UNIVERSITY OF CAPE COAST

# THE TEACHER FACTOR IN JUNIOR SECONDARY SCHOOL GIRLS' ACHIEVEMENT AND ATTITUDE TOWARDS MATHEMATICS

MAVIS AWUAH

2009

UNIVERSITY OF CAPE COAST

# THE TEACHER FACTOR IN JUNIOR SECONDARY SCHOOL GIRLS' ACHEIVEMENT AND ATTITUDE TOWARDS MATHEMATICS

BY

MAVIS AWUAH

Thesis submitted to the Department of Science and Mathematics Education of the Faculty of Education, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy Degree in Mathematics Education.

JUNE 2009

## DECLARATION

### Candidate's Declaration

*I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.*

Candidate's signature: .....Date.....

Name: Mavis Awuah.

### Supervisors' Declaration

*We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.*

Principal Supervisor's signature: ..... Date.....

Name: Prof. B. A. Eshun

Co-Supervisor's Signature: .....Date.....

Name: Mr. Benjamin Yao Sokpe

## ABSTRACT

This study was conducted to find out how school environments, particularly teachers, contribute to junior secondary school girls' achievement and attitude towards mathematics. The study involved 262 girls from twelve (12) mixed and six (6) all-girls junior high schools and their mathematics teachers.

An achievement test and questionnaires were the instruments used to collect data. The data from the achievement test and the questionnaires were analysed using the independent samples t-test and Pearson product -moment correlations at 5% significant level. The results revealed that female teachers were of the belief that boys show higher ability in mathematics than girls, and girls learn better in cooperative activities while the male teachers indicated that boys and girls were equal in these respect. Non-mathematics major and non-professional teachers were of the view that girls achieve lesser in mathematics than boys while the mathematics major and professional teachers believe that boys and girls achieve at the same level in mathematics.

Girls taught by mathematics major and professional teachers performed significantly better than girls taught by non-mathematics major and non-professional teachers. The girls rated the behaviour of male and professional teachers significantly more positive than that of the female and non-professional teachers. It was found that teacher-student relationship influence students' attitude toward mathematics, and there is a significant positive correlation between girls' attitude and achievement in mathematics. The implications of the findings were discussed and one of the recommendations made was that, mathematics teachers must put an end to any practices or behaviours that dispirit the girls in their learning of the subject.

## ACKNOWLEDGEMENTS

I wish to express my appreciation to the following people without whom this study would not have been possible.

My sincere gratitude goes to my two supervisors, Prof. B. A. Eshun and Mr. B. Y. Sokpe, for their immeasurable contributions, suggestions and corrections throughout the study. To the Junior Secondary School teachers who participated in this study and also allowed their students (Girls) to participate, I say “thank you very much” for your time and insight. I thank all those who contributed in one way or the other to make this piece of work a success.

## DEDICATION

I dedicate this piece of work to my family for their support and prayers in the course of my studies.

## TABLE OF CONTENTS


| | | Page |
|---|---|---|
| **DECLARATION** | | ii |
| **ABSTRACT** | | iii |
| **ACKNOWLEDEMENTS** | | iv |
| **DEDICATION** | | v |
| **LIST OF TABLES** | | ix |
| **Chapter** | | |
| 1 | **INTRODUCTION** | 1 |
| | Overview | 1 |
| | Background to the Study | 1 |
| | Statement of the Problem | 5 |
| | Purpose of the Study | 8 |
| | Research Questions | 9 |
| | Hypotheses | 10 |
| | Significance of the Study | 10 |
| | Delimitations | 11 |
| | Limitations | 11 |
| | Definition of Terms | 12 |
| | Organisation of the Study | 12 |
| 2 | **REVIEW OF THE RELATED LITERATURE** | 13 |
| | Overview | 13 |
| | The Nature of Attitudes | 14 |

Attitude towards Mathematics 14

Mathematics Anxiety 15

Mathematics as a Male Domain 17

Self-confidence 18

Teacher Beliefs 19

Impact of Teachers' Professional Training

On Students' Achievement 22

Teachers' Subject of specialisation and

Qualification and Students' Achievement 25

Teachers' Years of Teaching Experience

and Students' Achievement 27

Teachers' gender and Students' Attitude and

Achievement in Mathematics 29

Effects of Single-sex school on Girls' Attitude

and Achievement 31

Teachers' Behaviour 33

Summary of key points raised in the Literature Review 36

3 **METHODOLOGY** 37

Overview 37

Research Design 37

Population 38

Sample and Sampling Procedure 38

Instruments 39

Validity and Reliability of the Instruments 40

Data collection 42

Data Analysis 42

4 **RESULTS AND DISCUSSIONS** 46

Overview 46

Research Question One 46

Research Question Two 67

Hypothesis One 73

Hypothesis Two 76

Research Question Three 79

Research Question Four 88

Hypothesis Three 92

Hypothesis Four 95

5 **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS** 99

Summary 99

Conclusions 101

Recommendations 105

Suggestions for Future Research 106

**REFERENCES** 107

**APPENDICES** 121

## LIST OF TABLES


| Table | | Page |
|---|---|---|
| 1 | Mathematics Teachers' responses to items on Beliefs about Female Students by Gender | 48 |
| 2 | Responses of Mathematics major and Non- mathematics major Teachers to items on Beliefs about Female Students | 51 |
| 3 | Responses of Professional and Non- professional Teachers to items on Beliefs about Female Students | 55 |
| 4 | Responses of Mathematics Teachers to items on Beliefs about Effective Methodology by Gender | 59 |
| 5 | Responses of Mathematics major and Non-mathematics major Teachers on Beliefs about Effective Methodology | 62 |
| 6 | Responses of Professional and Non-professional Teachers to items on Beliefs about Effective Methodology | 65 |
| 7 | Mean Performance of Girls by School Type | 68 |
| 8 | Mean Performance of Girls by Gender of Mathematics Teachers | 69 |
| 9 | Mean Performance of Girls by the Subject majors of their Mathematics Teachers | 70 |
| 10 | Mean Performance of Girls by Professional Status of their Mathematics Teachers | 71 |
| 11 | One-way ANOVA Test on Girls Performance by the Level of their Teachers' Professional Qualifications | 73 |

| | | |
|---|---|---|
| 12 | Mean Performance of Girls by the Level of Professional Qualifications of their Teachers | 75 |
| 13 | One-way ANOVA Test on Girls' Performance by Teachers' Years of Teaching Experience | 76 |
| 14 | Pair-wise Test on Mean Performance of Girls by their Teachers' Years of Experience | 77 |
| 15 | Mean Scores on the Attitudinal variables by Gender of Teacher | 81 |
| 16 | Mean Scores on the Attitudinal variables by Teachers' Major Subject | 83 |
| 17 | Mean Scores on the Attitudinal variables by School Type | 85 |
| 18 | Mean score on the Attitudinal variables by Professional Status of Teachers | 87 |
| 19 | Means Scores on Perceived Teacher's Behaviour by Gender of Teachers | 89 |
| 20 | Mean Scores on the Perceive Teacher's Behaviour by Teachers Major Subject | 90 |
| 21 | Mean Scores on the Perceive Teachers' Behaviour by Teachers' Professional Status | 91 |
| 22 | Correlation between the Scores on Girls' Perceptions of the Mathematics Teachers' Behaviour and the Scores on the Attitudinal variables | 94 |
| 23 | Correlation between the Scores on the Achievement test and the Attitudinal variables | 97 |

# CHAPTER 1

# INTRODUCTION

## Overview

This chapter is centred on the background to the study, statement of the problem, purpose of the study, significance of the study, research questions/hypotheses, delimitation and limitation, and definition of terms.

## Background to the Study

Science, mathematics and technology have been recognized as the tools for development. The ability of any nation to compete successfully in the global market today, to a large extent, depends on the mathematical literacy of its citizens. Utilization of science, mathematics and technology has been interlinked with the improvement in productivity and wealth creation of a nation. This explains why it is important to have skilled human resources in science, mathematics and technology as a nation. The key to the economic development of Ghana therefore depends on the development of a strong science, mathematics and technology base (Anamuah –Mensah, 2007).

In Ghana, the teaching of mathematics starts at the primary level through to the senior high school level, and it is compulsory for all students because

mathematics has been recognized as a tool in many other subjects (physics, geography, economics, chemistry and so on). However, many students especially females fear mathematics and perceive it to be difficult. Studies have revealed that there are gender disparities in attitudes and performance of students in mathematics in favour of boys (Eshun, 1990; Eshun, 1999).

In the past, studying mathematics was considered more appropriate for males than for females. In a research carried out as part of the Second International Mathematics study, Schuildkamp-Kundiger (1982) reported sex-related differences in mathematics achievement in a wide range of countries of differing economic levels. In general in most of these countries girls drop mathematics as early as possible, thereby precluding themselves from taking mathematics at the university level and excluding themselves from many carries.

History has it that there was a recurrent belief that women were just no good at mathematics. Researchers generally have the same opinion on some significant psychological differences between boys and girls: that girl generally exhibit a lack of confidence in mathematics, and believe that to be successful in it is unfeminine; that boys attribute success in mathematics to their ability and failure in it to bad luck or to lack of trying hard enough, while girls feel just the opposite. Girls believe that success in mathematics is due to extra hard work, or to good luck, and failure in it is due to lack of ability. Thus, if boys are not doing well, they feel they should make more effort, while girls feel they might have to quit, as they lack ability. These psychological variables imply the cause of the problem and a possible approach to its solution.

Until recent years, it was widely accepted that males would outperform females in mathematics and that mathematics and its related careers were entirely for males. It was argued that female brains were too small. Child and Smithers (1971) argue that the physical development of males' brains have more improved spatial ability than that of females, and Gray (1981) is of the view that these differences can explain the differences in males and females' abilities in some science subjects. Data supported these beliefs. Once mathematics becomes an optional subject, more boys than girls opt to study it and, on average, males' performance levels were significantly higher than females (e.g. Baah-Korang, 2002; Leder, 1992).

Attempts were made particularly, by Western nations to re-dress the inequities. Intervention programmes focused on females with the aim of raising levels of partaking and performance to equal males (Leder, Forgasz & Solar, 1996). To re-dress the problem of inequities in mathematics in Ghana, as part of the 1987 educational reform, Ghana Education Service established Science, Technology and Mathematics Educational (STME) clinics to encourage and sustain the participation of girls in science, technology and mathematics in the senior secondary schools (Awortwi, 1998). The clinics which initially focused on senior secondary school girls, now involve both boys and girls from the junior secondary schools. It has been discovered that such after school clinics and programmes have had a positive impact on girls in terms of the knowledge and favourable attitudes acquired (e.g. Karp & Niemi, 2000).

The government's attention was also drawn to the fact that there are few female teachers in the field especially in mathematics. A great emphasis was placed on hiring more female teachers. It was argued that the female teachers could serve as role models for girls to expel their misconceptions particularly, about mathematics and to motivate them to opt for mathematics (elective) at the senior secondary level (Eshun, 2000a).

To increase the number of female teachers at the primary and junior secondary schools, the Ghana Education Service in 2002 instituted the "ACCESS" programme for females who have passes in all the senior secondary school certificate examination (SSSCE) subjects except one of these subjects; science, mathematics and English. Remedial classes were run for them and those who were successful were enrolled into the various teacher training colleges. It has therefore, become imperative to find out how the female teachers have influenced the female students.

It can be inferred from the discussions above that, studies on gender issues in mathematics have been approached from different perspective. There is a great deal of literature on gender differences relating to mathematics students but not much have been done on teachers and their impact on students.

It has been argued that students' achievements sometimes depend on the school environment (teachers and the school type). A conclusion drawn from examining International Association for the Evaluation of educational Achievement (IEA) data for 21 countries was that, in general, males are more capable than females in teaching mathematics and the sciences (Saha, 1983).

However, another study indicates that students of female teachers had significantly higher achievement scores in mathematics and other subjects than those taught by male teachers (Mwamwenda & Mwamwenda, 1989).

## Statement of the Problem

Mathematics is among the important subjects on the school curriculum of most countries. In Ghana, it is compulsory for all students from primary to senior high school. However, it is the subject that most students especially females fear most. On completion of one's basic education, one is expected to get a pass in mathematics at least grade six before he can gain admission into any of our second cycle institutions. Many students are unable to further their education after the junior high school because they failed in mathematics. The lower attainment of students in mathematics is one area of educational alarm that appears to be attitudinally based.

Some research findings have indicated that females in Senior Secondary Schools achieve less in mathematics and have negative attitudes towards mathematics (Eshun, 1999; Nkani, 1993). Also, there is differential enrolment by boys and girls in elective mathematics, in favour of the boys (Baah-Korang, 2002). The National Assessment of Educational Progress (NAEP, 1980) reported that, at age 14, school girls in the United States compared equally in mathematics achievement with boys, but, by age 17, majority of the girls no longer study mathematics, and those who do continue usual lower achievement scores than boys.

Even though, junior secondary school boys and girls do not have the option to select or not to select mathematics, the teaching and learning of mathematics in the junior secondary schools has an effect on achievement and attitudes toward mathematics. Students, in their early years, develop the skills and attitudes toward learning that form the basis for future academic growth (Boland, 1995).

Fennema (1982) indicates that the middle school years appear to be critical in the development of sex- related differences. Differences are often found with males pulling ahead of females near the end of middle school when students are 13 to 15 years old. In the united kingdom, the Assessment of Performance Unit (APU, 1980), which monitors attitude and performance in mathematics of 11 to 15-year olds, showed the same differences, both in attitude and in performance as noted by NAEP above and fennema (1982). But it found them already beginning at age 11. For this reason, the study focused on junior secondary schools.

Fennema (1982) continues to reveal that many girls achieve higher than many boys. Variation in achievement is found between high and low achieving boys and high and low achieving girls (intra-sex) rather than between boys and girls (inter-sex). It was therefore necessary to investigate into the intra-sex differences.

One cognitive area where boys time and again out-perform girls is that of spatial visualization (the ability to mentally manipulate objects in space). Fennema and Sherman (1978) revealed that spatial visualization plays an

important role in learning geometry. They investigated the relationship between mathematics achievement and spatial visualisation skills and concluded that the data do not explain the differences found in mathematics achievement, and asking if the very small difference in spatial visualization between boys and girls could possibly account for the large sex- related difference in achievement they concluded that it could not be. This suggests that other factors contribute to the lower achievement of girls in mathematics.

Fennema (2000) proposed that as research on teachers continues to improve, it must include gender as a variable and the impact that teachers' cognition has on students. It has been found that the gender of a teacher matters in learning. Boys and girls are affected in different ways by their teacher's gender, female science teachers appear to reduce the probability that a girl would be seen as inattentive in science (Dee, 2006). A research finding by Lee and Lockhead (1990) indicates that more positive attitudes towards mathematics were demonstrated by females taught by female teachers. Mallam (1993) using the data from a stratified random sample of 240 female students from five coeducational and six all-girls secondary schools in Nigeria, had a similar result. She discovered that the highest proportion of female students demonstrating positive attitude towards mathematics was found in all-girls schools where mathematics was taught by females while the lowest proportion was in coeducational secondary schools where mathematics was taught by male teachers.

Studies have also revealed that the gender of a teacher has an impact on students' performance. Students of female teachers appear to outperform those of

male teachers (Mwamwenda & Mwamwenda, 1989). Warwich and Jatoi (1994) also argue that students of male teachers score significantly higher in mathematics test than those of female teachers. These contradicting results make the need to look into the teacher's gender in relation to attitude and achievement of students in mathematics very crucial.

## Purpose of the Study

The study sought to solicit teachers' opinions about some beliefs held about female students and also their views about effective pedagogical practices based on their experiences as mathematics teachers. In addition, the study tried to find out and compare the attitudes and performance of girls taught by male mathematics teachers and those taught by female mathematics teachers. The study also compared students' performance in terms of their teacher's professional qualification, subject of specialization and year of teaching experience. Finally, it determined and compared the attitudes and achievement of girls in the mixed schools and those in the single- sex schools. The perceptions of girls' attitudes towards mathematics were compared along the following attitudinal variables;

Mathematics anxiety

Mathematics as a male domain

Confidence in mathematics

Girls' perception about their mathematics teacher's behaviour towards them was also determined.

## Research Questions

The study investigated the following questions:

1. Do different categories of mathematics teachers differ on their:
    a) Beliefs about female students?
    b) Views about effective methodology for girls?
2. Is there any significant difference between the mean performance of:

a. Girls taught by female mathematics teachers and those taught by male mathematics teachers?

b. Girls in the single -sex schools and girls in the mixed schools?

c. Girls taught by teachers who specialized in mathematics and girls taught by teachers who specialised in subjects other than mathematics?

d. Girls taught by professional teachers and girls taught by non-professional teachers?

3. Is there any significant difference between the attitude of:
    a. Girls taught by female and those taught by male mathematics teachers towards mathematics?
    b. Girls taught by mathematics major and those taught by non-mathematics major teachers towards mathematics?
    c. Girls in the single -sex and girls in the mixed schools towards mathematics?
    d. Girls taught by professional and girls taught by non- professional teachers towards mathematics?

4. What is the perception of girls about their mathematics teachers' behaviour towards them?

## Hypotheses

The following hypotheses were formulated to guide the study.

1. Girls taught by teachers with different professional qualifications perform at the same level.
2. Girls taught by teachers with different years of teaching experience perform at the same level.
3. There is no correlation between girls' perceptions about their mathematics teacher's behaviour and their attitude towards mathematics.
4. There is no correlation between girls' attitude toward mathematics and their achievement in mathematics.

## Significance of the Study

The outcome of this study will reveal the role that the mathematics teacher's gender, qualification, subject of specialization, experience, beliefs about girls and about effective pedagogy play in the observed failure rate of Junior Secondary School leavers particularly girls and negative attitude of girls toward mathematics. It will also help in improving the teaching and learning of mathematics in the junior high schools, and this in turn will increase the number of students more especially females to enter the senior high schools and opt to study elective mathematics. The outcome of the study will lend support to the efforts being made by Ghana Education service and some Non- governmental organisations (NGO's) in finding solution to the high failure rate of students in

mathematics. The result of the study will also add to the body of existing knowledge on students' achievement and attitudes.

