent	Valid Percent	Cumulative Percent
Boys‟ in Single-sex School	81	33.8	33.8	33.8
Girls‟ in Single-sex School	39	16.3	16.3	50.0
Boys in mixed school	80	33.3	33.3	83.3
Girls in mixed school	40	16.7	16.7	100.0
Total	240	100.0	100.0	

Table 4.2 shows the number of respondents for the whole research per the type of school. By type of school, which are single-sex boys‟ school, single-sex girls‟ school and mixed schools. Out of the 240 students, 33.8% (n=81) were boys from single-sex boys‟ school, 16.3% (n=39) were also boys from mixed school, 33.3% (n=80) were girls from single-sex girls‟ school, and finally, 16.7% (n=40) were girls from mixed school.

4.2 Overall mathematics achievement of senior high school boys and girls in the selected schools

Research question 1 sought to find out the overall mathematics achievement of senior high school boys and girls in the selected schools. The students were given a thirty minutes test, as stated in Chapter 3, on questions based on what they were taught in first and second year (see Appendix B). Tables 4.3 shows the descriptive statistics of the results of the test.

Table 4.3: Descriptive statistics of the results of the test

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Mathematics Achievement	Boys	120	14.7833	4.67639	.42689
	Girls	120	20.5500	5.12015	.46740

Table 4.3 indicates the averages of mathematics achievement scores obtained by boys and girls irrespective of type of school. From the Table 4.3, girls had a mean score that was greater than that of the boys. The interpretation is that girls achieve better

than boys. Considering the standard deviations, it could be seen that the mathematics achievement of girls (SD=4.67) were more widely dispersed than that of the boys (SD=5.12) meaning that a greater number of the boys‟ scores were closer to the mean. One of the inferences that could be drawn from these findings is that girls achieve better in mathematics than boys irrespective of the school. The researcher made this inference because all of the students who participated in this study did the test.

4.3 Differences in the mathematics achievement of senior high school boys and girls from single-sex and mixed schools

The results from the Table 4.3 shows that girls achieved better than boys in mathematics achievement as the society see otherwise. This was disturbing to the researcher. For the sake of clarity, the researcher then examined the results for the boys and girls by the types of school attended (i.e. single-sex boys, single-sex girls, mixed school girls and mixed school boys) to examine whether or not school-type influenced the students‟ performance. The mean and standard deviations of mathematical achievement scores obtained by the students in the different school types were obtained as presented in Table 4.4.

Table 4.4: Mean mathematical achievement scores obtained by students by school type

School type(sex)	N	Mean	Std. Deviation
Boys in single-sex school	81	15.8	4.92
Boys in mixed school	39	12.8	3.35
Girls in single-sex school	80	21.8	4.80
Girls in mixed school	40	18.1	4.86
Total boys	120	14.78	4.67
Total girls	120	20.55	5.12
Total all	**240**	**17.7**	**5.68**

Table 4.4 indicates that the mean achievement scores of students from single-sex boys‟ school was 15.8 with standard deviation of 4.92 and the mean achievement scores of students from single-sex girls‟ school was 21.8 with standard deviation of 4.80. Similarly, the mean achievement scores of from mixed-school boys was 12.7 with standard deviation of 3.36 and that of mixed schools girls was 18.1 with standard deviation of 4.87. It can be seen from the table that single-sex girls‟ school students did achieve a higher mean than single-sex boys‟ school students, and they both outperformed the mixed-school boys and girls. Also the mixed-school girls achieved a higher mean score than single-sex school boys and mixed-school boys. In all mixed-school boys achieved the lowest mean. To test whether or not the differences observed in the means were statistically significant, a One-way ANOVA test carried out to compare the means of the four school types and also to test the null hypothesis that there is no significant difference between the means of the three school types as

the data met all the assumptions of ANOVA. The result of the test is presented in Table 4.4.