## Delimitations

Due to time and financial constraints, the study will be limited to three metropolitan areas in Ghana namely; Accra, Cape Coast and Kumasi metropolises, and due to the fact that the educational experiences of students in these metropolises are richer than those of their counterparts in the rural areas. Junior secondary school (JSS) form three girls and their mathematics teachers will be selected for the study. The selected teachers should have taught the girls for at least one year. The JSS form three girls were selected because they had covered a lot of the topics in the syllabus at the time of the research.

## Limitations

Even though questionnaires are widely used in assessing peoples' attitudes, the use of the questionnaire alone in this study to determine Junior Secondary School girls' attitude towards mathematics might not have given a deeper insight of the girls' attitude. Thus it could be possible that combination of different techniques (like questionnaire and interview or observation) could produce better result than what has been produced by the questionnaire alone.

Also, because of the purposive sampling technique used to select the Junior Secondary Schools for the study the findings of this study could not be generalised. The findings will however, serve as indicators of what contribute to girls' low achievement and negative attitude towards mathematics.

## Definition of Terms

Performance/Achievement: The score a student obtains in a test

Attitude: a feeling that a person holds about an object or a person. It can be positive or negative.

All-girls schools: schools in which only girls are students.

Mixed- schools: schools in which both boys and girls are students.

Professional teachers: teachers who had their post secondary training in education.

Teacher behavior: how teacher relates with students (girls).

Teachers' beliefs: teachers' beliefs about the ability of girls.

## Organisation of the Study

The study is presented in five chapters. Chapter one is focused on the background to the study, statement of the problem, purpose of the study, significance of the study, research questions/hypotheses, delimitation and limitation, and definition of terms. Chapter two is the review of the related literature. Chapter three is the methodology: the research design, population and sample, instruments and mode of analysis are described in this chapter. Chapter four presents the findings from the analysis, and discussions. Chapter five is centred on summary of the study, conclusions and recommendations.

# CHAPTER 2

# REVIEW OF THE RELATED LITERATURE

## Overview

This chapter is a review of the relevant literature related to the topic of the study. The researcher identifies previous studies and findings related to this research study. The literature is reviewed under the following subheadings.

a) The Nature of Attitudes
b) Attitudes toward Mathematics and the three selected Attitudinal variables
c) Teachers' Beliefs
d) Impact of Teachers' Professional Training on Students' Achievement
e) Teachers' Subject of Specialization/Qualification and Students' Achievement
f) Teachers' Years of Teaching Experience and Students' Achievement
g) Teachers' Gender and Students Attitudes and Achievement
h) Effects of Single-sex schooling on Girls' Achievement and Attitudes towards Mathematics
i) Teachers' Behaviour

## The Nature of Attitudes

Attitude like most abstract terms in English language has more than one meaning. Attitude lacks a precise definition. However, references can be made to some few writers on the subject.

Kyriacou (as cited in Nabie, 2002), defines attitude as one's feeling towards a particular object or class of objects. According to Zanna and Rempel (1988), attitude is a disposition to respond favourably or unfavourably toward some person, thing, event, place, idea or situation. Attitudes are the thoughts and feelings that motivate someone to act as though he likes or dislikes something or somebody.

Allport (as cited in Eshun, 2000b) defines attitudes as a mental and neutral state of readiness organized through experiences exerting a directive or dynamic influence upon the individuals' response to all objects and situations with which it is related.

It can be inferred from the above definitions that attitudes are learnt from diverse situations. For instance, one can internalise the attitudes of those among whom he lives and from other public sources and institutions such as the mass media and education.

## Attitude towards Mathematics

Eshun (2000b) explains attitude toward mathematics as an inclination to an aspect of mathematics that an individual acquires through his/her beliefs and experiences but which could be changed. Nabie (2002) also, defines attitudes

toward mathematics as the acquisition of behaviours or feelings that turn to influence the choice of actions towards mathematics.

All the definitions suggest that attitudes are learnt and can be changed. The fact that attitudes are learnt and are capable of being changed is a major significance for studying them.

Christantiell (as cited in Nkani, 1993) indicated in his study of college students' attitudes towards arithmetic and quantitative scores on American college Examination that, "non – intellective factors such as attitude and emotional make-up have an important bearing upon students' success with their subjects.

Attitudes towards mathematics may affect students' willingness to learn mathematics. Kidd (2003) says that, for many people the feeling of dislike, frustration, and failure could have effect on their attitudes.

**Mathematics Anxiety**

Anxiety is a state of arousal caused by a threat to the well- being of an individual. An anxious person feels endangered in some way, and he is tensed and ready to respond. Being anxious is a common human experience but for some people feelings of this kind disorganises their mental functioning.

"Despite the fact that some anxiety can be motivating, excessive anxiety can cause "downshifting" in which "the brain's usual processing mechanisms start to alter by lessening perceptions, preventing short term memory and behaving in more primitive reactions" (McKee 2002, p. 2).

Many definitions have been given for mathematics anxiety. According to Tobias and Weissbrod (as cited in Foire, 1999, p. 403), mathematics anxiety is

"the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem". Mathematics anxiety is an emotional and cognitive fear of mathematics.

Russell (2008) notes that mathematics anxiety or fear of mathematics is quite common and, according to Zaslavsky (1994), people of all races and economic backgrounds fear mathematics, but women and minorities are most hindered by it. She reported a research which pointed out that around the seventh grade girls start to qualm their capabilities to study mathematics. Levine (1995) indicates that more females, to a large extent, experience mathematics anxiety than males.

Pries and Biggs (2001) describe a cycle of mathematics avoidance: In phase one, the person experiences unhelpful reactions to mathematics situations. These may result from past negative experiences with mathematics, and lead to a second phase in which a person dodges mathematics situations. The avoidance of mathematics situations leads to phase three, poor mathematics preparation, which brings them to phase four, poor performance in mathematics. This generates more negative experiences with mathematics and brings us back to phase one.

Some research findings indicate that there is a relationship between mathematics anxiety and mathematics achievement. Awanta (2000) says that relationship between anxiety and learning of mathematics is complex. Anxiety as a form of arousal of alertness can be helpful in learning but too much anxiety, particularly when combined with perceived lack of ability can hinder learning.

Zakaria and Nordin (2008) found that there is a relationship between mathematics anxiety and achievement. They found that the mean achievements of low, moderate and high anxious groups were significantly different. Their findings also revealed a low (r= -0.32) but significant negative correlation between mathematics anxiety and achievement. Callahan and Clennon (as cited in Eshun, 2000b) showed that high anxiety is associated with lower achievement in mathematics.

**Mathematics as a Male Domain**

Sex-role stereotyping and students' perceptions of their own abilities are among the causes suggested for gender-related differences in participation in mathematics. Perceptions of how appropriate mathematics is for females play a role in females' lower performance and participation in mathematics in relation to males. Literature on this topic points to the generally held perception that doing mathematics is consistent with a male self-image than with a female self- image.

Dungsworth, (1981) reporting on a survey by the Rheinland-Palatinate Ministry of Education in the Federal Republic of Germany, made as a result of the declining of employment prospect for young women, confirms that sex-related preferences for mathematics and science subjects are already established in the lower school, and that by the end of senior secondary school, boys far outnumber girls in those classes.

Hanson (1997) indicates that females' dispositions toward mathematics and hence achievement and participation in mathematics are believed to be socialised, inculcated by a society that tend to view mathematics as a male

domain and which perpetuates the idea that males are naturally more mathematically inclined. Fennema and Sherman (1977) claimed that boys were more stereotyped with respect to mathematics as being a male dominated domain. But literature indicates that, both sexes had sex-role stereotyped opinions about mathematics. For instance, Sherman (1982) found that a considerable proportion of girls in secondary school "play dumb" in their mathematics classes because it is not consistent with their self-concept.

Analyzing 1,937 responses to the Fennema-Sherman Attitude Scale, Pederson et al. (as cited in Morin, 2003) discovered that girls in the eighth grade were less likely to plan to take mathematics in high school than girls in seventh-grade. Girls' responses to questions regarding perceptions about mathematics careers indicated an increase in influences from sexual stereotyping of careers between the two grades. This observation about the negative influence of sex-role stereotypes particularly for girls was also made by Ethington (1992).

**Self- confidence**

Self-confidence is one of the attitudinal variables found to influence students' achievement and participation in mathematics. Hannula, Maijala and Pehkonen (2004), in their longitudinal study on self- confidence, indicated that the learning of mathematics is influenced by the student's mathematics related beliefs, especially self confidence. Bae, Choy, Geddes, Sabble, and Snyder (2000) also argue that "Achievement gaps appear more closely related to attitudes than to course taking" (p.117). Based on their analysis of National Assessment of Educational Progress (NAEP) data trends, Bae et al. (2000) found that females are

less likely than males to think they were good at mathematics. A study conducted by Cann (2009) revealed that in all the schools in Wales girls were more likely than boys to report feelings of anxiety and a lack of confidence in mathematics.

Jones and Smart (1995) see lack of confidence to be the main reason for girls' low participation in mathematics. Reyes (as cited in Ma & Kishor, 1997) found that Confidence, which is a major component of self-concept, correlates positively with achievement, with correlation coefficients larger than 0.40 at the secondary school level. Fennema and Sherman (1977) also indicated that confidence in mathematics learning correlates highly with achievement than any affective variable and achievement. An analysis of the educational Longitudinal study of 1988, revealed that eighth grade girls tended to have less interest in mathematics as a field of study. (Catsambis as cited in Morin, 2003).

## Teachers' Beliefs

Teachers may influence the educational experiences of boys and girls differently. It is believed that the teachers' attitudes towards boys and girls in the mathematics classroom could be a reason for success or failure as between boys and girls. Indeed, it is argued that the mathematical expectations of which teachers hold for boys and girls is shown in differential treatment on the basis of sex in mathematics classes (Dee, 2006). Therefore the students respond differently in class, so confirming the teachers' attitudes.

Sommers (2000) found from classroom observations that teachers are more likely to give praise and remediation in response to an answer to a question given by a boy but simple acknowledgement in response to that given by a girl.

What form is this differential treatment? It may be slight and entirely unconscious, such as was shown in a study by Gore and Roumagoux (1983) showing that the length of time a teacher waits for a student to begin responding to a teacher-posed question in mathematics differs between boys and girls; that teachers give significantly more 'wait-time' to boys than to girls.

Similarly, Fennema (1990) and Fennema, Peterson, Carpenter and Lubinski (1990) argue that teachers have different expectations of female and male students which lead the teachers to overrate the mathematics abilities of the males and underrate that of the females. Jones and Dindia (2004) indicated that teachers may indirectly communicate that they have different academic expectations of boys and girls and these biased expectations of teachers may then become self-fulfilling when students respond to them.

Tiedemann (2000) in a study of elementary school teachers found that teachers have the believe that girls are less rational than boys, even among boys and girls performing at the same level, and teachers believe that girls need to work harder in mathematics than boys to achieve the same level of performance. Some studies of classroom interaction have shown that girls' mathematical ideas are not as carefully listened to; that a boy's partial answer will be prompted by the teacher to be developed further, while a girl's will not be. A study by Becker (1981) showed a differential treatment as between boys and girls on the cognitive level of questions posed by the teacher, in the teacher's praised and criticism, and in the individual help given, all of these strengthening the idea that mathematics if a male domain.

Fennema et al. (1990) in their investigation into teacher beliefs in relation to gender and mathematics selected 38 first-grade female teachers in 24 schools in the US. The teachers were asked to identify their two most and least successful male and female students in mathematics to attribute causation of these students' successes and failures, and to describe their characteristics. Teachers' choices of the most and least successful students were compared with mathematics test scores of the students. The results of the analysis revealed that teachers hold different beliefs about males and females. Male students were perceived to be the best students, and the teachers were less accurate when selecting most successful male students. The teachers attributed the males' success in mathematics to ability than they did for the females, whose success was attributed to effort.

It is possible that teachers' differential treatment of boys and girls may be the result of different beliefs held about boys and girls. Fennema and Peterson (as cited in Morin, 2003), in a study into the differential treatment of boys and girls in the mathematics classroom, and whether teacher behaviour affect boys and girls differently found that using cooperative activities positively impact on girls' mathematics achievement than boys. Eshun and Abledu (2001) argue that small-group cooperative learning settings address the low ability student' need for individual attention and motivation which will be provided by their more able peers. Akoto (2003) in a study into the effects of cooperative learning on performance found that, small-group cooperative learning approach in the teaching of mathematics leads to higher students achievement and improve attitudes towards mathematics.

There is an assumption that male and female teachers have biases with respect to how they engage and treat boys and girls in the classroom. For example, Jones and Dindia (2004) cite several small-scale studies that examine teacher biases and conclude that a teacher's gender is the most obvious factor that seems to shape sex equity in the classroom. However, the available evidence on the extent to which male and female teachers share any particular belief about girls and boys is limited. Morin (2003), in a study on beliefs about mathematics students and effective pedagogy, found that, male and female teachers do not hold significantly different gender-related beliefs about mathematics students or pedagogy. Brophy (1985, p. 137) concludes that "teachers do not systematically discriminate against students of the opposite sex". No such study have been conducted in Ghana therefore, this study was to investigate into gender related beliefs of male and female mathematics teachers at the junior secondary school level in Ghana, in addition, junior secondary school mathematic teachers have attained different levels of mathematics education. Therefore, the study also investigated whether this has any bearing on their beliefs about female students and effective methodology.

**Impact of Teachers' Professional Training on Students' Achievement**

There is a common thought that professional qualification of a teacher is a very essential merit of every effective teacher, though some studies indicate otherwise. Ball and Cohen (1999) were of the view that teachers should have an in-depth understanding of meanings and connections in subject matters and not just procedures and isolated information. Lochead and Komenan (1980) in a

review of teacher quality on the achievement of students noted that 60% of 60 studies that examined the effect of teacher education on student behaviour found positive relationship.

There are different views on the impact that a teacher's training has on students' achievement in mathematics. The findings of different researchers on the relationship between teacher training and student achievement in mathematics are contradicting. Some researchers in mathematics education indicate that students' achievement is a function of teacher education programs. Researchers who are of this view assume that when teachers of mathematics are well-trained the students they teach will also achieve more in mathematics. Those with the opposing view see teachers' training to have very little influence on students' achievement in mathematics.

Some research findings have indicated that the training of mathematics teachers positively relate to student learning outcomes in the subject. Bressoux (1996), using a quasi-experimental design, found that teacher professional training in mathematics increases students' performance in mathematics. Darling-Hammond (1992) reviewed over one hundred studies on the subject and concluded that fully prepared (trained) teachers are more effective in the classroom and their students demonstrates the larger achievement gains than those teachers unprepared. Angrist and Lavy (2001) for instance, claimed that there is a strong relation between teacher training and student achievement in mathematics.

Findings by other researchers have also indicated a stronger and more consistent positive result of professional educational training on teachers'

effectiveness. Adeyeye and Arifolo (1999) in their study of impacts of teachers' professional qualification and academic qualification on students in Chemistry in Eketi State found that, a statistically significance difference exist between the academic achievement of students taught by professional and non- professional teachers in Chemistry in secondary school level. Those taught by professional teachers showed a better overall academic achievement in Chemistry in Ekiti state. Dildy (1982), investigating the results of a randomized trial, found that teacher training increases student performance. A similar finding by Monk (1994) in studying student's mathematics and science achievement found that the education coursework of a teacher had a strong positive influence on students learning and was sometimes more influential than extra subject matter preparation.

In Ghana, teachers are supposed to be trained in the various teacher training colleges and the universities of education (University of Cape Coast and University of Education, Winneba). In the two universities mentioned, the training is done in specific subjects of specializations of the teacher trainees. However, there are some teachers who have been recruited into the teaching field without the prerequisite training in education this untrained teachers may have a negative influence on Junior Secondary School students' achievement in mathematics.

For children to receive quality education, we need qualified, competent and committed teachers. That is to say, to ensure quality education is to emphasize teacher quality. Darling-Hammond (2000) says that the effects of well-

equipped teachers on students' achievement can overshadow student background factors such as language, poverty and minority status. She further argues that other kinds of investment such as reduced class size, overall spending on education and teacher salaries do not relate more strongly to students achievements than teacher quality.

A study that examined the mathematics achievement of elementary school students also found that students taught by new, uncertified teachers did significantly worse on achievement tests than did those taught by new, certified teachers (Laczko-Kerr & Berliner, 2002). Some other findings by other researchers however, contradict the earlier findings discussed. Other literatures reveal that the training of mathematics teachers contributes very little to students' achievement in mathematics. Wiley and Yoon (1995), and Cohen and Hill (2000) for example, find teacher development programs to have at least small impact on student performance.

**Teachers' Subject of Specialization/Qualification and Students' Achievement**

In addition to the professional training of teachers, literature has also revealed that the mathematics teachers' subject of speciality and teachers' qualifications have significant influence on students' achievement in mathematics. Findings on studies on subject areas of teachers in which advanced degrees were earned have been consistent in revealing a positive effect of teacher degree on students' achievement. Darling-Hammond and Sykes, (2005) found that among the variables used in assessing teacher quality, the percentage of

teachers with full certificate and a major in the field is a more powerful predictors of student achievement that teacher education levels.

Wayne and Youngs (2003) indicates that certification in a particular subject area, in this case, mathematics, may result in more effective teaching. Byrne (as cited in Darling Hammond, 2001), summarized the results of over thirty studies relating to teachers subject matter knowledge on students achievement. The results revealed a positive relationship.

Begle (1979) found that the number of credits a teacher had in mathematics methods courses had a strong correlation with student performance than was the number of mathematics courses or other indicators of teacher preparation. A Pedagogical-content knowledge in mathematics has been found to be one major tool that gets the mathematics teacher to execute his duty as a subject teacher well and the students to achieve more in mathematics. Thus to say for example, what teachers know both about subject-matter and students, determine how they select teaching methods and instructional materials and how well they present the materials in the class.

Trends in International Mathematics and Science Studies (TIMSS, 1999) report indicates that teachers' major areas of study during their post-secondary teacher preparations give some indication of their preparation to teach mathematics and also, higher achievement in mathematics is associated with teachers having a bachelor's degree and or master's degree in mathematics.

The National Commission on Teaching and America's Future (1996), says a major factor that can make a distinction in improving students' achievement is

knowledgeable and skilful teachers. The finding suggests that teachers' subjects of specialization and mastery are important elements in students' learning of the subjects. Work by other researchers also supports that teachers' qualification and subject-content specialization influence students' learning outcomes.

Goldhaber and Brewer (2000), using a nationally- representative data provided in National- Education Longitudinal Study of 1988( NELS: 88) to find the impact of teachers' holding masters degrees on high school students' mathematics achievement showed the essence of the subject in which the degree was awarded. The study revealed that students achievement gains in mathematics were positively associated with those assigned to teachers who earned their degrees in mathematics.

Clotfelter, Helen and Jacob (2006), based on students test scores performance, argues that even the weakest student gain much improvements in teacher quality. Carpenter and Fennema (as cited in Fennema and Franke 1992), found that in the aspects of mathematics where the teacher was more knowledgeable, teaching and consequently learning was richer.

**Teachers' Years of Teaching Experience and Students' Achievement**

In addition to teacher professional qualification and subject-content specialization, other factors may impact students' achievement in mathematics. One of such factors is years of teaching experience of the teacher.

Research findings have indicated positive correlations between years of teaching experience and higher student achievement. Teacher's inexperience is shown to have a strong negative effect on student performance. Conversely,

experienced teachers produce higher student achievement. Teachers with more than five years in the classroom seem to be more effective than new teachers. Rivkin, Hanushek, and Kain (2005) in analysing the UTD Texas Schools Project data, showed that students of experienced teachers attained considerably higher levels of achievement than did students of teachers with one to three years of experience.

Similarly, Fetler (2001) in analysis of mathematics achievement and dropout rates in a sample of California high schools found that schools whose dropout rates were within the highest 10 percent had 50 percent more new teachers than did schools in the lowest 10 percent. Ehrenberg and Brewer (1994) also found that teacher experience was positively related to white and African American student gain scores, but negatively related to Hispanic gain scores. Goldhaber and Brewer (1996) also found that teacher experience is positively related to high school students' achievement.

Greenwald, Hedges, and Laine (1996) examined data from 60 studies and found a positive correlation between years of teacher experience and student test scores. Another study by Murnane and Phillips (1981) suggest that teachers with less teaching experience normally produce smaller learning gains in their students compared with teachers with more teaching years of teaching experience.

Rosenholtz (1986) also argues that teachers with less than three years of teaching experience are not effective as more experience teachers. Hwakins, stancavage and Dossey (1998) specify that teaching experience can be viewed as a resource to which students have access. Teachers with more teaching experience

have worked with a feeler multiplicity of students and have developed a greater stock of instructional strategies. Hawkins, et al (1998) found that in 1996 the amount of general teaching experience for teachers of fourth-grade mathematics indicated that students who were taught by teachers with less than 5 years of teaching experience had performance below the performance of students whose teachers had 6-10 years or 25 or more years of teaching experience. Ferguson (1991) found in his study of over 900 school districts in Texas that, teacher experience was positively associated with student achievement gains at the district level.

On the contrary, more knowledgeable teachers in educational settings with no opportunity for staff development may become dormant in their performance. Teacher's age also count in his performance, older teachers may grow tired in their teaching. In his study of high school mathematics and science teachers, Monk (1994) found that teacher experience had no effect on student performance.

## Teachers' Gender and Students' Achievement and Attitude towards Mathematics

Research on student-teacher interactions has also focused on whether students' outcomes vary when students and teacher share the same gender. Assigning students to same-gender teachers could be educationally beneficial to the students. For example, same-gender teachers may communicate different expectations to the students (boys and girls) in their classrooms, they could influence student engagement with work or student behaviour (Dee, 2006) and they could also serve as role models (Eshun, 2000a).

The conclusions from studies on effects of teacher's gender on students' academic outcomes are quite varied. Nixon and Robinson (1999), using data from the National Longitudinal Survey of Youth (NLSY), found that females attending high schools with a higher percentage of female faculty had higher levels of educational achievement. They also found no association between the presence of female faculty and the educational achievement of male students. Dees (2006) argues that girls have better educational outcomes when taught by female teachers and boys are better off when taught by a man.

Gorman (2006) claims that, one year with a female mathematics teacher would close the gender gap in 13 year olds by half and eliminate entirely the smaller achievement gap in mathematics. Another finding by Mwamwenda and Mwamwenda (1989) also indicates that students of female teachers had significantly higher achievement scores in mathematics and other subjects than those taught by male teachers.

In contrast, Ehrenberg, Goldhaber and Brewer (1995) using cross-sectional data on 10th graders participating in the National- Education Longitudinal Study of 1988 (NELS: 88), found that a teacher's gender was not linked with the achievement gains of girls nor boys. Warwich and Jatoi (1994) also argue that students of male teachers score significantly higher in mathematics test than those of female teachers.

The under representation of female science and mathematics teachers hence lack of female role-models, particularly in secondary schools have been found to have negative effects on girls (Female Education in Mathematics and

Science in Africa [FEMSA], 1997). Research findings on students attitude towards mathematics shows that female teachers positively impact on girls' attitudes. A research finding by Lee and Lockhead (1990) indicates that more positive attitudes towards mathematics were demonstrated by females taught by female teachers. Mallam (1993), using the data from a stratified random sample of 240 female students from five mixed and six all-girls secondary schools in Nigeria had a similar result. She discovered that the highest proportion of female students demonstrating positive attitude towards mathematics was found in all-girls schools where mathematics was taught by females while the lowest proportion was in coeducational secondary schools where mathematics was taught by male teachers.

A typical pattern on the effects of teachers' gender on students' mathematics achievement cannot be drawn from the literature.

**Effects of Single –sex schools on Girls Attitude and Achievement**

There are literatures that support the idea of single-sex schooling for girls. A study by Collis (1987) has indicated that single-sex school environments have tended to be more closely associated with positive attitudes towards mathematics, particularly by girls. Schildkamp-kundiger (1982) report that in most countries in Western Europe and United states which reported sex-difference in mathematical achievement it was noted that these differences were greatly reduced in all-girls schools.

Authors who have argued for single-sex classes (e.g. Streitmatter, 1997; Wood and Brown, 1997), claim that single-sex mathematics classrooms for girls

will increase their confidence, achievement and subsequent participation in higher-level coursework in mathematics. Durost (1996), Tulloch (1995) and Smith (1994) have argued that in single-sex classrooms girls experience an environment in which they are not subject to the same higher levels of intimidation by boys, usually found in mixed-sex classrooms.

Smith ( as cited in UNESCO,1985) studied the results of 18 months of teaching one class of girls separately from boys, and another class mixed, with the same teacher trying to give each an identical treatment. He found that the mathematics performance of the girls in the mixed classroom declined significantly in comparison, both with the boys in this classroom, and also in comparison with the all-girls classroom. But the girls in the all-girls classroom achieved equally with the boys in the mixed classroom.

Mallam (1993), using the data from a stratified random sample of 240 female students from five coeducational and six all-girls secondary schools in Nigeria discovered that the highest proportion of female students demonstrating positive attitude towards mathematics was found in all-girls schools where mathematics was taught by females while the lowest proportion was in coeducational secondary schools where mathematics was taught by male teachers.

Nkani (1993) found that girls in single-sex Senior Secondary Schools achieve higher and have positive attitudes toward mathematics than girls and boys in the mixed (coeducational) school. Streitmatter (1997), also found out that the participants in his two-year study of seventh-and eighth-grade girls in all-female mathematics classes had enhanced ability to learn the mathematics, an improved

view of themselves as mathematicians, and clear indication that they prefer this type of environment.

However, after trying single-sex math classrooms in mixed schools for a few years in the United Kingdom, some schools in the United Kingdom gave them up and returned to the mixed-classrooms because they were associated with discipline problem. Smith (as cited in UNESCO, 1985) indicates teachers had some reservations about single-sex classrooms because discipline was a problem. Wilce (as cited in UNESCO, 1985), suggest that the improved performance of girls may be due to other factors, and that the single –sex group generate more problems than they solve; the problems he identified included negative staff reactions, and increased discipline problems. Fennema (1979) cautioned about single –sex classrooms, as a results of past segregation of women and minorities.

**Teachers' Behaviour**

The learning environment in which students learn particularly teacher - students relationship is important, and Williams (1988) suggests mathematics teachers offer a classroom environment in which students feel comfortable. Teachers need to strongly examine their behaviour and reactions to students and others' actions and reactions as well, and avoid criticisms.

Lindholm, (1981) report of a group in Sweden that focused on changing teachers' attitude towards accepting girls' rightful place in mathematics and science. He explains that, teachers must accord to girls' experiences and suggestions the same status as they give to those of boys'. After noting that when thinking about the technological future, boys place very little emphasis on human

beings while girls more often describe the everyday social and human situation, Lindholm points out that it is this essential contribution that girls can make to help form an enhanced society.

Steele and Arth (1998) were of the same view. They say teachers have to be extremely careful in the manner in which they ask for correct answers and suggest teachers never single out any student but rather, ask for volunteers. Steele and Arth continue to declare that, if students are struggling with a problem, teachers need to persuade them not to give up, but to point out to the students the positive things they are doing to solve the problem.

To educate future teachers on problem areas in mathematics such as sex-role stereotyping in mathematics teaching, Bishop (1982) uses two methods;

> students' group research project, and simulation and role-play activities. He describes the group project as consisting of the following: 'individual student could test children on a written-attitude instrument, interview individual children using photographs as stimuli, interview teachers about differences between the boys and girls they teach, observe and record classroom interactions between pupils or between pupils and the teacher, observe non-verbal behavioural patterns in class, and experiment with the use of reverse sex-role math problems. He argues that after a time for reflection and analysis, the group discussion of different findings can be a most stimulations experience for all concerned including of course the tutor. (Bishop, 1982, p.129).

He claims that the stimulation and role-play activities help students to become aware of the feelings, perceptions, and emotions which are present in the social act of teaching.

In view of the fact that most teachers are unaware of their influence on students' attitudes toward mathematics and girls, Raat, (1981) in the MENT-project (Girls in Science and Technology) in the Netherlands demonstrates to teachers the negative situation of girls in physics lessons by using video-tapes showing how teachers interact one way with boys and another way with girls. The tapes also illustrate the different ways boys and girls co-operate in lessons.

Teacher-student relationship has been identified to have a significant influence on overall school and behavioural adjustment (Baker, Terry, Bridger, & Winsor, 1997). Arem (2003) believes one way to reduce or possibly avoid mathematics anxiety among students is by creating success. She supports having a strong, positive belief system—especially for the mathematics anxious.

Williams (1988) also, indicates that teachers need to be familiar with mathematics strengths and weaknesses of each student, and teachers can help weaker mathematics students feel successful by giving them assignments that will likely give them a success.

Pianta, Steinberg and Rollins (1995) also, found that positive teacher-student relationships, defined as "warm, close, communicative," are related to behavioural competency and better school adjustment. The effects of negative attitudes of teachers was examined by McLeod (1994) who found that children come to school with positive attitudes towards mathematics but their attitudes

become less positive as they progress through primary school. There is therefore the need to investigate into the impacts that a teachers' behaviour have on their students' attitude toward mathematics

Hancock, Shannon, and Trentham (1993), in a study into teacher-student gender interactions in students rating of teachers, found from a data gathered from 29,519 students' ratings of their teachers in the US that; in general boys tended to rate male teachers higher and girls also rated female teachers higher. An earlier study by Tieman and Rankin-Ullock (1985) indicated that students rated teachers of the opposite sex more highly.

**Summary of key points raised in the Literature Review**

Teacher characteristics have been found to affect students' education. The pedagogical-content knowledge of the mathematics teacher has been found to be associated with higher achievement gains in mathematics of the students. Teachers' inexperience is believed to have a negative impact on students' mathematics achievements; hence students of experience teachers are believed to outperform those of inexperience teachers. Female teachers are found to have a positive impact on girls' attitude toward mathematics; however, from the literature no conclusion can be drawn on effects of teacher's gender on students' achievements in mathematics. Single-sex school environment also promote positive attitude and higher achievement in mathematics particularly of girls.

# CHAPTER 3

# METHODOLOGY

## Overview

This chapter focuses on the research design, population, sample and sampling technique, instruments used for the study, validity and reliability of the instruments, data collection procedure and analysis of data.

## Research Design

The survey design was used for this study. Survey involves collection of data by means of test, questionnaires, observations, interviews or examination of documents. Surveys gather data at a particular point in time with a view of (a) describing the nature of existing conditions or (b) identifying standards against which existing conditions can be compared or (c) determining the relationships that exist between specific events.(Cohen & Manion, 1989).

The survey was used because it is a design that gathers information from a sample of a predetermined population (Fraenkel & Wallen, 2000). This design was appropriate for the study because the study attempted to give a snap shot of the achievements and attitudes of students in relation to the gender and

qualifications of their mathematics teachers, and by school type. Also the study attempted to describe characteristics of a population using a sample.

Mitchell and Jolley (2004) indicated that it is economical to use survey because it makes it possible for many subjects to be studied at a particular point in time. Also, survey has the advantage of providing a lot of helpful information from the subjects of the study (Fraenkel & Wallen, 2000). However, the problems involved in using the survey design for such a study includes; getting adequate number of questionnaires completed and returned, and getting respondents to sincerely respond to the items on the questionnaire.

## Population

Population for the study was all public junior secondary school girls and their mathematics teachers. The target population from which samples were selected for the study was all junior high school form three girls and their mathematics teachers.

## Sample and Sampling Procedure

Because of time, convenient sampling was first used to select the Cape Coast, Accra and Kumasi metropolises. The junior secondary schools in these metropolises were put into two groups; single-sex schools and mixed (coeducational) schools. In these selected metropolises, the mixed schools were stratified into two groups (those with female mathematics teachers and those with male mathematics teachers). Purposive sampling was used to select two schools from each category; the schools where the current form three mathematics teacher taught the class when they were in form two were selected for the study.

Two single-sex (all-girls) schools were randomly selected using computer generated numbers from the cape coast and Kumasi metropolises. In the Accra metropolis, there were only two public single-sex (all- girls) school and these schools were conveniently sampled for the study.

In schools where the junior high school form three girls were 15 or less, all of them were sampled but in schools where they were more than 15, lottery was used to select 15 of them. The mathematics teachers in the selected schools who have taught the girls for at least one year at the time of the study were also sampled for the study.

In all 262 girls and their 18 mathematics teacher (eight females and 10 males) were selected for the study.

**Instruments**

The instruments that were used for the study were questionnaires and achievement test. A questionnaire was prepared to elicit girls' responses to the attitudinal variables and the perception of the mathematics teacher's behaviour towards them. The items on the questionnaire were based on the variables; mathematics as a male domain, mathematics anxiety, confidence in mathematics, and Perception of teacher's behaviour. Seven (7) items were constructed on each of the attitudinal variables. Five-point likert scale items were used, the options were; 'strongly agree', 'agree', 'uncertain', 'disagree' and 'strongly disagree'.

Ten (10) items were constructed to elicit girls' responses on their perception of the teacher's behaviour towards them. Five- point likert scale items were used.

The responses were; ‘Very true’, ‘True’, ‘not sure’, ‘not true to some degree’ and ‘not true at all’.

An achievement test was constructed and administered to the girls. The achievement test was based on the JSS syllabus. To cover a wide range of the syllabus multiple choice items were constructed.

A different questionnaire was constructed for the mathematics teachers to elicit information about their beliefs about female students and effective pedagogy for students. Ten (10) items were constructed on teacher’s perceptions about female students and ten (10) items on effective methodology for females. The responses were ‘agree with the statement’, ‘boys and girls are equal in this respect’ and ‘the opposite is true for this statement’.

**Validity and Reliability of the Instruments**

The achievement test was strictly based on the JSS syllabus also sample BECE mathematics questions particularly that of 2007 was used as a guide in constructing the test items. On the questionnaire for girls, the items on the male domain and self-confidence variables were adapted from the “Fennema-Sherman Attitude Scales (1976)”, those on the anxiety variable were adapted from Eshun’s (1987) instruments, and those on the perception of the mathematics teacher’s behaviour were adapted from the availability and acceptance sub-scale.

The items on the teachers’ questionnaire soliciting teachers’ views on beliefs about female students and effective methodology were adapted from the instruments used by Morin (2003) surveys on teachers’ gender related beliefs.

These instruments were made available to an expert in the field to determine their face validity after which they were pilot-tested on some 84 junior high school girls and 32 mathematics teachers in the Komenda Edina Eguafo Abirim (KEEA) district in the Central region.

The reliability of the questionnaires and the achievement test were estimated using coefficient alpha method and Kuder-Richardson (K-R 21) formula respectively. Coefficient alpha method is used to estimate the reliability of a test in which the score to each item take on a range of values. Kuder- Richardson (K-R) 21 formula is used to estimate the reliability of items scored dichotomously so it was used to estimate the reliability of the achievement test. The calculation is shown in Appendix E.

The reliability of the achievement test was determined to be 0.752. For the girls' questionnaire, the cronbach alpha for each of the variables was determined. The cronbach alpha for the mathematics anxiety sub-scale was determined to be 0.830, that of the mathematics as a male domain sub-scale was 0.77, 0.792 was obtained for the self confidence sub-scale and that of the students' perception of teacher's behaviour towards them was 0.856.

The reliability coefficient of the teachers' questionnaire was also determined. The cronbach alpha for the items on teachers' perceptions about female students was calculated to be 0.773 and that of the effective pedagogy items was 0.750.

## Data Collection

Data were collected by the researcher. The researcher visited the selected schools to seek permission from the heads and explained the purpose of the study to them, and also arranged the date and time for the administration of the instruments. The questionnaires and the achievement test were administered on the same day.

The purpose of the study was explained to the mathematics teachers involved and the girls before the instruments were administered. The researcher waited and collected the instruments back after the girls and their mathematics teachers had responded to them.

In all the selected schools, the achievement test was administered first followed by the questionnaire for girls and that for teachers. The administration of the questionnaires and achievement test in the 18 selected schools took about one and half months.