Table 4.5: Results of the One-way ANOVA comparing differences in means of the boys and girls

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	1995.267	1	1995.267	82.990	.000
Within Groups	5722.067	238	24.042		
Total	**7717.333**	**239**			

Table 4.5 reports a One-way- Anova test carried out to compare the means of the boys and girls, that is, to test the null hypothesis that there is no significant difference between the means of the two groups as the data met all the assumptions of ANOVA. It can be observed from the results that there is statistically significant difference between at least two means ($p < 0.0001$). Also a Post hoc Test (Table 4.6) was carried out to compare the means using the Turkey‟s test since One-Way-Anova is an omnibus and cannot determine which group exactly differs from the other.

Table 4.6: Cross difference between groups using Tukey Post-Hoc

Type of school			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Boys in single-sex school	Mixed school	boys	2.98386*	.90716	.006	.6366	5.3311
	Single school	girls	-6.04691*	.73366	.000	-7.9452	-4.1486
	Mixed school	girls	-2.29691	.89947	.055	-4.6242	.0304
Boys in mixed school	Single school	boys	-2.98386*	.90716	.006	-5.3311	-.6366
	Single school	girls	-9.03077*	.90900	.000	-11.3827	-6.6788
	Mixed school	girls	-5.28077*	1.04742	.000	-7.9909	-2.5707
Girls in single-sex school	Single school	boys	6.04691*	.73366	.000	4.1486	7.9452
	Mixed school	boys	9.03077*	.90900	.000	6.6788	11.3827
	Mixed school	girls	3.75000*	.90133	.000	1.4179	6.0821
Girls in mixed	Single school	boys	2.29691	.89947	.055	-.0304	4.6242

school	Mixed school	boys	5.28077*	1.04742	.000	2.5707	7.9909
	Single school	girls	-3.75000*	.90133	.000	-6.0821	-1.4179

The results in Table 4.6 show how the mean scores of the two groups differ as well as the group that has the highest mean. The result indicated a statistically significantly different between the groups F (1, 238) = 82.99, p < .0001. The post-hoc multiple comparison test (Table 4.6) revealed that except for the means for boys in single-sex school (M =15.8, SD = 4.92) and girls in mixed school 3 (M =18.1, SD = 4.86) which were not significantly different, all other groups revealed statistically significantly differences in means.

In conclusion, we accept the alternative hypothesis that there is a significant difference between the boys in single-sex school and boys in mixed school; boys in single-sex school and girls in mixed school; and finally boys in mixed school and girls in mixed school.

4.4 Differences in single-sex and mixed senior high school students' perceived ability in, and attitude to, mathematics

The final research question is to find out whether or not there are differences in single-sex and mixed senior high school students‟ perceived ability in, and attitude to, mathematics. The students were given questionnaires to rate statements on their perceived ability in, and attitude to, mathematics on a likert scale of 1 – 5 as explained in chapter 3. The responses of the negatively worded statements in the questionnaire

were re-coded to obtain positive statements as also described in Chapter 3. The descriptive statistics of the students‟ rating of their perceived ability in, and attitude to, mathematics are presented in Table 4.7.

Table 4.7: Descriptive statistics of the students' perceived ability in, and attitude to, mathematics

	N	Min	Max	Mean	Std. Dev
Statements on perceived ability					
Perceived interest in mathematics	240	1	5	4.08	.902
Effort usually put in learning mathematics work	240	1	5	3.90	1.083
Performance in mathematics	240	1	5	2.32	.982
Overall perceived ability	240	1.33	5.00	3.98	.816
Statements on attitude					
I like attending mathematics classes	228	1	5	4.03	1.03
I wish to continue mathematics to a higher level	238	1	5	3.96	1.204
Mathematics is a subject for those who are gifted	227	1	5	3.77	1.035
Doing mathematics make me nervous or upset	227	1	5	3.45	1.149
Mathematics is difficult	231	1	5	3.23	1.109
I am afraid of mathematics	227	1	5	2.22	0.886
Overall attitude	240	1.00	5.00	3.47	.557

These results (Table 4.7) indicated the mean scores of the students‟ their perceived ability in, and attitude to, mathematics. Though the students rated their „perceived interest in mathematics‟ highest [M=4.08, SD=1.03], they generally rated low their performance in the subject [M=2.32, SD=.982]. However, the overall perceived ability score [M=3.98, SD=0.816] suggests the students have a good perception of their abilities in mathematics. On the attitude scale the highest scoring items were „I like attending mathematics classes‟ and „I wish to continue mathematics to a higher level‟ and the least was „I am afraid of mathematics‟. The overall attitude score [M=3.47, SD=0.557] suggesting the students have a positive attitude towards mathematics.