## Data Analysis

After collecting the data, the responses to the items on both the teachers' questionnaire and students' questionnaire were coded. The responses to the items on the section B of the students' questionnaire were assigned values: '5'for 'strongly agree', '4' for 'agree', '3' for 'undecided', '2' for 'disagree' and '1' for 'strongly disagree'. If a student disagree with a statement indicating a negative attitude (e. g, I know I will not do well in mathematics), the response was interpreted as "agree" and if strongly disagree it was interpreted as "strongly agree". A score of less than 3 measures a negative characteristic of the attitudinal

variable and a score of greater than 3 indicates a positive characteristic of the variable. The maximum score a person could obtain on each of the attitudinal variables was 35 and the minimum was 7. A total score of above 21 on a variable indicates a positive characteristic of the attitudinal variable and a total score of less than 21 a negative characteristic of the attitudinal variable.

The independent t –test was used to test whether there is significant difference between the responses to the items on the attitudinal variables of:

1. girls in mixed schools and girls in single-sex schools
2. girls taught by female mathematics teachers and girls taught by male mathematics teachers
3. Girls taught by teachers with mathematics majors and teachers with non-mathematics majors.
4. Girls taught by professional teachers and those taught by non-professionals

The section 'C' of the students' questionnaire solicits students' perception of their mathematics teachers' behaviour towards them. The items on this part of the questionnaire were assigned values; 5 for 'Very true', 4 for 'True', 3 for 'not sure', 2 for 'not true to some degree' and 1for 'not true at all'. Responses to statements that express negative behaviour were coded in the reverse order. A total score above 30 indicates a positive perception of the teacher's behaviour and less than 30 indicates a negative perception of the teacher's behaviour. Independent samples t-test was used to determine whether there is significant difference in how girls perceive their mathematics teacher behaviour.

The teachers' questionnaire was in three sections, the first section sought personal information about the teachers. The section B was to solicit teachers' views about some beliefs about female students. Section C was to solicit their views on various teaching strategies. The items on both sections B and C were coded the same way; 1 for 'agree with the statement', 2 for 'think boys and girls are equal in this respect' and 3 for 'believe the opposite is true for this statement'. Means and standard deviations were calculated. The nearer the mean is to 1 indicate "believe the statement is true", the nearer it is to 3 indicate "believe the opposite of the statement is true" and the nearer it is to 2 indicate "believe boys and girls are equal in respect to the statement". The independent samples t-test was used to find whether there was a significantly difference in the responses by gender of teachers, by subject of specialization and by professional status.

The achievement test was scored out of thirty (30) using rubrics. The means and standard deviations were determined for the scores of students on the achievement test. Independent samples t-test was used to test whether there is significant difference in the mean performance of:

1. Girls in mixed schools and girls in single-sex schools.
2. Girls taught by female mathematics teachers and girls taught by male mathematics teachers.
3. Girls taught by teachers with mathematics majors and teachers with non-mathematics majors.
4. Girls taught by professional teachers and those taught by non-professionals

The Pearson- product moment correlation was used to determine whether there is correlation between; girls' perception of their mathematics teacher's behaviour and their attitudes toward mathematics, and girls' attitude and achievement.

# CHAPTER 4

# RESULTS AND DISCUSSIONS

## Overview

This chapter presents the findings on the study of "The Teacher Factor in Junior Secondary School Girls' Achievement and Attitudes towards Mathematics". The findings are presented and discussed in relation to the research questions.

## Research Question One

Research question one (a) was formulated as follows:

Do different categories of mathematics teachers differ in their beliefs about female students?

To answer this question data on teachers' beliefs about female students were obtained from mathematics teachers. There were three responses to each of the items, the responses were coded1 for 'agree with the statement', 2 for 'think boys and girls were equal in this respect' and 3 for 'believe the opposite was true for this statement'. The nearer the mean is to 1 indicate "believe the statement is true", the nearer it is to 3 indicate "believe the opposite of the statement is true"

and the nearer it is to 2 indicate "believe boys and girls are equal in respect to the statement" .

The analysis of the responses to the items on teachers' beliefs about female students was done by gender, teachers' subject of specialization and by professional status.

## Analysis of Mathematics Teachers' Responses to the items on Beliefs about Female Students

An independent samples t-test on the responses of male and female teachers to all the items showed that there is no significant difference between male and female mathematics teachers' beliefs about their female students.

However, a test on each of the statements showed that they differed significantly on one item "Girls show less ability in mathematics than boys". Patterns of responses to the statements have been presented in Table 1 and responses to some of the statements explained.

### Girls have lower perception of their abilities than boys

Male teachers had a mean score of 1.50 and female teachers had a mean score of 1.29 as in Table1. These mean scores indicate that male teachers than female teachers regard both girls and boys to have equal perceptions of their abilities.

The independent samples t-test on these mean scores revealed no significant difference between them, ($t_{(16)} < 1.96$ $p > 0.05$), indicating that mathematics teachers (male and female) do not differ much on their perceptions about students' perceptions of their abilities in mathematics.

**Table 1: Mathematics Teachers' Responses to items on Beliefs about Female Students by Gender**

| Item | Gender | Mean | SD | t | P |
|---|---|---|---|---|---|
| 1. Girls are less likely to work hard in math if they dislike the subject than boys. | Males | 1.80 | 0.63 | 0.63 | 0.54 |
| | Females | 1.63 | 0.52 | | |
| 2. Girls have a lower perception of their abilities than boys. | Males | 1.50 | 0.53 | 0.85 | 0.41 |
| | Females | 1.29 | 0.49 | | |
| 3. Girls work less independently in math than boys. | Males | 1.50 | 0.53 | 0.00 | 1.00 |
| | Females | 1.50 | 0.54 | | |
| 4. Girls show less ability in math than boys. | Males | 1.90 | 0.74 | 2.17 | 0.04 |
| | Females | 1.25 | 0.46 | | |
| 5. Girls are less willing to work hard in math than boys. | Males | 1.60 | 0.69 | 1.74 | 0.10 |
| | Females | 1.13 | 0.35 | | |
| 6. Girls demonstrate less interest in math than boys. | Males | 1.40 | 0.69 | 0.66 | 0.52 |
| | Females | 1.63 | 0.74 | | |
| 7. Girls are less likely than boys to imagine themselves pursuing math careers. | Males | 1.30 | 0.48 | 1.38 | 0.19 |
| | Females | 1.75 | 0.89 | | |

Table 1 continued

| | Item | Gender | Mean | SD | t | p |
|---|---|---|---|---|---|---|
| 8. | Girls do not see math as important for their future careers. | Males | 1.90 | 0.57 | 1.52 | 0.15 |
| | | Females | 1.50 | 0.54 | | |
| 9. | Girls are more willing to attribute success in math to luck than boys. | Males | 2.11 | 0.60 | 0.05 | 0.96 |
| | | Females | 2.13 | 0.64 | | |
| 10. | Girls achieve lesser in math than boys. | Males | 1.40 | 0.69 | 0.52 | 0.61 |
| | | Females | 1.25 | 0.46 | | |
| 11. | All items | Males | 1.62 | 0.30 | 0.76 | 0.46 |
| | | Females | 1.53 | 0.16 | | |

Alpha = 0.05

**Girls show less ability in mathematics than boys**

On this item, male teachers had a mean score of 1.90 and female teachers had 1.25. These mean scores shows that female teachers than male teachers see girls to have lower ability in mathematics than boys, and male teachers than female teachers also see girls and boys to have equal abilities in mathematics.

Independent samples t-test on these mean scores at 5% alpha level as in Table 1showed that there was a significant difference between the mean scores ($t_{(16)} > 1.96$ $p < 0.05$).

**Girls are less willing to work hard in mathematics than boys**

The mean score of male teachers on this item was 1.60 and that of female teachers was 1.13 as presented in Table 1, indicating that female teachers are of

the belief that girls are less willing to work hard in mathematics and male teachers are of the belief that boys and girls are equal in this respect.

An independent samples t-test at 5% alpha level on these mean scores indicated however that, the means were not significantly different ($t_{(16)} < 1.96$ $p > 0.05$).

**Analysis of Mathematics major and Non-mathematics major Teachers' Responses to items on Beliefs about Female Students**

Analysis of the responses of teachers who specialized in subjects other than mathematics and those who specialized in mathematics showed that they differed significantly on only one of the items: "Girls achieve lesser in mathematics than boys". An independent samples t-test on their overall means on all the items however showed no significant difference between these groups of teachers. Pattern of responses to some of the items are presented in Table 2.

**Girls are less willing to work hard in mathematics than boys**

Teachers who specialised (majored) in mathematics were of the view that both boys and girls were equal with regard to this statement. They had a mean score of 1.60 which is closer to 2. Teachers who majored in subjects other than mathematics had a mean score of 1.13 which indicate that they are more of the view that boys work hard in mathematics than girls.

The independent samples t-test at 5% significant level as in Table 2 showed however that the difference between their mean scores was not significant ($t_{(16)} < 1.96$ $p > 0.05$).

**Table 2: Responses of Mathematics major and Non- Mathematics major Teachers to items on Beliefs about Female Students**

| Item | Subject | Mean | SD | t | p |
|---|---|---|---|---|---|
| 1. Girls are less likely to work hard in math if they dislike the subject than boys. | Mathematics | 1.70 | 0.48 | 0.18 | 0.86 |
| | Others | 1.75 | 0.71 | | |
| 2. Girls have a lower perception of their abilities than boys. | Mathematics | 1.44 | 0.53 | 0.27 | 0.79 |
| | Others | 1.38 | 0.52 | | |
| 3. Girls work less independently in math than boys. | Mathematics | 1.50 | 0.53 | 0.00 | 1.00 |
| | Others | 1.50 | 0.54 | | |
| 4. Girls show less ability in math than boys. | Mathematics | 1.70 | 0.68 | 0.59 | 0.56 |
| | Others | 1.50 | 0.76 | | |
| 5. Girls are less willing to work hard in math than boys. | Mathematics | 1.60 | 0.69 | 1.74 | 0.10 |
| | Others | 1.13 | 0.35 | | |
| 6. Girls demonstrate less interest in math than boys. | Mathematics | 1.50 | 0.85 | 0.00 | 1.00 |
| | Others | 1.50 | 0.54 | | |

Table 2 continued

| | Item | Subject | Mean | SD | t | p |
|---|---|---|---|---|---|---|
| 7. | Girls are less likely than boys to imagine themselves pursuing math careers. | Mathematics<br>Others | 1.50<br>1.50 | 0.71<br>0.76 | 0.00 | 1.00 |
| 8. | Girls do not see math as important for their future careers. | Mathematics<br>Others | 1.60<br>1.88 | 0.52<br>0.64 | 1.01 | 0.33 |
| 9. | Girls are more willing to attribute success in math to luck than boys. | Mathematics<br>Others | 2.11<br>2.13 | 0.60<br>0.64 | 0.05 | 0.96 |
| 10. | Girls achieve lesser in math than boys. | Mathematics<br>Others | 1.60<br>1.00 | 0.69<br>0.00 | 2.41 | 0.03 |
| 11. | All items | Mathematics<br>Others | 1.62<br>1.51 | 0.24<br>0.17 | 0.843 | 0.41 |

Alpha = 0.05.

**Girls are more willing to attribute success in mathematics to luck than boys**

The mean scores of both group of teachers on this item indicated that they belief both boys and girls attribute success in mathematics to luck. Mathematics majored teachers had a mean score of 2.11 and non –mathematics majored teachers had a mean score of 2.13 as presented in Table 2.

Independent samples t-test on the means also showed no significant difference in their responses to this item ($t_{(16)} < 1.96$ $p > 0.05$).

**Girls achieve lesser in mathematics than boys**

An independent samples t-test on the responses of mathematics majored teachers and non- mathematics majored teachers as shown in Table 2 revealed that they differed significantly on views held on this item ($t_{(16)} > 1.96$ $p < 0.05$). Mathematics majored teachers had a mean score of 1.60 and standard deviation of 0.69 indicating that they are more of the belief that boys and girls achieve equally in mathematics, and the non- mathematics majored teachers had a mean of 1.00 and standard deviation of 0.00 indicating that they are of the belief that girls achieve lesser in mathematics than boys.

## Analysis of Professional and Non-professional Teachers' Responses to items on Beliefs about Female Students

The analysis of the responses to the items on beliefs about female students revealed that professional and non-professional teachers differed significantly on their responses to one of the items on beliefs about female students "Girls achieve lesser in math than boys". Their overall means however indicates that they do not hold significantly different beliefs about females.

The results of the analysis of their responses to the items are presented in Table 3 and some of the responses discussed.

**Girls are more willing to attribute success in math to luck than boys**

Analysis of the responses of these two groups of teachers on this item as presented in Table 3 revealed no significant difference between their mean scores ($t_{(16)} < 1.96$ $p > 0.05$).

Professional teachers had a mean score of 2.18 and non professional teachers had a mean score of 2.00 indicating that both group of teachers regard boys and girls to be equal with respect to this statement.

**Girls achieve lesser in mathematics than boys**

On this item, professional teachers had a mean score of 1.50 and standard deviation of 0.67 indicating that they were of the view that boys and girls are equal with regard to this statement. Non-professional teachers on the other hand had a mean score of 1.00 and standard deviation of 0.00 which also indicate that they were of the belief that boys achieve higher in mathematics than girls.

The independent samples t-test on these mean scores as in Table 3 showed that they were significantly different ($t_{(16)} > 1.96$ $p < 0.05$).

**Girls do not see mathematics as important for their future careers like boys**

Professional teachers had a mean score of 1.58and standard deviation of 0.52, and non professional teacher had a mean score of 2.00 with standard deviation of 0.63 indicating that both group of teachers were of the belief that both boys and girls have equal regards for the importance of mathematics for their future careers. Independent samples t-test on the means at 5% alpha level as in Table 3 showed that they did not differ significantly ($t_{(16)} < 1.96$ $p > 0.05$).

**Table 3: Responses of Professional and Non- professional Teachers to items on Beliefs about Female Students**

| | Item | Status | Mean | SD | t | p |
|---|---|---|---|---|---|---|
| 1. | Girls are less likely to work hard in math if they dislike the subject than boys. | Professional<br>Non-professional | 1.67<br>1.83 | 0.49<br>0.75 | 0.57 | 0.58 |
| 2. | Girls have a lower perception of their abilities than boys. | Professional<br>Non-professional | 1.45<br>1.33 | 0.52<br>0.52 | 0.46 | 0.65 |
| 3. | Girls work less independently in math than boys. | Professional<br>Non-professional | 1.42<br>1.50 | 0.52<br>0.54 | 0.43 | 0.63 |
| 4. | Girls show less ability in math than boys. | Professional<br>Non-professional | 1.67<br>1.67 | 0.65<br>0.52 | 0.97 | 0.35 |
| 5. | Girls demonstrate less interest in math than boys. | Professional<br>Non-professional | 1.58<br>1.17 | 0.79<br>0.41 | 0.69 | 0.49 |
| 6. | Girls are less willing to work hard in math than boys. | Professional<br>Non-professional | 1.50<br>1.50 | 0.67<br>0.84 | 0.47 | 0.65 |

Table 3 continued

| | Item | Status | Mean | SD | t | p |
|---|---|---|---|---|---|---|
| 7. | Girls are less likely than boys to imagine themselves pursuing math careers. | Professional<br>Non-professional | 1.67<br>1.33 | 0.78<br>0.52 | 1.46 | 0.16 |
| 8. | Girls do not see math as important for their future careers. | Professional<br>Non-professional | 1.58<br>2.00 | 0.52<br>0.63 | 1.51 | 0.15 |
| 9. | Girls are more willing to attribute success in math to luck than boys. | Professional<br>Non-professional | 2.18<br>2.00 | 0.60<br>0.63 | 0.58 | 0.57 |
| 10. | Girls achieve lesser in math than boys. | Professional<br>Non-professional | 1.50<br>1.00 | 0.67<br>0.00 | 2.57 | 0.03 |
| 11. | All items | Professional<br>Non-professional | 1.61<br>1.52 | 0.29<br>0.13 | 0.71 | 0.49 |

Alpha =0.05

The findings indicate that all categories of teachers do not differ much on their beliefs about female students. This finding is consistent with that of Morin (2003), who also found no significant differences in the junior high school male and female mathematics teachers' beliefs about mathematics students. However,

the analysis revealed that female teachers were of the view that boys have higher ability in mathematics than girls while male teachers believe that boys and girls have the equal abilities in mathematics (see Table 1),

Non-professional teachers (Table 3) and non-mathematics major teachers (Table2) were also of the belief that boys achieve higher in mathematics than girls. The beliefs of these categories of teachers are consistent with the findings of Fennema (1990), Fennema et al (1990) and Jones and Dindia (2004). Fennema (1990) and Fennema et al (1990) found that teachers have different expectations of female and male students which lead the teachers to overrate the mathematics abilities of the males and underrate that of the females. Jones and Dindia (2004) also indicate that teachers may indirectly communicate that they have different academic expectations of boys and girls and these biased expectations of teachers may then become self-fulfilling when students respond to them.

**Research Question One (b)**

Research question one (b) was formulated as: Do different categories of mathematics teachers differ on their views about effective methodology for girls? Responses to the items on views about effective methodology were similar to those of the perceptions about female students described in research question one. Again responses to the items on views about effective methodology were analyzed by gender, by subject of specialization and by profession status.

## Result of the Analysis of the Responses to the items on Beliefs about Effective Methodology by Gender of Teachers

Male and female teachers did not differ significantly on their views about effective methodology for girls. They differed significantly on only one statement. "Girls learn better in cooperative activities". Table 4 presents the results of the analysis of their responses to the statements. Some responses are discussed.

**Girls learn better in cooperative activities**

Female mathematics teachers had a mean score of 1.13 and standard deviation of 0.35 indicating that they were more of the view that girls learn better in cooperative activities. Male teachers on the other hand, indicated that boys and girls were equal with respect to this statement. They had a mean score of 1.89 and standard deviation of 0.33.

Independent samples t-test on these means as presented in Table 4 showed that they were significantly different ($t_{(16)} > 1.96$ $p < 0.05$). That is male and female teachers had different beliefs with regard to this statement.

**Girls do not respond better to criticisms like boys**

Independent samples t-test on the mean scores of male and female teachers on this item showed no significant difference in their mean scores ($t_{(16)} < 1.96$ $p > 0.05$). The mean scores of both groups of teachers showed that they were more of the belief that boys and girls respond the same way to criticisms. Both group of teachers had a mean score of 1.50 (See Table 4).

**Linking mathematics concepts to real world situations has a greater impact on motivating girls than boys**

Male teachers had a mean score of 1.90 while female teachers had 1.63 on this item as shown in Table 4. These mean scores indicate that male and female teachers were of the view that linking mathematics concepts to real world situations impact equally on boys and girls. Independent samples t-test on these means showed no significant difference between them ($t_{(16)} < 1.96$ $p > 0.05$).

**Table 4: Responses of Mathematics Teachers to items on Beliefs about Effective Methodology by Gender**

| Items | Gender | Mean | SD | t | P |
|---|---|---|---|---|---|
| 1. Girls tend to learn better in a competitive environment. | Male | 1.50 | 0.53 | 0.00 | 1.00 |
| | Female | 1.50 | 0.76 | | |
| 2. Girls' families are more likely than boys' families to encourage them to pursue math at the SHS. | Male | 2.50 | 0.53 | 1.033 | 0.32 |
| | Female | 2.13 | 0.99 | | |
| 3. Girls require more encouragement to participate in math class than boys. | Male | 1.50 | 0.53 | 0.50 | 0.62 |
| | Female | 1.38 | 0.52 | | |
| 4. Girls do not respond better to criticisms like boys. | Male | 1.50 | 0.71 | 0.00 | 1.00 |
| | Female | 1.50 | 0.76 | | |
| 5. Girls need more praise than boys to stay motivated. | Male | 1.56 | 0.53 | 0.22 | 0.83 |
| | Female | 1.50 | 0.54 | | |

Table 4 continued

| Item | Gender | Mean | SD | t | P |
|---|---|---|---|---|---|
| 6. Girls learn better in cooperative environment. | Male | 1.89 | 0.33 | 4.58 | 0.00 |
| | Female | 1.13 | 0.35 | | |
| 7. Exposure to same sex role models is important for girls than for boys. | Male | 1.50 | 0.53 | 1.05 | 0.307 |
| | Female | 1.25 | 0.46 | | |
| 8. Girls need more encouragement to solve problems independently. | Male | 1.30 | 0.48 | 0.83 | 0.42 |
| | Female | 1.50 | 0.54 | | |
| 9. Linking math concepts to real world situations has a greater impact on girls than boys. | Male | 1.90 | 0.32 | 1.39 | 0.18 |
| | Female | 1.63 | 0.52 | | |
| 10. Peers have a greater influence on girls' decision to pursue math at the SHS than they do influence boys' decision. | Male | 2.10 | 0.74 | 0.07 | 0.95 |
| | Female | 2.13 | 0.84 | | |
| 11. All items | Male | 1.78 | 0.19 | 0.93 | 0.38 |
| | Female | 1.61 | 0.20 | | |

Alpha=0.05

**Analysis of Responses of Mathematics major and Non-mathematics major Teachers to items on Beliefs about Effective Methodology**

The two groups of teachers did not differ significantly on their responses to any of the items on beliefs about effective methodology. However, observe pattern of responses to the items are presented in Table 5.

**Girls require more encouragement to participate in mathematics class than boys**

Independent samples t-test at 5% significant level on the mean scores of mathematics major and non-mathematics major teachers on this item as in Table 5 showed no significant difference between them ($t_{(16)} < 1.96$ $p > 0.05$).

The mean score of mathematics major teachers was 1.40 indicating that they were more of the belief that girls require more encouragement than boys to participate in a mathematics class. Non-mathematics major teachers also, had a mean of 1.50 on this item, which indicate that they were of the belief that boys and girls require the same level of encouragement to participate in a mathematics class.

**Girls need more praise than boys to stay motivated**

Mathematics major teachers had a mean score of 1.50 and non-mathematics major teachers had a mean score of 1.57, see Table 5. These mean scores indicate that both group of teachers saw boys and girls to require the same amount of praise to stay motivated. The independent samples t-test on their means also showed that they did not differ on their views about this item ($t_{(16)} < 1.96$ $p > 0.05$).

**Table 5: Responses of Mathematics major and Non-mathematics major Teachers on Beliefs about Effective Methodology**

| Items | Subject | Mean | SD | t | P |
|---|---|---|---|---|---|
| 1. Girls tend to learn better in a competitive environment. | Mathematics | 1.40 | 0.52 | 0.76 | 0.46 |
| | Others | 1.63 | 0.74 | | |
| 2. Girls' families are more likely than boys' families to encourage them to pursue math at the SHS. | Mathematics | 2.10 | 0.74 | 1.49 | 0.15 |
| | Others | 2.63 | 0.74 | | |
| 3. Girls require more encouragement to participate in math class than boys. | Mathematics | 1.40 | 0.52 | 0.40 | 0.69 |
| | Others | 1.50 | 0.54 | | |
| 4. Girls do not respond better to criticisms like boys. | Mathematics | 1.70 | 0.82 | 1.38 | 0.19 |
| | Others | 1.25 | 0.46 | | |
| 5. Girls need more praise than boys to stay motivated. | Mathematics | 1.50 | 0.53 | 0.27 | 0.79 |
| | Others | 1.57 | 0.54 | | |
| 6. Girls learn better in cooperative environment. | Mathematics | 1.40 | 0.52 | 1.26 | 0.23 |
| | Others | 1.71 | 0.49 | | |
| 7. Exposure to same sex role models is important for girls than for boys. | Mathematics | 1.30 | 0.48 | 0.83 | 0.42 |
| | Others | 1.50 | 0.53 | | |

Table 5 continued

| Item | Subject | Mean | SD | t | P |
|---|---|---|---|---|---|
| 8. Girls need more encouragement to solve problems independently. | Mathematics | 1.50 | 0.53 | 1.05 | 0.31 |
| | Others | 1.25 | 0.46 | | |
| 9. Linking math concepts to real world situations has a greater impact on girls than boys. | Mathematics | 1.90 | 0.316 | 1.39 | 0.18 |
| | Others | 1.63 | 0.52 | | |
| 10. Peers have a greater influence on girls' decision to pursue math at the SHS than they do influence boys' decision. | Mathematics | 1.90 | 0.74 | 1.35 | 0.19 |
| | Others | 2.38 | 0.74 | | |
| 11. All items | Mathematics | 1.64 | 0.24 | 1.32 | 0.21 |
| | Others | 1.78 | 0.17 | | |

Alpha= 0.05

**Linking mathematics concepts to real world situations has a greater impact on girls than boys**

Both group of teachers indicated that they believe linking mathematics concepts to real world situations has the same impact on boys and girls. Mathematics major teachers had a mean of 1.90 on this item and non-mathematics major teachers had a mean of 1.63 as shown in Table 5. The independent samples t-test on their means showed no significant difference between them ($t_{(16)} < 1.96$ $p > 0.05$).

**Analysis of professional and non-professional teachers' responses to the items on views about effective methodology**

Responses of the two groups of teachers on these items were not statistically significantly different. Responses to the statements are reported in Table 6 and some discussed.

**Girls require more encouragement to participate in mathematics class than do boys**

On this item, professional teachers had a mean of 1.33indicting that they believed the statement is true while the non-professional teachers had a mean of 1.67which indicates that they were more of the belief that boys and girls require the same level of encouragement to participate in mathematics class.

However, independent samples t-test on the means as presented in Table 6 showed that they were not significantly different ($t_{(16)} < 1.96$ $p > 0.05$).

**Girls do not respond better to criticism like boys**

The professional teachers indicated that boys and girls respond in the same way to criticisms, they had a mean score of 1.67. The non-professional teachers, on the other hand, had a mean score of 1.17 indicating they believed the statement is true. The independent samples t-test on the means at 5% alpha level as in Table 6, however, showed no significant difference between them ($t_{(16)} < 1.96$ $p > 0.05$).

**Girls need more encouragement to solve problems independently**

The mean scores of the two groups of teachers showed that professional teachers believed that boys and girls need the same level of encouragement to solve problems independently, and the non- professional teachers also indicated

that they believe the statement is true. The professional and the non-professional teachers had a mean of 1.50 and 1.17 respectively. Independent samples t-test on the mean scores as in Table 6, however showed no significant difference between their responses to this item ($t_{(16)} < 1.96$ $p > 0.05$).

**Table 6: Responses of Professional and Non-Professional Teachers to Items on Beliefs about Effective Methodology**

| Items | Status | mean | SD | t | P |
|---|---|---|---|---|---|
| 1. Girls tend to learn better in a competitive environment. | Professional | 1.42 | 0.52 | 0.80 | 0.44 |
| | Non-professional | 1.67 | 0.82 | | |
| 2. Girls' families are more likely than boys' families to encourage them to pursue math at the SHS. | Professional | 2.25 | 0.75 | 0.64 | 0.52 |
| | Non-professional | 2.50 | 0.84 | | |
| 3. Girls require more encouragement to participate in math class than boys. | Professional | 1.33 | 0.49 | 1.33 | 0.20 |
| | Non-professional | 1.67 | 0.52 | | |
| 4. Girls do not respond better to criticisms like boys. | Professional | 1.67 | 0.78 | 1.46 | 0.16 |
| | Non-professional | 1.17 | 0.41 | | |
| 5. Girls need more praise than boys to stay motivated. | Professional | 1.42 | 0.52 | 1.45 | 0.17 |
| | Non-professional | 1.80 | 0.45 | | |

Table 6 continued

| Item | Status | Mean | SD | t | P |
|---|---|---|---|---|---|
| 6. Girls learn better in cooperative environment | Professional | 1.42 | 0.52 | 1.45 | 1.45 |
| | Non-professional | 1.80 | 0.45 | | |
| 7. Exposure to same sex role models is important for girls than for boys. | Professional | 1.42 | 0.52 | 0.32 | 0.75 |
| | Non-professional | 1.33 | 0.52 | | |
| 8. Girls need more encouragement to solve problems independently. | Professional | 1.50 | 0.52 | 1.36 | 0.19 |
| | Non-professional | 1.17 | 0.41 | | |
| 9. Linking math concepts to real world situations has a greater impact on girls than boys. | Professional | 1.83 | 0.39 | 0.77 | 0.45 |
| | Non-professional | 1.67 | 0.52 | | |
| 10. Peers have a greater influence on girls' decision to pursue math at the SHS than they do influence boys' decision. | Professional | 2.08 | 0.79 | 0.21 | 0.83 |
| | Non-professional | 2.17 | 0.75 | | |
| 11. All items | Professional | 1.66 | 1.02 | 0.92 | 0.37 |
| | Non-professional | 1.76 | 0.33 | | |

Alpha=0.05

The analysis of the responses to items on beliefs about effective methodology showed that all categories of teachers do not differ significantly on

their beliefs about effective methodology for girls. This finding is also consistent with that of Morin (2003) that male and female junior high school mathematics teachers do not hold significantly different beliefs about effective pedagogy. However, it was revealed that male and female teachers responded in significantly different ways to one of the items; "girls learn better in cooperative activities" (see Table 4). The female teachers were of belief that girls learn better in cooperative activities while the male teachers indicated that boys and girls learn the same way in cooperative activities. The belief of female teachers on this item is consistent with the claims of Fennema and Peterson (1987) that using cooperative activities correlates positively with girls' mathematics achievement, and that of Eshun and Ableduu (2001) that small-group cooperative learning settings address the low ability student' need for individual attention and motivation which will be provided by their more able peers. Akoto (2003) also found that, using small-group cooperative learning approach in the teaching of mathematics leads to higher students' achievement and improve attitudes towards mathematics.

**Research Question Two**

Research question two was stated as follows:

Is there any significant difference between the mean performances of:

1. Girls in all-girls schools and girls in the mixed schools?
2. Girls taught by male teachers and girls taught by female teachers?
3. Girls taught by teachers who specialized in mathematics and girls taught by teachers who specialized in other subjects?

4. Girls taught by professional and girls taught by non- professional teachers?

The achievement test was scored out of thirty (30) and analysed according to the research question.

**Mean Performance of Girls in All-girls Schools and Girls in the Mixed Schools**

The mean score on the achievement test for girls in all-girls schools was calculated to be 15.90 and that of girls in the mixed schools was 17.09. The means indicated that girls in the mixed schools performed a little better than their counterparts in the all-girls schools.

Independent samples t-test was used to test whether the difference between the mean scores was significant. The result as in Table 7 indicated that, at 5% significant level the difference was not significant ($t_{(260)} < 1.96$, $p > 0.05$). That is, girls in all-girls schools did not performed significantly lower than their colleagues in the mixed schools.

**Table 7**: **Mean Performance of Girls by School Type**

| School | mean | SD | t | p |
|---|---|---|---|---|
| All- girls | 15.90 | 5.667 | 1.755 | 0.080 |
| Mixed | 17.09 | 4.926 | | |

Alpha =0.05

**Mean Performance of Girls according to the Gender of their Mathematics Teachers**

Girls taught by male mathematics teacher had a mean score of 16.58 and those taught by female mathematics teachers had a mean score of 16.71. Girls taught by female mathematics teachers scored a little higher than the girls taught by male teachers.

To find out whether there is a significant difference between the two mean scores, independent samples t-test was used at 5% significant level. The result as shown in Table 8 revealed that the difference was not significant ($t_{(260)} < 1.96$ and $p > 0.05$). This indicates that girls taught by female mathematics teachers did not perform significantly better than girls taught by male teacher.

**Table 8**: **Mean Performance of Girls by Gender of Mathematics Teachers**

| Sex | Mean | SD | t-value | P –value |
|---|---|---|---|---|
| Male | 16.58 | 5.164 | 0.198 | 0.649 |
| Female | 16.71 | 5.297 | | |

Alpha =0.05,

**Mean Performance of Girls according to the Subject Majors of their Mathematics Teachers**

The mean score of girls were calculated according to their teachers' subject of specialization and independent samples t-test was ran to compare the means. The analysis of the scores of girls taught by teachers who specialized in mathematics and girls taught by teachers who specialized in subjects other than mathematics as shown in Table 9 revealed that the girls taught by teachers who

specialized in mathematics did significantly better than those taught by teachers who specialized in other subjects ($t_{(260)} > 1.96$, $p<0.05$).

The effect size was calculated to be 1.49 which shows that the mean difference between them was large. Cohen (1988) claims that effect size of $< 0.2$, $0.2 < d < 0.8$ and $d > 0.8$ respectively indicate small, medium and large mean difference. The calculation of the effect size is shown in Appendix F.

**Table 9: Mean Performance of Girls by the Subject Majors of their Mathematics Teachers**

| Subject | Mean | SD | t | P | Effect size (d) |
|---|---|---|---|---|---|
| Mathematics | 19.11 | 3.72 | 11.74 | 0.000 | 1.47 |
| Others | 12.83 | 4.91 | | | |

Alpha =0.05

**Mean Performance of Girls taught by Professional Teachers and Girls taught by Non- professional Teachers**

The results of the analysis as presented in Table 10 showed that girls taught by professional teachers scored significantly higher on the achievement test than girls taught by non -professional teachers ($t_{(260)} > 1.96$, $p < 0.05$). The mean difference between them was found to be large; the calculated effect size was 1.36

**Table 10: Mean Performance of Girls by Professional Status of their Mathematics Teachers**

| Status | Mean | SD | t | p | d |
|---|---|---|---|---|---|
| Professional | 18.64 | 4.017 | 10.373 | 0.000 | 1.36 |
| Non-professional | 12.68 | 5.060 | | | |

Alpha=0.05

Comparison of the mean scores on the achievement test of girls in mixed schools and girls in single sex schools revealed no significant difference between them. This result is not consistent with that of Nkani (1993), that, girls in single sex schools outperform those in the mixed schools, and Streitmatter (1997), wood and Brown (1997) who also claim that single-sex mathematics classrooms for girls will increase their confidence, achievement and subsequent participation in higher-level coursework in mathematics.

The analysis of the performance of girls taught by male teacher and those taught by female teacher showed that there was no significant difference between their performances. This result contrast with the claims of Nixon and Robinson (1999) who found that females attending high schools with a higher percentage of female faculty had higher levels of educational achievement, and that of Mwamwenda and Mwamwenda (1989), who claim that students of female teachers had significantly higher achievement scores in mathematics and other subjects than those taught by male teachers, and it is also not consistent with the claims of Warwich and Jatoi (1994) that students of male teachers score significantly higher in mathematics test than those of female teachers.

This finding is however consistent with the finding of Ehrenberg, Goldhaber and Brewer (1995) that a teacher's gender was not linked with the achievement gains of girls nor boys.

When the scores on the achievement test of girls taught by teachers with mathematics majors and girls taught by teachers with non-mathematics majors were compared, it was found that girls taught by teachers with mathematics majors significantly outperformed the girls taught by teachers with non-mathematics majors. This result is consistent with that of Goldhaber and Brewer (2000) that students taught by teachers with certificates in mathematics outperform the students whose teachers had certificates in other fields and TIMSS (1999) report which indicated that achievement in mathematics is associated with teachers having degrees in mathematics, and that of Begle (1979) who found that the number of credits a teacher had in mathematics methods courses had a strong correlation with student performance. It is also consistent with the claims of Wayne and Youngs (2003) that certification in a particular subject area, in this case, mathematics, may result in more effective teaching and that of Byrne (as cited in Darling Hammond, 2001 that there is a positive relationship between teachers subject of specialization and students achievement.

The professional training of teachers was also found to have impact on girls' achievement. The comparison of the girls' performance on the test by the professional status of their mathematics teachers showed that, girls of professional teachers significantly performed better than girls of non-professional teachers. This result is consistent with the findings of Angrist and Lavy (2001) who claim

that there is a strong relation between teacher training and student achievement in mathematics and Dildy (1982) that teachers training increases students performance and that of Bressoux (1996), who also found that teachers' professional training in mathematics increases students' performance in mathematics.

**Hypothesis One**

$H_o$: Girls taught by teachers with different levels of professional qualifications perform at the same level.

$H_1$: Girls taught by teachers with different levels of professional qualifications do not perform at the same level.