The students‟ mean rating of their perceived ability in, and attitude to, mathematics were further analysed to determine whether or not there were differences between the sexes. To do this a One-way ANOVA test was carried out to test the null hypothesis that there is no significant difference between the means of the three groups as the data met all the assumptions of ANOVA (Table 3.2). Table 4.8 shows the descriptive statistics on groups‟ responses (i.e. single-sex boys, single-sex girls and mixed school students) and Table 4.8 shows the results of the one-way analysis of variance (ANOVA) comparing each group‟s mean rating on perceived ability in, and attitude to, mathematics.

Table 4.8: Descriptive statistics of students' responses from the questionnaire

					95% Confidence Interval for Mean			
Gender	**N**	**Mean**	**Std. Dev.**	**Std. Error**	**Lower Bound**	**Lower Bound**	**Min**	**Max**
Perceived ability in mathematics								
Single-sex boys	82	3.97	0.80	0.09	3.80	4.15	2.33	5
Single-sex girls	66	4.01	0.84	0.10	3.80	4.21	1.33	5
Mixed school students	92	3.97	0.83	0.09	3.80	4.14	1.67	5
All	240	3.98	0.82	0.05	3.88	4.08	1.33	5
Attitude to mathematics								
Single-sex boys	82	3.40	0.58	0.06	3.28	3.53	1.00	5
Single-sex girls	66	3.50	0.54	0.07	3.36	3.63	2.17	5
Mixed school students	92	3.52	0.55	0.06	3.41	3.63	2.17	5
All	240	3.47	0.56	0.04	3.40	3.54	1.00	5

Table 4.9: Results of the one-way analysis of variance (ANOVA) comparing each group's mean rating of engagement

	Sum of Squares	df	Mean Square	F	Sig.
Perceived ability in mathematics					
Between Groups	.062	2	.031	.046	.955
Within Groups	159.445	237	.673		
Total	159.507	239			
Attitude to mathematics					
Between Groups	.635	2	.317	1.023	.361
Within Groups	73.518	237	.310		
Total	.635	2	.317	1.023	.361

It can be observed from the results (Table 4.8) that the means were close indeed and hence the results in Table 4.9 showed no statistically significant difference between the group means at $p < 0.05$ level. That is, for perceived ability in mathematics, the result indicated that there was no statistically significantly difference between the groups F (2,237) = 0.046, $p < 0.05$. Also for attitude to mathematics, the result indicated that there was no statistically significantly difference between the groups F (2,237) = 1.023, $p < 0.05$. By conclusion, since the p-value is greater than the significance levels the null hypotheses could not be rejected hence there is statistically no significant difference between the mean scores of the three groups in their perceived ability in, and attitude to, mathematics.

4.5 Discussion of Finding

This research was conducted to investigate gender differences in mathematics achievement of senior high school students in four selected districts in the Central Region. In order to achieve this research purpose, three research questions were answered. It will be observed that there was equal number of respondents with respect to gender. The respondents for this study were 240 and they were made up of 120 boys and 120 girls constituting 50% for each. Also, out of the 240 students that participated in the study, 33.8% (n=81) were boys from single-sex boys‟ school, 16.3% (n=39) were boys from mixed school, 33.3% (n=80) were girls from single-sex girls‟ school, and finally, 16.7% (n=40) were girls from mixed school.

The theoretical framework that supports this study stated that differences in educational outcomes occur because of inherent deficiencies or weaknesses in girls' experiences, knowledge, and skills. But the analysis so far depicted that that single-sex girls‟ school students did achieve a higher mean than single-sex boys‟ school students, and they both outperformed the mixed-school boys and girls. Also the mixed-school girls achieved a higher mean score than single-sex school boys and mixed-school boys. In all mixed- school boys achieved the lowest mean.

Evidence from the analysis made above indicates that girls achieve better in mathematics than boys irrespective of the school -i.e. single-sex or mixed. It was found that, with respect to achievement in mathematics, female students outperformed their male counterparts though the difference between the males and females was narrow. The theoretical framework that supports this study stated that differences in educational outcomes occur because of inherent deficiencies or weaknesses in girls' experiences, knowledge, and skills. However, the analysis so far depicted that single-

sex girls‟ school students did achieve a higher mean than single-sex boys‟ school students, and they both outperformed the mixed-school boys and girls also the mixed-school girls achieved a higher mean score than single-sex school boys and mixed-school boys. In all mixed- school boys achieved the lowest mean.

The findings 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. It is also in agreement with the narrow gender gap in achievement observed in the USA (Perie, Moran & Luktus, 2005) and in Australia (Forgasz, Leder & Vale, 2000). This is however at variance with Ogunkunle (2007), in Nigeria, where part of the findings established significant difference in support of males and another part in support of the females. It also disagrees with earlier studies of Fennema (2000) and Asante (2010) which showed significant gender differences.

However, research conducted by Bosire, Mondoh and Barmao (2008) discovered that boys in some single-sex schools did not perform better than their counterparts in co-educational schools. Tully and Jacobs (2008) also observed that male students from single-gender schools underperformed in comparison to male students from a co-educational environment. It could be inferred from these findings that boys outperform girls in the presence of girls. Therefore, when boys are separated from girls, their (boys) performance shrinks.

Other findings related to the students‟ perceived ability to do mathematics and their attitude to the subject. The findings on the students‟ overall perceived ability to do mathematics suggest the students have a good perception of their abilities in the subject. On the attitude scale, the highest scoring items were „I like attending mathematics classes‟ and „I wish to continue mathematics to a higher level‟ and the

least was „I am afraid of mathematics". The overall attitude score [M=3.47, SD=0.557] suggesting the students have a positive attitude towards mathematics.

These findings confirm what Posamentier et al. (2006), said about the teaching of mathematics that it is not about dispensing rules, definitions and procedures for students to memorise, but engaging students as active participants through discussion and collaboration among students. Johnson and Johnson (1990) also concluded that to achieve success in learning mathematics, students should be given the opportunity to communicate mathematically, reasoning mathematically, develop self-confidence that motivate them to solve mathematics problems and one of the ways this could be done was through cooperative learning.

Various literature sources have emphasised that boys at single-sex schools have more diverse role models of their own sex. Also, there is an understated pressure toward gender stereotyping in mixed schools. In boys' schools, boys feel free to be themselves, to follow their interests and talents in what might be regarded as non-macho pursuits: music, arts, and drama. These only began after they enrolled in a single-sex school. In the single-sex environment, they did not feel any embarrassment in showing an interest in those "non-macho" activities. All these have effect in the mathematics achievement in boys. Girls on the other hand do not have enough role models in the society.

Therefore, educational stakeholders and policy makers should try to institute policies that would help bring up the mathematics achievement both in boys and girls but especially in boys in schools high so that the achievement will be balanced. If care is not taken, a time will come where girls will take over mathematics in all the schools and this will not help in the smooth running of the educational system in the country.

This is because of the various findings which geared towards girls achieving better in mathematics in the various secondary schools.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 Overview

The purpose of the study was to investigate gender differences in mathematics achievement of senior high school students in four selected districts in the Central Region of Ghana.

5.1 Summary of the Study

This research was aimed at determining the overall mathematics achievement of senior high school boys and girls in the selected schools in the Central region and explore gender differences in single-sex and mixed senior high school students‟ perceived ability in mathematics, and attitude to mathematics.