One-way ANOVA test on the scores of the girls on the achievement test according to the professional qualification levels of their mathematics teachers revealed that, girls taught by teachers with different levels of professional qualifications do not perform at the same level ($F_{(2,\ 170)} > 2.60$, $P < 0.05$). Therefore, the null hypothesis was rejected in favour of the alternative hypothesis. The result is presented in Table 11

**Table 11: One-Way ANOVA Test on Girls' Performance by the Level of their Teachers' Professional Qualifications**

| | Sum of squares | df | Mean square | F | sig |
|---|---|---|---|---|---|
| Between groups | 165.004 | 2 | 82.502 | | |
| Within groups | 2615.574 | 170 | 15.386 | 5.362 | 0.006 |
| Total | 2780.578 | 172 | | | |

Alpha =0.05

To find out where the differences exist, a Bonferoni posthoc test was run at 0.05 significant level. Bonferroni posthoc test uses t tests to perform pairwise comparisons between group means, but controls overall error rate (type one error) by setting the error rate for each test to the experimentwise error rate divided by the total number of tests. Hence, the observed significance level is adjusted for the fact that multiple comparisons are being made.

**Girls taught by Teachers with Certificate "A" and Girls taught by Teachers with Diploma in Basic Education (DBE)**

Pair-wise test as shown in Table 12 revealed a significant difference between the mean scores of girls taught by teachers with 3'year certificate "A" (cert "A") and girls taught by teachers with diploma in basic education (DBE), with a mean difference of 2.606 and a p-value of 0.004.

**Girls taught by Teachers with Diploma in Basic Education (DBE) and Girls taught by Teachers with Bachelor of Education (B.Ed)**

The Bonferroni test showed no significant difference between the mean score of girls taught by teachers with diploma in basic education (DBE) and that of girls taught by teachers with bachelor of education (B.Ed). The mean difference was found to be 1.260 and the p-value was 0.221.

**Girls taught by Teachers with Certificate "A" and Girls taught by Teachers with Bachelor of Education (B.Ed)**

The difference between the mean score of girls taught by teachers with bachelor of education (B.Ed) and that of girls taught by teachers with certificate

"A" was found to be 1.346. Bonferroni test at 5% alpha level as shown in Table 12 indicates that this mean difference is not significant. P-value was 0.218.

Base on the literature, it was expected that girls taught by teachers with bachelors' degree in mathematics will outperform the girls taught by teachers with certificate "A" and diploma in basic education (DBE). However, the findings revealed no significant difference between the performance of girls taught by teachers with bachelor of education (B.ED) and that of girls taught by teachers with DBE. This finding is not consistent with TIMSS (1999) report which indicated higher achievement in mathematics is associated with teachers having a bachelor's degree and or master's degree in mathematics.

However, the finding that girls taught by teachers with DBE qualification significantly outperformed their counterparts taught by teachers with certificate "A" is consistent with TIMSS (1999) report.

**Table 12: Mean Performance of Girls by the Level of Professional Qualifications of their Teachers**

| Qualification | Mean difference | Sig. |
|---|---|---|
| Cert. "A" | | |
| DBE | 2.606 | 0.004 |
| DBE | | |
| B.Ed | 1.260 | 0.221 |
| Cert. "A" | | |
| B.Ed | 1.346 | 0.218 |

Alpha= 0.05

**Hypothesis Two**

$H_o$: Girls taught by teachers with different years of teaching experience perform at the same level.

$H_1$: Girls taught by teachers with different years of teaching experience do not perform at the same level.

One-way ANOVA was used to test whether the girls taught by teachers with different years of teaching experience perform at the same level. The result as presented in Table 13 shows that girls taught by teachers with different years of teaching experience do not perform at the same level ($F_{(2, 259)} > 3.00$, $P < 0.05$). So the null hypothesis was rejected in favour of the alternative hypothesis.

**Table 13: One-Way ANOVA Test on Girls' Performance by Teachers' Years of Teaching Experience**

| | Sum of squares | df | Mean squares | F | Sig. |
|---|---|---|---|---|---|
| Between groups | 312.559 | 2 | 156.280 | 5.967 | 0.003 |
| Within groups | 6783.715 | 259 | 26.192 | | |
| Total | 7096.275 | 261 | | | |

Alpha = 0.05

**Performance of Girls taught by Teachers with 1-4 and those taught by Teachers with 5-10 Years Teaching Experience**

The difference between the mean scores of girls taught by teachers with 1-4 and girls taught by teachers with 5-10 years teaching experience was found to be 0.983 and the Bonferroni test as shown in Table 14 revealed that this mean difference is not significant at 5% alpha level.

**Performance of Girls taught by Teachers with 1-4 and those taught by Teachers with above 10 Years Teaching Experience**

The Bonferroni test revealed a significant difference between the performance of girls taught by teachers with 1-4 years teaching experience and that of girls taught by teachers with above 10 years teaching experience. The mean difference was 3.057 and the p-value was 0.002 as in Table 14. Thus girls taught by teachers with 1-4 years teaching experience performed significantly better than girls taught by teachers with above 10 years teaching experience.

**Table 14: Pair-Wise Test on Mean Performance of Girls by their Teachers' Years of Experience**

| Years | Mean difference | Sig. |
|---|---|---|
| 1-4 | | |
| 5-10 | 0.983 | 0.759 |
| 1-4 | | |
| Above 10 | 3.057 | 0.002 |
| 5-10 | | |
| Above 10 | 2.074 | 0.029 |

Alpha=0.05

**Performance of Girls taught by Teachers with 5-10 and those taught by Teachers with above 10 Years Teaching Experience**

The Bonferroni test at 5% significant level as shown in Table 14 revealed a significant difference between the performance of girls taught by teachers with 5-10 and those taught by teachers with above 10 years teaching experience. The girls taught by teachers with 5-10years teaching experience performed

significantly better than girls taught by teachers with above 10 years teaching experience. The mean difference was found to be 2.074 and the p-value was 0.029.

It was found that girls taught by teachers with 1-4 and 5-10 years teaching experiences performed significantly better than girls taught by teachers with above 10 years teaching experience. This finding is not consistent with the findings of Rivkin, Hannushek and Kain (2005) that students of experience teachers attained considerably higher levels of achievement than did students of teachers with one to three years of teaching experience, and that of Greenwald, Hedges, and Laine (1996), who also found a positive relationship between years of teacher experience and student test scores.

This finding again contradicts that of Murnane and Phillips (1981) that teachers with less teaching experience normally produce smaller learning gains in their students compared with teachers with more teaching years of teaching experience, and the findings of Rosenholtz (1986) and Hawkins, et al (1998) who found that students who were taught by teachers with less than 5 years of teaching experience had performance below the performance of students whose teachers had 6-10 years or 25 or more years of teaching experience.

However, this finding is consistent with the finding of Monk (1994) that teacher experience had no effect on student performance.

## Research Question Three

The research question three was formulated as:

Is there any significant difference between the attitudes of:

a. Girls taught by female mathematics teachers and those taught by male mathematics teachers towards mathematics?
b. Girls taught by mathematics major teachers and those taught by non-mathematics major teachers towards mathematics?
c. Girls in the single -sex schools and girls in mixed schools?
d. Girls taught by professional teachers and girls taught by non-professional teachers towards mathematics

To answer this question, responses to the various attitudinal variables were assigned values as described in chapter three, a total score of more than 21 on a variable indicates a positive characteristic of the variable and a total score of less than 21indicates a negative characteristic of the variable. The responses were analyzed in relation to the gender of the mathematics teacher, school type, and teachers' subject of specialization and by professional status of teachers.

## Girls taught by Male Mathematics Teachers and Girls taught by Female Mathematics Teachers

### Anxiety

An independent samples t-test was run to compare the scores of the two groups on anxiety, the result as in Table 15, shows that, at 5% significant level there was a statistically significant difference between the mean scores on the anxiety variable of girls taught by male teachers and girls taught by female

teachers [$t_{(260)} > 1.96$, $p < 0.05$]. Thus girls taught by male teachers experienced less anxiety than girls taught by female teachers. However, their mean difference was found to be small; the effect size was calculated to be 0.12.

**Male Domain**

Again, scores of the two groups of girls on the male domain variable was compared, independent samples t-test was run, and the outcome revealed no significant difference between the mean scores of the two groups of girls on the male domain variable, [$t_{(260)} < 1.96$ $p > 0.05$]. See Table 15.

The mean scores of the two groups however, indicate that they do not regard mathematics as a male domain

**Self - confidence**

Using the independent t-test to compare the two groups showed that the difference between the mean scores of the two groups on self-confidence variable was significant. Even though both groups had a mean score above 21, see Table 15, indicating they are both confident, girls taught by male teachers are more confident in themselves than those taught by female teachers [$t_{(260)} > 1.96$, $p < 0.05$]. Their mean difference was however found to be medium; effect size was 0.44.

The result of the analysis of the overall scores on all the three variables as in Table 15 shows that girls taught by male teachers demonstrate significant positive attitude towards mathematics than girls taught by female teachers [$t_{(260)} > 1.96$ $p < 0.05$].

**Table 15: Mean Scores on the Attitudinal Variables by Gender of Teacher**

| Attitudinal variable | Teacher's sex | Mean score | Std. deviation | t-value | p-value | d |
|---|---|---|---|---|---|---|
| Anxiety | Male | 26.40 | 5.127 | 3.005 | 0.003 | 0.12 |
| | Female | 24.49 | 5.117 | | | |
| Male domain | Male | 26.69 | 4.405 | 1.262 | 0.204 | |
| | Female | 26.04 | 3.844 | | | |
| Self confidence | Male | 28.37 | 4.633 | 3.560 | 0.000 | 0.44 |
| | Female | 26.12 | 5.595 | | | |
| All variables | Male | 27.16 | 3.99 | 3.25 | 0.001 | |
| | Female | 25.55 | 3.95 | | | |

Alpha=0.05

**Teacher's subject of specialization and girls attitudes toward mathematics**

Girl's responses to the items on the three attitudinal variables were analyzed with respect to the major subjects of specialization of their mathematics teachers. The girls were put into two groups; those of teachers who specialized in mathematics and those of teachers who did not specialized in mathematics, and their responses to the items on each of the attitudinal variables were analyzed in that respect. The results of the analyses are presented in Table 16.

**Anxiety**

Independent samples t-test on the mean scores of girls taught by teachers who specialized in mathematics and that of girls taught by teachers who specialized in subjects other than mathematics showed that, their mean scores on

the anxiety variable were significantly different at 5% significant level [$t_{(260)}$ >1.96 $p < 0.05$].

The result as presented in Table 16 shows that Girls taught by teachers who specialized in mathematics scored significantly higher than girls taught by teachers who did not specialized in mathematics. Although, both groups scored above 21 the t-test indicate that girls taught by teachers who specialized in mathematics are less anxious than girls taught by teachers who did not specialized in mathematics. The mean difference between their scores was found to be medium; the effect size was calculated to be 0.38.

**Male Domain**

Although, the mean scores of both groups indicated that they do not regard mathematics as a male domain, independent samples t-test on their mean scores presented in Table 16 indicate at 5% significant level that, girls taught by teachers who specialized in mathematics are less likely to regard mathematics as a male domain than girls taught by teachers who did not specialized in mathematics [$t_{(260)}$ >1.96 $p < 0.05$]. The calculated effect size was 0.33 indicating that their mean difference was medium.

**Table 16: Mean Scores on the Attitudinal Variables by Teachers' Major Subject**

| Variables | Subject | Mean | SD | t | P | d |
|---|---|---|---|---|---|---|
| Anxiety | Mathematics | 26.31 | 4.544 | 3.008 | 0.003 | 0.38 |
| | Others | 24.36 | 5.908 | | | |
| Male | Mathematics | 26.94 | 3.795 | 2.618 | 0.009 | 0.33 |
| domain | Others | 25.57 | 4.580 | | | |
| Self- | Mathematics | 27.88 | 4.840 | 2.044 | 0.042 | 0.26 |
| confidence | Others | 26.54 | 5.643 | | | |
| All | Mathematics | 27.04 | 3.57 | 3.08 | 0.002 | |
| variables | Others | 25.49 | 4.54 | | | |

Alpha =0.05

**Self confidence**

Again both groups of girls had means above 21, indicating that they are confident in themselves when it comes to mathematics. However, a t-test at 5% significant level on their mean scores as presented in Table 16 showed that girls taught by teachers who specialized in mathematics are more confident than girls taught by teachers who specialized in subjects other than mathematics [$t_{(260)} > 1.96$ $p < 0.05$]. The effect size was calculated to be 0.26 which shows that their mean difference is medium.

The analysis of the overall score on the three variables as in Table 16 indicated that girls taught by mathematics major teachers scored significantly higher than girls taught by non- mathematics major teachers. Thus girls taught by

mathematics major teachers have significant positive attitude toward mathematics than girls taught by non-mathematics major teachers [$t_{(260)} > 1.96$ $p < 0.05$] even though the mean scores indicate that both group of girls have positive attitude toward mathematics.

### Attitude of Girls in All-girls Schools and Girls in Mixed Schools

#### Anxiety

The mean scores of the two groups of girls on the anxiety variable were calculated and compared, shown in Table 17. The t-test indicated that at 0.05 alpha level, the means were significantly different [$t_{(260)} > 1.96$ $p < 0.05$]. Thus girls in mixed schools were less anxious than girls in single sex schools. The calculated effect size of 0.41 indicates that the difference between the mean scores was medium.

#### Male Domain

Comparison of the mean scores of the two groups of girls on this variable as shown in Table 17 indicate that, there was a significant difference between the mean scores of girls in all-girls schools and girls in mixed schools at 5% alpha level [$t_{(260)} > 1.96$ $p < 0.05$]. That is, girls in mixed schools are less likely to regard mathematics as a male domain than girls in all-girls schools. Their mean difference was also found to be medium with calculated effect size of 0.28.

#### Self confidence

The mean scores of the two groups indicated that both groups of girls were confident in themselves in doing mathematics. And Independent samples t-test on

their means as shown in Table 17, revealed no significant difference between them [$t_{(260)} < 1.96$ $p > 0.05$].

The overall scores of both groups of girls on all the three attitudinal variables showed that both groups of girls have positive attitude toward mathematics. However, the independent samples t- test on the means as in Table 17 indicates that girls in mixed schools have a significant positive attitude toward mathematics than girls in all-girls schools [$t_{(260)} > 1.96$ $p < 0.05$].

**Table 17: Mean Scores on the Attitudinal Variables by School Type**

| Variables | School type | Mean | SD | t | P | D |
|---|---|---|---|---|---|---|
| Anxiety | all-girls | 24.19 | 4.992 | 3.164 | 0.002 | 0.41 |
| | mixed | 26.25 | 5.181 | | | |
| Male | All-girls | 25 .70 | 3.823 | 1.980 | 0.049 | 0.28 |
| domain | Mixed | 26.77 | 4.301 | | | |
| Self- | All-girls | 27.14 | 4.948 | 0.473 | 0.636 | |
| confidence | Mixed | 27.47 | 5.339 | | | |
| All | All-girls | 26.88 | 4.17 | 2.39 | 0.022 | |
| variable | Mixed | 25.68 | 3.67 | | | |

Alpha = 0.05

**Attitude of Girls taught by Professional Teachers and Girls taught by Non-professional Teachers**

**Anxiety**

The calculated means of the two groups on this variable indicates that, both groups are not anxious in mathematics. Independent samples t-test at 5% alpha level on the mean scores showed that, the mean scores of girls taught by

professional teachers was significantly greater than that of girls taught by non-professional teachers [$t_{(260)} > 1.96$ $p < 0.05$]. Thus, girls taught by professional teachers were less likely to be anxious in mathematics than girls taught by non-professional teachers. The effect size was calculated to be 0.37 indicating that, their mean difference was medium. See Table18.

**Male Domain**

Girls taught by non-professional teachers had a mean score of 25.88 on this variable and girls taught by professional teachers had a mean score of 26.67. These means scores indicate that both groups of girls did not regard mathematics as a male domain.

Independent samples t-test at 5% alpha level on these means showed that they were not significantly different [$t_{(260)} < 1.96$ $p > 0.05$]. See Table18

**Self confidence**

The mean scores of the two groups of girls; mean score of 27.75 and 26.57 for girls taught by professional teachers and non-professional teachers respectively, indicate that both groups are confident in mathematics. A t-test at 5% alpha level on the mean scores of the two groups as presented in Table 18 indicates no significant difference in the mean scores [$t_{(260)} < 1.96$ $p > 0.05$].

The analysis of the overall scores on the three variables as in Table 18 shows that both the girls taught by professional and non-professional teachers have a positive attitude toward mathematics. However, the independent samples t-test on the means revealed that girls taught by professional teachers have a significant positive attitude toward mathematics than girls taught by non-professional teachers. [$t_{(260)} > 1.96$ $p < 0.05$].

**Table 18: Mean Scores on the Attitudinal Variables by Professional Status of their Teachers**

| Variable | Status | Mean | SD | t | P | d |
|---|---|---|---|---|---|---|
| Anxiety | Professional | 26.18 | 4.610 | 2.847 | 0.005 | 0.37 |
| | Non-professional | 24.27 | 6.036 | | | |
| Male domain | Professional | 26.67 | 3.844 | 1.456 | 0.147 | |
| | Non-professional | 25.88 | 4.719 | | | |
| Self-confidence | Professional | 27.75 | 4.789 | 1.748 | 0.082 | |
| | Non-professional | 26.57 | 5.882 | | | |
| All variables | Professional | 26.87 | 3.59 | 2.47 | 0.014 | |
| | Non-professional | 25.57 | 4.71 | | | |

Alpha =0.05

The analysis of the responses to the items on the attitudinal variables by gender of mathematics teachers revealed that girls taught by male teachers have a significant positive attitude toward mathematics than girls taught by female teachers. This result is not consistent with that of Lee and Lockheed (1990) and Mallam (1993) that girls taught by female teachers have positive attitude towards mathematics than those taught by male teachers.

From the findings in literature it was expected that girls in all-girls schools will have positive attitude towards mathematics than girls in mixed schools. It

was however; found that girls in mixed schools rather have a significant positive attitude toward mathematics than their counterparts in all-girls schools. This finding is in contrast to that of Collis (1987), who claimed that single-sex school environments have tended to be more closely associated with positive attitudes towards mathematics, particularly by girls and that of Nkani (1993), who found that girls in single-sex senior secondary schools achieve higher and have positive attitudes toward mathematics than girls and boys in the mixed (coeducational) schools.

Professional and mathematics major teachers may impact positively on girls' attitude toward mathematics than non-professional and non-mathematics major teachers. It was revealed from the analysis that; girls of professional teachers have significant positive attitude towards mathematics than girls of non-professional teachers, and girls of mathematics major teachers also have significant positive attitude towards mathematics than those of non-mathematics major teachers.