A sample of 240 students was used in the study. The researcher used one achievements test and questionnaires for data collection. The tests focused on the students‟ achievements and their working processes, while the questionnaire focused on students‟ perceived ability in learning mathematics and attitude to mathematics. The study used quantitative methodologies which employs a quasi-experiment as a strategy of inquiry. The data was analyzed and presented largely using descriptive statistics (i.e. frequency distribution, percentages, charts, mean, median, and mode) and inferential statistics (i.e. one-way between subjects ANOVA). The one-way between subjects ANOVA was used because participants in each group are not related in any way. Also a Post hoc Test was carried out to compare the means using the Turkey‟s test since one-way-Anova is an omnibus and cannot determine which group exactly differs from the other.

The groups of participants are independent from one another. SPSS version 20.0 software was used for the data analysis because it was user friendly and it helped in most of the analysis of the quantitative data.

5.2 Summary of Findings

The results of the study show that females achieve better in mathematics than males. Again, males put much effort in their mathematics work than females do. Though it was established that males put much effort in doing mathematics work, females see the need practice makes one perfect so they try to come out with various strategies to help them practice more. On the contrary, females see teachers to discourage them in the learning of mathematics. With all the above features, boys do not perceive mathematics to be difficult but the same percentage of males and females whose performances are weak strongly disagree that mathematics is difficult. So therefore, there is equality when it comes to the level of difficulty in mathematics.

Furthermore, boys are afraid of mathematics more than females do. This makes the outcome very interesting because it was also established that Males like attending mathematics classes more than females do and believe that mathematics is for the gifted. Finally, it was established that, More boys say mathematics makes them nervous than females do and that more males wish to further their education on mathematics than females do.

Although, the researcher could not find a single literature that support all the listed findings collectively, some individual and group researchers have found one or more of the findings to be influential factors that enhance mathematics gender achievement.

These literatures were thoroughly reviewed in chapter two (2) of this study and have been used to support the data analysis and the discussion in chapter four (4).

5.3 Conclusion

Mathematics, like all subjects, is an important element that is needed for the development of any nation. Honestly, it would not be enough for a country to just believe that Mathematics is important until a substantial amount of the subject contents have been successfully imparted into a country‟s schooling citizens. This has made students‟ mathematics achievement an issue of concern to many countries today. These concerns have necessitated numerous educational researchers to investigate to know what should be done by educational institutions to enhance the teaching and learning of Mathematics.

Various outcomes and contributions made in the past regarding opportunities that have been provided to students to learn and achieve in mathematics have been reviewed in this research to inform readers of what have existed already. This review had ranged from Huitt‟s model of teaching/learning that was propounded in 1995, that had described student learning as a function of existed school systems which involve individual roles of stakeholders to present research findings. While some reviewed researches criticised methods used in teaching mathematics and also condemned shorter instructional periods for the teaching and learning of Mathematics, others made suggestions and recommendations that would help improve gender achievement in the subject.

In Ghana, some members of the public have always pointed accusing figures any time the issue of students‟ low mathematics achievement on gender is raised. These

people‟s criticism is based on no evidence and their victims have been the gender of the student that is the student being a male or a female and even the type of school being it single sex or mixed. However, findings from this research have proven that it takes more than these criticised victims (the school or gender) to realise this educational goal of improved mathematics gender achievement. The findings of this study depicted that it takes a collective involvement of all the educational stakeholders to achieve this required mathematics achievement by students and this result is supported by Kaiser and Rogers (1995) model which is the theory underpinning this study. It served as the theoretical framework of this study. The theory states that differences in educational outcomes occur because of inherent deficiencies or weaknesses in females' experiences, knowledge, and skills.

5.4 Recommendations

It is not only important to assess gender differences in students‟ mathematics achievement but also imperative for all and sundry to appreciate that there are more things do be done as a nation to help bridge the performance gap in mathematics between students‟ in single-sex schools and mixed schools. Based on the findings of this study, the researcher would like to make the following recommendations as essential issues for consideration:

- On the strengths of the findings made by the study, it is imperative for one to appreciate that both males and females from single-sex males, single-sex females and mixed-school students from both private and public school all owe a common responsibility of contributing their individual quotas to ensure higher mathematics gender achievement at the SHS level.

- Since evidence from the analysis indicates that girls achieve better in mathematics than boys irrespective of the school-type, more single-sex girls‟ schools should be established in the country to encourage more girls in pursuing the subject;

- teaching and learning of mathematics at the SHS level should be strengthened in mixed schools with the provision of more qualified and committed female mathematics teachers to serve as role models of girls in order to receive the best out of them;

- The two premier universities (UCC & UEW) which have been charged to train professional teachers in Ghana should be well resourced to increase enrolment in girls so as to produce enough female mathematics teachers for Ghanaian classrooms.
- This study adopted exactly the intention of Kaiser and Rogers model which was used by this research as the theoretical framework and it is now evident from this study that males and females learning mathematics at SHS level can achieve more if they (males and females) discard various false perception they had about the learning if mathematics.

5.5 Suggestion for Further Studies

The educational implication of the findings of this study calls for further research into the reasons why single-sex female schools perform better and achieve better in mathematics than boys in single-sex schools as well as mixed schools. Such studies should also explore practices in mathematics teaching that make students in the single-sex girls‟ schools outperform their counterparts in boys single-sex schools as well as mixed schools.

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APPENDICES

QUESTIONNAIRE FOR STUDENTS

INSTRUCTIONS

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

Please mark with a cross (x)

1. Personal Information

Gender

Male ☐

Female ☐

2. What type of school do you attend?

Boys" school ☐

Girls" school ☐

Mixed school ☐

3. How would you grade your own performance in mathematics?

Excellent ☐

Very Good ☐

Good ☐

Weak ☐

Very Weak ☐

4. How would you say you like mathematics?

Very Much ☐
Much ☐
Average ☐
Dislike ☐
Highly dislike ☐

[Mark only one option with a cross (x)]

5. How much effort do you usually put in your mathematics work?

I do not try at all	
I do just enough to get by	
I give an average amount of effort	
I try very hard, but not as hard as I could	
I practise frequently	

6. Briefly explain your response in question 6

……..……..

.....……

…….....

.....

7. What is your view about mathematics?

View	Strongly Agr	Agree	Neutral	Disagree	Strongly
Mathematics is difficult					
I am afraid of mathematics					
I like attending mathematics classes					
Mathematics is a subject for those who are gifted					
Doing mathematics make me nervous or upset					
I wish to continue mathematics to a higher level					

TEST FOR STUDENTS

INSTRUCTIONS

Thank you for taking time to do this test. It is to add information on a research on going by an MPhil student. This test is to find out if there is a gender difference in mathematics achievement of senior high school students in Central Region.

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

<u>PROVIDE SHORT ANSWERS TO THE QUESTIONS</u>

<u>DURATION: 30 MINS</u>

Gender

Male ☐

Female ☐

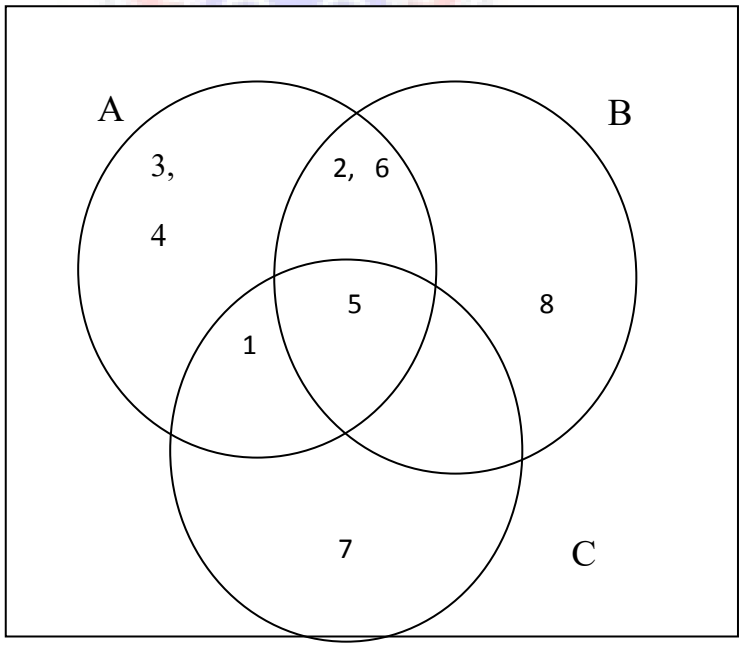
What type of school do you attend?