**Research Question Four**

Research question four was formulated as follows:

What are the girls' perceptions of their mathematics teacher's behaviour towards them?

To answer, this question, the responses of the girls to the items on perceived teacher's behaviour were coded and analyzed by the gender of the mathematics teachers, mathematics teachers subject of specialization and whether teacher is a professional or not.

There were ten items on this variable and as indicated earlier, the highest score a teacher could obtain was 50 and the lowest was 10. A score above 30 indicates a positive perception of the teacher's behaviour and a score of less than 30 indicates a negative perception of the teacher's behaviour.

**Girls taught by Female Teachers and Girls taught by Male Teachers' Perceptions about their Teachers' Behaviour towards Them**

The mean scores indicate that both groups of girls have a positive perception of their teachers behaviour. Independent samples t-test on the mean scores, Table 19 indicate that there was a significant difference between the means of the two groups. That is, girls taught by male teachers rated their teachers' behaviour more positively than girls taught by female teachers [$t_{(260)} > 1.96$ $p < 0.05$]. That is, male teachers relate well with their female students than female teachers. The effect size, d=0.43 also indicate that their mean difference is medium.

**Table 19: Means Scores on Perceived Teacher's Behaviour by Gender of Teachers**

| Gender | Means | SD | t | p | d |
|---|---|---|---|---|---|
| Male | 40.65 | 6.031 | 3.485 | 0.001 | 0.43 |
| Female | 37.89 | 6.732 | | | |

Alpha = 0.05

**Girls taught by Teachers who majored in Mathematics and Girls taught by Teachers who majored in Non-mathematics Subjects**

The mean scores of these two groups of girls show that they have positive perceptions of their teachers' behaviour towards them. The independent samples t-test at 5% alpha level as shown in Table 20 indicates that the two means are not significantly different ($t_{(260)} < 1.96$ $p > 0.05$). Thus, girls taught by teachers who specialized in mathematics and girls taught by teachers who did not specialized in mathematics have the same level of perceptions about their teachers' behaviour towards them.

**Table 20: Mean Scores on Perceive Teacher's Behaviour by Teachers' Major Subject**

| Subject | Mean | S D | t | P |
|---|---|---|---|---|
| Mathematics | 40.01 | 5.772 | 1.860 | 0.064 |
| Others | 38.48 | 7.404 | | |

Alpha = 0.05

**Girls taught by Professional Teachers and Girls taught by Non-professional Teachers**

Girls taught by professional teachers had a mean score of 40.11 and girls taught by non-professional teachers had a mean score of 38.01 on the students' perception of their mathematics teacher's behaviour towards them, this means indicate that both groups of girls have a positive perception of their teachers' behaviour.

Independent samples t-test on the mean scores as shown in Table 21 shows that the means were significantly different. Thus, at 5% alpha level, girls taught by professional teachers had a more positive perception of their teachers' behaviour towards them than girls taught by non-professional teachers ($t_{(260)} > 1.96$ $p < 0.05$). It could be inferred from the result that professional teachers relate well with their female students than non-professional teachers. The effect size was calculated to be 0.33, which indicates that their mean difference was medium.

**Table 21: Mean Scores on the Perceive Teachers' Behaviour by Teachers Professional Status**

| | Mean | Std | T | p | d |
|---|---|---|---|---|---|
| Professional | 40.11 | 5.577 | 2.484 | 0.014 | 0.33 |
| Non-professional | 38.01 | 7.857 | | | |

Alpha = 0.05

Even though the girls rated both male and female teachers' behaviour positively, they rated the male teachers significantly higher than female teachers. This result is not consistent with that of Hancock et al (1993), who found from a data gathered from 29,519 students' ratings of their teachers in the US that; in general boys tended to rate male teachers higher and girls also rated female teachers higher. It is however, consistent with the finding of Tieman and Rankin-Ullock (1985), that students rated teachers of the opposite sex more highly.

Professional teachers may have good interactions with their students (girls) than non-professional teachers. The girls rated the behaviour of

professional teachers highly significant than they rated the non- professional teachers, though both group of teachers were rated positively.

Mathematics major and non-mathematics major teachers were rated positively by their students (girls) however; the mathematics major teachers were rated a little higher than non-mathematics major teachers.

**Hypothesis three**

$H_o$: There is no correlation between girls' perceptions about their mathematics teachers' behaviour towards them and their attitude towards mathematics

$H_1$: There is a correlation between girls' perceptions about their mathematics teachers' behaviour towards them and their attitude towards mathematics

To test this hypothesis, scores on each of the three attitudinal variables and girls' perception of the teacher's behaviour towards them were obtain for each student and analyzed at 0.05 alpha level 2-tailed using Pearson product-moment correlation.

**Girls' Perception of the Mathematics Teachers' Behaviour towards them and their Anxiety**

The result as in Table 22 shows that there is a correlation between girls' perceptions of their teachers' behaviour towards them and their anxiety in mathematics, so the null hypothesis was rejected in favour of the alternative hypothesis.

The correlation between the girls' perception of their mathematics teachers' behaviour and their anxiety was calculated to be 0.530 and it was found to be significant at 0.05 alpha level (2 tailed). This indicates that the girls'

perception of their mathematics teachers' behaviour towards them explained 28% of their anxiety in mathematics, thus the coefficient of determination ($r^2$) was calculated to be 0.28.

**Girls' Perceptions of the Mathematics Teachers' Behaviour towards them and Male Domain variable**

The correlation between the girls' perception of their teachers' behaviour towards them and the male domain variable was found to be 0.434 as shown in Table 22. The correlation was tested to be significant at 0.05 alpha level 2-tailed. This implies the null hypothesis was rejected at 0.05 alpha level.

The coefficient of determination was calculated to be 0.188.Thus the girls' perceptions of their mathematics teachers' behaviour towards them explained 18.8% of the girls' perception that mathematics is a male domain or not.

**Girls' perceptions of their mathematics teachers' behaviour towards them and self-confidence variable**

The correlation between the girls' perceptions of the mathematics teachers' behaviour and the self-confidence variable was calculated to be 0.510 and it was tested to be significant at 0.05% alpha level (2- tailed) as in Table 22, so we reject the null hypothesis. The coefficient of determination was calculated to be 0.26, which is 26% of the girls confidence in mathematics was explained by their perceptions of their mathematics teachers' behaviour towards them.

**Table 22: Correlation between the Scores on Girls' Perceptions of the Mathematics Teachers' Behaviour and the Scores on the Attitudinal Variables**

| | | perceived teacher behaviour | anxiety | male domain | self-confidence |
|---|---|---|---|---|---|
| perceived teacher behaviour | Correlation | 1 | | | |
| | Covariance | 42.134 | | | |
| anxiety | Correlation | 0.530** | 1 | | |
| | Covariance | 17.796 | 27.046 | | |
| male domain | Correlation | 0.434** | 0.457** | 1 | |
| | Covariance | 11.641 | 9.893 | 17.360 | |
| self-confidence | Correlation | 0.510** | 0.69** | 0.422** | 1 |
| | Covariance | 17.266 | 18.784 | 9.137 | 27.050 |

Alpha=0.05 **significant 2-tailed, N=262

The results have revealed that there is a significant positive correlation between the students' perception of their teacher's behaviour towards them and

the three attitudinal variables (anxiety, male domain and self-confidence) that is to say that a good teacher-students relationship promote good students' attitude. This finding is consistent with the claim of Baker, et al. (1997) who identify teacher-student relationship to have a significant influence on overall school and behavioural adjustment and that of Pianta, et al.(1995) who also, found that positive teacher-student relationships, defined as "warm, close, communicative," are related to behavioural competency and better school adjustment. It is also consistent with the findings of McLeod (1994), that the negative attitudes of teachers have a negative influence on students' attitude toward mathematics.

**Hypothesis Four**

$H_o$: There is no correlation between girls' attitude toward mathematics and their achievement in mathematics.

$H_1$: There is a correlation between girls' attitude toward mathematics and their achievement in mathematics.

To test this hypothesis, scores on each of the attitudinal variables were calculated for each student and the achievement test was also scored. The Pearson product-moment correlation coefficient between the scores on the achievement test and the three attitudinal variables were calculated.

**Anxiety and Achievement Test**

The correlation between the achievement test and anxiety was calculated to be 0.374, when this was tested at 0.05 significant level (2-tailed) as in Table 23, it was found to be significant. So we reject the null hypothesis and conclude that there is a correlation between achievement test scores and anxiety.

The coefficient of determination was found to be 0.139. This implies mathematics anxiety explains 13.9% of the girls' achievement in the test.

**Male domain and Achievement Test**

The correlation between the score on the achievement test and that of the male domain variables as presented in Table 23 was found to be 0.354. This correlation coefficient was found to be significant at 0.05 alpha level (2- tailed). The coefficient of determination was calculated to be 0.125, thus the male domain variable explains 12.5% of the girls scores on the achievement test.

**Self-confidence and Achievement Test**

The correlation between the scores on the test and the scores on the self-confidence variable was found to be 0.294 as in Table23. This coefficient tested at 0.05 level of alpha was found to be significant.

The coefficient of determination was calculated to be 0.086. That is the scores obtained in the achievement test were 8.6% explained by the self-confidence of the girls in mathematics.

It was found out from the result of the analysis that all the three selected attitudinal variables correlated significantly with the girls' scores on the achievement test. This finding is consistent with the argument of Bae et al. (2000), that "Achievement gaps appear more closely related to attitudes than to course taking. It was found that anxiety correlates significantly with achievement; that is low anxiety levels is associated with high achievement gains.

**Table 23: Correlation between the Scores on the Achievement Test and the Attitudinal Variables**

| | | Score on test | anxiety | male domain | self-confidence |
|---|---|---|---|---|---|
| Score on test | Correlation | 1 | | | |
| | Covariance | 27.189 | | | |
| Anxiety | Correlation | 0.374** | 1 | | |
| | Covariance | 10.138 | 27.046 | | |
| male domain | Correlation | 0.354** | 0.457** | 1 | |
| | Covariance | 7.692 | 9.893 | 17.360 | |
| self-confidence | Correlation | 0.294** | 0.694** | 0.422** | 1 |
| | Covariance | 7.963 | 18.784 | 9.137 | 27.050 |

Alpha=0.05 **significant 2-tailed, N=262

This finding is consistent with the findings of Zakaria and Nordin (2008) who found a correlation between anxiety and achievement and that of Callahan and Clennon (as cited in Eshun ,2000b), that high anxiety is associated with lower achievement in mathematics.

Confidence was also found to correlate significantly with achievement. This finding is consistent with that of Reyes (1984) that Confidence, which is a

major component of self-concept, correlates positively with achievement. It is also consistent with that of Hannula et al. (2004), and Fennema and Sherman (1977). Hannula et al. (2000) found in their longitudinal study on self- confidence that the learning of mathematics is influenced by the student's mathematics related beliefs, especially self confidence. Fennema and Sherman (1977) also indicated that confidence in mathematics learning correlates highly with achievement than any affective variable and achievement.

# CHAPTER 5

## SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter gives a summary of the study, the conclusions drawn from the findings and the recommendations made.

### Summary

The study sought to find out the influences that teacher characteristics (mathematics teachers) and school type have on junior secondary school girls' achievement and attitude towards mathematics. The main aim was to investigate the extent to which teachers' gender, major subject of specialization and professional training impact on girls' achievement and attitudes. In addition the study investigated whether mathematics teachers hold different perceptions about female students and effective methodology for females.

The accessible population was the 2008/2009 final year junior secondary school girls and their mathematics teachers in Ghana. Purposive sampling was used to select girls from six schools each of Accra, Cape Coast and Kumasi metropolises. 262 girls and their 18 mathematics teachers were involved in the study.

The survey design was used for the study. Attitudinal questionnaire and achievement test were constructed and administered to the junior secondary

school form three girls and another questionnaire on beliefs about female students and effective methodology was constructed and administered to mathematics teachers. The data gathered from these three instruments were analysed quantitatively. The results of the study indicated among other things the following:

1. Even though girls taught by female teachers performed a little above the girls taught by male teachers, the difference was not significant, indicating that, the gender of the mathematics teacher does not matter much when it comes to achievement in mathematics. However, male teachers are likely to impact positively on junior secondary school girls' attitude towards mathematics than female teachers.
2. Teachers' subject of specialisation is an indicator of how well his/her students will achieve in mathematics. Teachers with mathematics majors are likely to impact positively on girls, hence the girls will develop positive attitude towards mathematics and consequently achieve high in mathematics.
3. Whether a school is mixed or single- sex may have no influence on girls' performance. However, it could be inferred from the findings that, teaching both boys and girls in the same classroom (mixed schools) could promote positive attitude of girls toward mathematics
4. Teachers' professional training is also an important factor in girls' achievement and attitude towards mathematics. Girls of professional

teachers had a more positive attitude towards mathematics and performed significantly higher than girls of the non-professional teachers.

## Conclusions

The following conclusions were drawn from the results of the analysis:

1. Teachers' beliefs about female students
    a. There was no significant difference between male and female teachers' beliefs about female students. However, they differed significantly on one item. Female teachers were of the belief that, girls show less ability in mathematics than boys whiles the male teachers were of the belief that boys and girls have the same ability in mathematics.
    b. There was a significant difference between the responses of professional and non-professional teachers on one item. the non-professional teachers in this study were of the belief that, boys achieve higher in mathematics than girls while the professional teachers were of the view that boys and girls achieve at the same level in mathematics
    c. The mathematics major and non- mathematics major teachers also differed significantly on one item. The non- mathematics major teachers indicated that girls achieve lesser in mathematics than boys, and the mathematics major teachers also indicated boys and girls achieve equally in mathematics.
2. Teachers' beliefs about effective methodology.

a. Male and female teachers differed significantly on only one item; "girls learn better in cooperative activities". Female teachers in this study indicated that girls learn better in cooperative activities while male teachers indicated that boys and girls learn the same way in cooperative activities.

b. All other categories of teachers did not differ significantly on any item.

3. Performance of the Girls on the Achievement Test

   a. Teacher's gender has no significant effect on the performance of the girls.

   b. There was no significant difference between the performance of girls in mixed schools and girls in the all-girls schools.

   c. There was a significant difference between the performance of girls taught by teachers with mathematics majors and that of girls taught by non-mathematics major teachers. Girls taught by teachers who majored in mathematics performed significantly better than girls taught by teachers who majored in other subjects.

   d. The professional training of the teacher was also found to affect performance. Girls taught by professional teachers performed significantly better than girls taught by non-professional teachers.

4. The girls' attitude towards mathematics

   a. Girls taught by male teachers had significantly higher scores on the anxiety and self –confidence variables than girls taught by female

teachers indicating that girls taught by male teachers have less anxiety and are more confident than girls taught by female teachers. Girls of male teachers had significant positive attitude towards mathematics than girls of female teachers.

b. Girls taught by teachers who majored in mathematics had significantly higher scores on all the three selected attitudinal variables than girls taught by non-mathematics major teachers, that is, girls taught by mathematics major teachers had a significant positive attitude towards mathematics than girls taught by non-mathematics major teachers.

c. Girls taught by professional teachers also showed they had less anxiety than girls taught by non-professional teachers. And their overall score on the three variables showed that they have a significant positive attitude towards mathematics than girls of non-professional teachers.

d. Girls in mixed schools and girls in all-girls schools differed significantly on the anxiety and male domain variables. Girls in mixed school indicated they were less anxious and less likely to regard mathematics as a male domain than girls in the all-girls schools. Girls in mixed schools had a significant positive attitude towards mathematics than girls in all-girls schools.

5. The Girls' Perceptions of their Mathematics Teachers' Behaviour towards them

a. Girls taught by male teachers had significant positive perception of their mathematics teachers' behaviour towards them than girls taught by female teachers.

b. Girls taught by professional teachers also had significant positive perception of their mathematics teachers' behaviour towards them than girls taught by non-professional teachers.

c. There was no significant difference between the perceptions of the girls taught by mathematics major and non-mathematics major teachers about their teachers' behaviour towards them. Both groups of girls rated their teachers' behaviour positively.

6. Relationship between girls' perceptions of their Mathematics Teachers behaviour towards them and their Attitude towards Mathematics

There was a significant positive correlation between the girls perception of their mathematics teachers behaviour and each of the three attitudinal variables; anxiety, male domain and self-confidence. That is girls' attitude towards mathematics is influence by their perceptions of their mathematics teachers' behaviour towards them. A good teacher- student's relationship therefore promotes positive attitude toward mathematics.

7. Relationship between the girls Attitude towards Mathematics and their Performance in the Achievement Test

There was a significant positive correlation between each of the three attitudinal variables (anxiety, male domain and self-confidence) and the girls' scores on the achievement test. Thus attitude explains the girls'

performance in the test. Positive attitude towards mathematics therefore leads to high achievements in mathematics.

## Recommendations

The following recommendations were given:

1. Mathematics teachers can make a significant positive or negative impact on girls. Mathematics teachers therefore have a responsibility of providing an environment in which female students can learn and appreciate, and enjoy the subject. Mathematics teachers must therefore put an end to any practices or behaviours that dispirit the girls in their learning of the subject.
2. Ghana Education Service should ensure that qualified (trained) teachers are recruited into the field to teach mathematics. Untrained teachers already recruited should be given professional training through distance learning or by any other means possible.
3. Ghana Education Service should also ensure that teachers employed to teach mathematics at the Junior High School level had their post secondary education in mathematics.
4. Mathematics teachers in the Junior High Schools with teachers' Certificate 'A' should be encouraged to upgrade themselves to get at least Diploma in Basic Education.

## Suggestions for Future Research

1. It is suggested that, a study into Junior High School mathematics teachers' beliefs about mathematics students and effective pedagogy be conducted to cover a larger sample of Junior High School mathematics teachers.
2. Also, it is suggested that a study into the differential treatment of male and female students in mathematics classes particularly at the Junior High School level be conducted.

## REFERENCES


Adeyeye, E., & Arifolo M. K. (1999). Teacher qualification and Student academic achievement in Chemistry at SSCE level: Ekiti State. *Journal of Educational Issues,* 2, 5-9.

Aiken, L. R. (1970). Attitudes toward mathematics. *Review of Educational Research,* 40, 551-596.