Boys" school ☐

Girls" school ☐

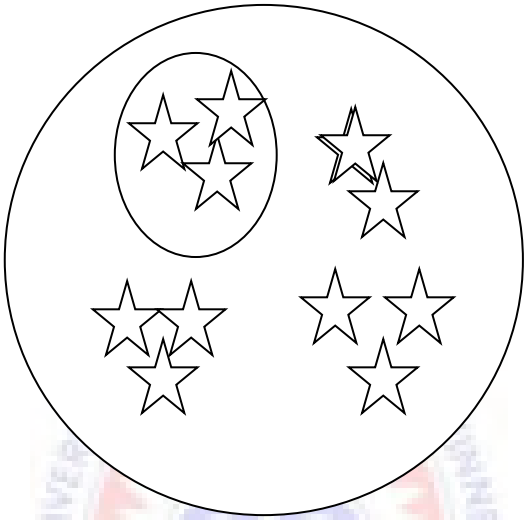
Mixed school ☐

Use the diagram below to answer questions 1 - 3



1. List the members of set A
2. Find A ∩ B

3. What is A U C
4. If the intersection of two sets gives a null set, the sets are said to be
5. The set {1, 2, 3, 4, 5, 6, 7, ...} can be describe as the set of
6. The set {0, 1, 2, 3, 4, 5, 6, ...} is described as the set of..
7. Which of the following can best describe the representation in the diagram?



8. The notation a/b is a fraction, what is the name is given to the b?
9. If you and your brother ate two-thirds and one-quarter of a bar of chocolate, how much of the chocolate will be left?
10. The sum of two consecutive odd numbers is 32, find the first member.
11. Find the mode of the following set of data; 2, 4, 3, 5, 3, 3, 1, 4, 6, 3.
12. The distribution in table 1 shows the height of 30 ladies in the government class form 3.

    Find the modal class.

Class	140-143	144-147	148 -151	156 -159	160 -163	164–167	168 - 171
Freq	1	2	7	5	3	3	1

13. Make d the subject if the relation 3r + dk = c
14. The cost of a calculator and a watch is GH¢ 35.00 if 2 watches and 5 calculators cost GH¢ 130.00. Find how much each of the items cost?
15. Expressed 4^{-2} as a fraction.

PART II

Answer any **one** in this part

1. Two functions f and g are defined on the set R of real numbers by f(x) = 2x - 5 and g(x) = x^2 –4. Find the values of y, if f(y + 1) = g(y).

2. The equation of the line through A(1, 1) and B(3, 5) is of the form ax+by+c=0.

i. Find the values of a, b and c.

ii. Find the values of $\sqrt{a^2 - b + c^2}$

3. The lines 3x+y=12 and x-2y=11 intersect 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.

MARKING SCHEME

PART 1

QN	DETAILS	MARKS
1.	A = {1, 2, 3, 4, 5, 6 }	M1 for any three members correct A1 for all correct. (-½ ee)
2.	A ∩ B = { 2, 5, 6 }	B2 (-1 each error)
3.	A = {1, 2, 3, 4, 5, 6 } C = {1, 5, 7 } A ∪ C = {1, 2, 3, 4, 5, 6, 7 }	M1 for either A or C correct (-½ each error) A1 for A ∪ C (-½ ee)
4.	Disjoint sets	B1
5.	Set of counting numbers	B1
6.	Set of whole numbers	B 1
7.	Subset	B2
8.	b is a natural number because b ≠ 0	B2
9.	The chocolate left $= 1 - \left(\frac{2}{3} + \frac{1}{4}\right)$ $= 1 - \left(\frac{8+3}{12}\right)$	M1 for adding $\frac{2}{3}$ and $\frac{1}{4}$

	=1 $-\frac{11}{12}$ = 1 - $\frac{1}{12}$	M1 for subtracting A1 for $\frac{1}{12}$
10.	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 x = 15
11.	The mode is 3	B1
12.	The modal class is 148 – 151	B1
13.	3r + dk dk = c – 3r d = $\frac{c-3r}{k}$	M1 for c – 3r A1 for d = $\frac{c-3r}{k}$
14.	x + y = 35 -------(1) 2x + 5y = 130-----(2)	B1 for either eqn 1 or 2 correct

	$2(35 - y) + 5y = 130$ $70 - 2y + 5y = 130$ $y = 20, x = 15$ $(x, y) \rightarrow (15, 20)$	M1 for substituting (35 –y) into eqn 2 M1 for solving A1 A1 for x = 15 and y = 20
15.	$4^{-2} = \frac{1}{4^2} = \frac{1}{16}$	M1 for the fraction $\frac{1}{4^2}$ A1 for $\frac{1}{16}$

PART II

QN	DETAILS	MARKS
1.	$f(y + 1) = g(y)$ $2(y + 1) - 5 = y^2 - 4$ $2y + 2 - 5 = y^2 - 4$ $y^2 - 2y - 1 = 0$	 M2 for substitution M2 for expanding 2(y + 1) M2 for all terms correct M2 for simplifying A2 for all correct
	Using quadratic formula $y = \frac{-(2) \pm \sqrt{(-2)^2 - 4(1)(-1)}}{2(1)}$ $y = \frac{2 \pm \sqrt{8}}{2}$	 M1 for substituting A1 for all correct M1 A1

	$y = \frac{2 \pm 2\sqrt{2}}{2}$ $y = 1 + \sqrt{2}$ $y = 1 - \sqrt{2}$	M1 for simplifying $\sqrt{8}$ M1 for solving A2 for answer $1 + \sqrt{2}$ M1 for solving A2 for answer $1 - \sqrt{2}$ [20 marks]
2.	$y - 5 = \frac{5-1}{3-1}(x - 1)$ $y - 5 = 2(x - 1)$ $y - 5 = 2x - 2$ $2x - y + 3 = 0$	M2 for $\frac{5-1}{3-1}$ (ie the gradient) M2 for substitution A1 for all correct M1 for expanding $2(x - 1)$ M1 for simplifying and re-arranging A2 [9 marks]
i. ii.	$ax + by + c \equiv 2x - y + 3 = 0$ $a = 2$, $b = -1$ and $c = 3$ $\sqrt{(2)^2 - (-1) + (3)^2}$	M1 for comparing both sides A2,A2, A2 for a=2, b=-1, c=3 each M1 for substitution (any two

	$\sqrt{4+1+9}$ $\sqrt{14}$	correct) A1 for all correct M1 for solving A1 [20 marks]
3.	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 P(x, y) →(5, -3)	B1 for eqn (3) M1 for solving A1 for y = -3 M1 for substitution M1 for simplifying A1 for x = 5 [6 marks]
	$y + 3 = \frac{-3-1}{5-1}(x-5)$ y + 3 = -1 (x – 5) x + y – 3 = 0	M2 for the gradient $\frac{-3-1}{5-1}$ M1 for substitution (any side correct) A1 for all correct M1 for solving A2 for the answer [7 marks]

i.	Comparing the two equations $ax + by + c \equiv x + y - 3 = 0$ $a = 1, b = 1$ and $c = -3$	A1, A1, A1 for a=1, b=1, c=-3 each [3 marks]
	$\lvert PQ\rvert = \sqrt{(1-5)^2 + (1+3)^2}$ $\sqrt{4^2 + 4^2}$ $\sqrt{32}$ $4\sqrt{2}$	M1 for substitution any term correct A1 for all correct M1 for simplifying A1 for $4\sqrt{2}$