Akoto, P. V. (2003). *Effects of Small Group Cooperative Learning on Performance in Mathematics of Junior Secondary School Students*. unpublished thesis, University of Cape Coast.

Anamuah-Mensah, J. (2007). *The Educational Reform and Science and Mathematics Education.* A keynote address at the stakeholders of Nuffic practical project meeting.

Angrist, J. D., & Lavy, V. (2001). Does teacher training affect pupil learning? Evidence from matched comparisons in Jerusalem public schools. *Journal of Labor Economics,* 19(2), 343-369.

Arem, C. A. (2003). Conquering mathematics anxiety. *A Self-Help Workbook*. Pacific Grove, *CA:* Wadsworth Group.

Assessment of Performance unit (1980). *Mathematics Development, Primary Survey,* report No. 1. London, HMSO.

Awanta, E. (2000). Helping students overcome mathematics anxiety. *Journal of the Mathematics Association of Ghana,* 12, 58-63.

Awortwi, S. G. (1998). *STM Empowering the Girl Child for National Development*. A report on the STME Zonal clinics, Accra.

Baah-Korang, K. (2002). *Gender Differences in Participation and Achievement in Elective Mathematics of Senior Secondary School Students*. Unpublished thesis, University of Cape Coast.

Bae, Y., Choy, S., Geddes, C., Sabble, J., & Snyder, T. (2000). Trends in educational equity of girls and women. *Education Statistics Quarterly*, 2(2), 115-120.

Baker, J. A., Terry, T., Bridger, R., & Winsor, A. (1997). Schools as caring communities: A relational approach to school reform. *School Psychology Review*, 26, 276-588.

Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practionioners: Towards a practiced based theory of professional education. In Darling – Hammond & G. Sykes, (3rd ed.). *Teaching as a Learning Profession: Handbook of Policy and Practice*. San Francisco: Jossey Bass.

Becker, J. R. (1981). Differential treatment of females and males in mathematics classes. *Journal for Research in Mathematics Education*, 12(1), 40-50.

Begle, E. G. (1979). Critical Variables in Mathematics Education, MAA-NCTM, Washington DC. *Handbook of Research on Mathematical Teaching and Learning*.

Bishop, A. (1982). The implication of research for mathematics teacher education. *Journal of Education for Teaching*, 8(2), 118- 135.

Bishop, A. J., & Nickson, M. ( 1983). *A Review of Research in Mathematical Education*, Part B, NFER-Nelson, Windsor.

Boland, P. (1995). *Gender-Fair Math*. Newton, MA: WEEA publishing centre.

Bressoux, P. (1996). The effect of teachers' training on pupils' achievement: The case of elementary schools in France. *School Effectiveness and School Improvement* 7(3), 252-279.

Brophy, J. (1985). Interactions of male and female students with male and female teachers. In L.C. Wilkinson & C. B. Marrett. (Eds.). *Gender Influences in Classroom Interaction*, Orlando, FL: Academic Press Inc.

Cann, R. (2009). Girls' participation in post-16 mathematics: a view from pupils in Wales. *Gender and Education.*

Child, D., & Smithers, A. (1971). Some cognitve and affective factors in subject choice. *Research in Education,* 5(1), 37-39.

Clotfelter, C. T., Helen F. L., & Jacob L. V. (2006). Teacher-student matching and assessment of teacher effectiveness, *Journal of Human Resources,* 41(2006), 778-820.

Cohen, D. F., & Hill, C. H. (2000). Instructional policy and classroom performance: The mathematics reform in California. *Teachers College Record* 102(2), 294-343.

Cohen, L., & Manion, L. (1989). *Research Methodology in Education* (3rd ed.). routledge, 97- 101.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioural Sciences* (2nded.). Hillsdale, NJ: Lawrence Erlbaum associates.

Collis, B. (1987). Sex differences in the association between secondary school students' attitudes toward mathematics and toward computers. *Journal for Research in Mathematics Education,* 18(5), 394-402.

Darling-Hammond, L. (1992). *Teacher and knowledge: Alternative Certification For Teachers*. Washington D.C: Eric Clearinghouse on Education.

Darling –Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. *Journal of Education Policy Analysis,* 8(1).

Darling –Hammond. (2001). Teacher quality and student achievement: A review of state policy evidence. *Education Policy Analysis Archives,* 8.

Darling–Hammond, L., & Sykes, G. (2005). *Teaching as a Learning Profession: Handbook of Policy and Practice*. (3rd ed.). San Francisco: Jossey Bass.

Dees, T. S. (2006). The why chromosome: How a teacher's gender affects boys and girls. *Education Next,* 6, 4, 2-3.

Dildy, P. (1982). Improving student achievement by appropriate teacher in-service training: Utilizing program for effective teaching (PET) *Education* 102(2), 132-138.

Durost, R. A. (1996). Single sex math classes: What and for whom? One school's experiences. *NASSP Bulletin,* 80, 27-31.

Ehrenberg, R. G., & Brewer, D. J. (1994). Do school and teacher characteristics matter? Evidence from High School and Beyond. *Economics of Education Review,* 13(1), 1-17.

Ehrenberg, R. G., Goldhaber, D. D., & Brewer, D. J. (1995). Do teachers' race, gender and ethnicity matter? Evidence from the National Educational Longitudinal Study of 1988. *Industrial and Labour Relations Review*

48(3): 547-561.

Eshun, B. A. (1987). *School-based Mathematics Methods and Laboratory Experience*. Cellysburg College.

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

Eshun, B. A. (2000a). *Mathematics in Computer Age*. A presidential address presented at the Mathematics association of Ghana, Accra.

Eshun, B. A. (2000b). Sex- differences in attitude of students towards mathematics in secondary schools. *Journal of the Mathematical Association of Ghana* 12, 1-13.

Eshun, B. A., & Abledu, G. K. (2001). The effects of alternative assessment on the attitudes and achievement in mathematics of female pre-service teachers in Ghana, *African Journal of Educational Studies in Mathematics and Sciences*, 1, 21-30.

Ethington, C. A. (1992). Gender differences in a psychological model of mathematics achievement. *Journal for Research in Mathematics Education,* 23(2), 166-181.

Fennema, E. (1982). Girls and Mathematics: The Crucial middle grades. *Mathematics for the Middle Grade (5-9),* 9-13

Fennema, E. (1990). Teachers' beliefs and gender differences in mathematics, In E. Fennema & G. C. Leder (Ed.). *Mathematics and Gender*, New York: Teachers' College Press pp169-187.

Fennema, E. (2000). *Gender and Mathematics: What is known and what do I wish was known?* A paper prepared for the 5th annual forum of the national institute for Science education, May 22-23, Detroit, Michegan.

Fennema, E., & Franke, M. L. (1992). Teachers' knowledge and its impact. In D.A. Grouws (Ed). *Handbook of Research on Mathematics Teaching and Learning*. 147-164. NewYork: Macmillan publishing company.

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitude scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *JSAS: Catalog of Selected Documents in Psychology,* 6(2), 31.

Fennema, E., & Sherman, J. A. (1977). Sex-related differences in mathematics achievement, spatial visualization, and affective factors. *American Educational Research Journal*, 14, 51-71.

Fennema, E., & Sherman, J. A. (1978). Sex-related differences in mathematics achievement, and related factors: A further study. *Journal for Research in Mathematics Education,* 9(3), 189-203.

Fennema, E., Peterson, P. L., Carpenter, T. P., & Lubinski, C. A. (1990). Teachers' attributions and beliefs about girls, boys and mathematics, *Educational Studies in Mathematics,* 21, 55-69.

Fennema, E., Ryan, M., Frost, L. A., & Hopp, C. (1990). Gender differences in mathematics attitudes and affects: a meta-analysis, *Psychology of Women Quarterly,* 14, 299-324.

Female Education in Mathematics and Science in Africa (FEMSA, 1997). *FEMSA's Report*. Nairobi, FAWE. 1-19.

Ferguson, R. F. (1991). Paying for public education: New evidence on how and why money matters. Harvard. *Journal of Teacher Education*, 44(1), 56-64

Fetler, M. (2001). Student mathematic achievement test scores, dropout rates, and teacher characteristics. *Teacher Education Quarterly,* 28(1), 151-168.

Fiore, G. (1999). Math abused students: Are we prepared to teach them? *Math Teacher*, 92(5), 403-406.

Fraenkel, J. R., & Wallen, N. E. (2000). *How to Design and Evaluate Research in Education* (4th ed.). New York: McGraw-Hill, Inc.

Goldhaber, D. D., & Brewer, D. J. (1996). *Evaluation of Effect of Teacher Degree Level*. Rockville, MD: Westat, Inc.

Goldhader, D. D., & Brewer, D. J. (2000). Does teacher certification matter? High school teacher certification status and student achievement. *Educational Evaluation and Policy Analysis*, 22(2), 129-146.

Gore, D. A., & Roumagoux, D. V. (1983). Wait- time as a variable in sex-related differences during fourth-grade mathematics instruction. *Journal of Educational Research,* 76(5), 273 – 275.

Gorman, L. (2006). *Teachers and the Gender Gaps in Student Achievement,* retrieved on 1/2/2008 from http:/www.nber.org/digest/may06/w11660.html

Gray, J. A. (1981). A biological basis for sex differences in achievement in science? In A. Kelly (ed.). *The missing half: Girls and Science Education*. Manchester, UK: Manchester University.

Greenwald, R., Hedges, L.V., & Laine, R.D. (1996). The effect of school resources on student achievement. *Review of Educational Research,* 66(3), 361-396.

Hancock, G. R., Shannon, D. M., & Trentham, L. L. (1993). Student and Teacher gender ratings of a university faculty: results from five colleges of study; *Journal of Personnel Evaluation in Education,* 6, 235-248.

Hanson, K. (1997). *Gender, Discourse, and Technology*. Newton, MA: Educational Development Centre.

Hannula, S. M., Maijala, H., & Pehkonen, E. (2004). Developing understanding and self- confidence in mathematics; Grades 5-8. *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education.* 3, 17-24.

Hawkins, E. F., Stancavage, F. B., & Dossey, J. A. (1998). *School Policies and Practices Affecting Instruction in Mathematics*

Jones, S. M., & Dindia, K. (2004). A meta-analytic perspective on sex equity in the classroom, *Review of Educational Research,* 74(4), 443-471.

Jones, L., & Smart, T. (1995). Confidence and mathematics: A gender issue? *Gender and Education,* 7, 157-166.

Kahle, J. B., & Meece, J. (1994). Research on gender issues in the classroom. In D. Gabel (Ed.). *Handbook on Science Teaching and Learning*.

Macmillan, New York, 542–57

Khan, S. B., & Weiss, J. (1973). In R. M. W. Travers (Ed.). *Second Handbook of Research on Teaching.* Rand McNally, Chicago, 759-804.

Karp, K. S., & Niemi, R. C. (2000). The math club for girls and other problem solvers. *Mathematics Teaching in the Middle school,* 5, 426-432.

Laczko-Kerr, I., & Berliner, D. C. (2002). The effectiveness of "Teach for America" and other under-certified teachers on student academic achievement: A case of harmful public policy. *Education Policy Analysis Archives,* 10(37).

Lee, B. E., & Lockhead, M. E. (1990). The effects of single- sex schooling on achievement and attitudes in Nigeria. *Comparative Education Review,* 34 (2), 209-231.

Leder, G. C. (1992). Mathematics and gender: Changing perspectives. In D. A. Grouws (Ed.). *Handbook of Research on Mathematics Teaching and Learning*. New York: Macmillan, 597-622.

Leder, G. C., & Forgasz H. J. (1998). Single-sex groupings for mathematics: An equitable solution? In C. Keitel (Ed.). *Social Justice and Mathematics Education*. Frei Universita_ t Press, Berlin, 162–79.

Leder, G. C., Forgasz, H. J., & Solar, C. (1996). Research and intervention programs in mathematics education: A gendered issue. In K. Bishop, C. Clements, J. Keitel, Kilpatrick & C. Laborde (Eds.). *International Handbook of Mathematics Education*, Part 2, Dordrecht, Netherlands: Kluwer. 945 - 985.

Levine, G. (1995). Closing the gender gap: Focus on mathematics anxiety. *Contemporary Education,* 67, 42-45.

Lindholm, L. P. (1981). Informing children about Science and Technology: Some suggestions and practical attempts. In J. H. Raat, J. Harding & I. Mottier (Eds.). *Contributions GASAT – Conference; Papers of the Conference Girls and Science and Technology*, Eindhoven, Eindhoven University of Technology. 275-283.

Lockhead, M. & Komena, A. (1980). *School Effectiveness on students Achievement in Nigeria and Swaziland*, Washington DC: The World Bank.

Ma, X., & Kishor, N. (1997). Attitude toward self, social factors, and achievement in mathematics: A meta-analytic review. *Educational Psychology Review,* 9(2), 92.

Mallam, W. A. (1993). 'Impact of school -type and sex of the teacher on female students' attitudes toward mathematics in Nigerian secondary schools'. *Educational Studies in Mathematic,* 24, 223-229.

McKee, D. K. (2002). *Reducing Math Anxiety through Teaching and Learning Styles,* unpublished Master of Education Thesis, Weber State University,

McLeod, D. B. (1994). Research on affect and mathematics learning in the JRME: 1970 to the present. *Journal for Research in Mathematics Education,* 25(6), 637-647.

Morin, G. (2003). *Does Sex matter? Gender-related Beliefs of Male and Female Junior High School Math Teachers,* Monograph, International Educational

Administration and Policy Analysis, School of Education, Stanford University.

Monk, D. H. (1994). Subject area preparation of secondary mathematics and science teachers and students achievement. *Economic of Education Review*, 13(92), 125-145.

Mitchell, M. L., & Jolley, J. M. (2004). *Research Designed Explained* (5th ed.). Wadsworth: Thompson Learning Inc.

Murnane, R. J., & Phillips, B. R. (1981). Learning by doing, vintage, and selection: Three pieces of the puzzle relating teaching experience and teaching performance. *Economics of Education Review*, 1(4), 453-465.

Mwamwenda, T. S., & Mwamwenda, B. B. (1989). Teacher characteristics and pupils' academic achievement in Botswana primary education. *International Journal of Educational Development*, 9(1), 31-42.

National Assessment of Educational Progress (1980). *NAEP Newsletter,* 13(2)

National Commission on Teaching and America's Future. (1996). What matters most. *Teaching for America's future*. New York.

Nkani, A. W. K. (1993). *Achievement and Attitudes of Students towards Mathematics in the senior Secondary School*. Unpublished dissertation, University of Cape Coast.

Nixon, L. A., & Robinson, M. D. (1999). The educational attainment of young women: Role model effects of female high school faculty. *Demography 36*(2), 185-194.

Pianta, R. C., Steinberg, M. S., & Rollins, K. B. (1995). The first two years of

school: Teacher-child relationships and deflections in children's classroom adjustment. *Development and Psychopathology*, 7, 295-312.

Preis, C., & Biggs, B. T. (2001). Can instructors help learners overcome math anxiety*? ATEA Journal*, 28(4), 6-10.

Rivkin, S. G., Hanushek, E.A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, 73(2), 417-458.

Raat, J. H. (1981). Intervention strategies in favour of girls' achievement in Science (physics) and Technology in MENT – project. In J. H. Raat, J. Harding & I. Mottier (Eds.). *Contributions GASAT – Conference; Papers of the Conference Girls and Science and Technology*, Eindhoven, Eindhoven University of Technology. 183-190.

Rosenholtz, S. J. (1986). *The Organizational Context of Teaching*. New York: Longman.

Saha, L. J. (1983). Social structure and teacher effects on academic achievement: a comparative analysis. *Comparative Education Review,* 27(1), 69-88.

Schildkamp-Kundiger, E. (1982). *An International Review of Gender and Mathematics* Eric Clearing house for Science and science, Mathematics and Environmental Education, Columbus, Ohio.

Smith, I. D. (1994). The co-educational/single sex schooling debate. *Forum of Education*, 49(1), 15-31.

Sommers, C. H. (2000). *The War against Boys: How misguided Feminism is harming our Young Men*. New York: Simon and Schuster.

Sherman, J.A. (1982). Mathematics the critical filter: A look at some residues. *Psychology of Women Quarterly,* 6(4), 428-444.

Steele, D. F., & Arth, A. A. (1998). Lowering anxiety in the math curriculum. *Education Digest,* 63(7), 18-23.

Streitmatter, J. (1997). An explolatory study of risk-taking and attitudes in a girls-only middle school math class. *The Elementary School Journal,* 98, 15-26.

Trends in International Mathematics and Science Studies (TIMSS, 1999). *TIMSS Benchmarking Report Chap6_2*, retrieved on 1/12008 from http://timss.bc.edu/timss1999b/mathbench_report/t99bmath_chap_6_2.html.

Tiedemann, J. (2000). Gender-related beliefs of teachers in elementary school mathematics. *Educational Studies in Mathematics 4*, 1197-207.

Tieman, R., & Rankin-Ullock, B. (1985). Students evaluation of teachers. *Teaching Sociology,* 12, 177-191.

Tulloch, M. (1995). Gender diferences in bulling experiences and attitudes to social relationships in high school students. *Australian Journal of Education,* 39(3), 270-293.

UNESCO, (1985). The education of the secondary school teachers of mathematics. *Studies in Mathematics Education,* 4, 47-58.

Warwich, D. P., & Jatoi, H. (1994). Teacher gender and students' achievement in Pakistan. *Comparative Education Review,* 39(3), 377-399.

Wayne, A. J., & Youngs, P. (2003). Teacher characteristics and student achievement gains: A review. *Review of Educational Research,* 73 (1), 89-122.

Wiley, D. E., & Yoon, B. (1995). Teacher reports on opportunity to learn: Analyses of the 1993 California Learning Assessment System (CLAS). *Educational Evaluation and Policy Analysis*, 17(3), 355-370.

Williams, W. V. (1988). Answers to questions about math anxiety. *School Science and Mathematics*, 88(2), 95-104.

Wood, B. S., & Brown, L. A. (1997). Participation in an all-female Algebra 1 class: Effects on high school math and science selection. *Journal of Women and Minority in Science and Engineering,* 3, 265-277.

Zakaria, E., & Nordin, N. M. (2008). The effects of mathematics anxiety on matriculation students as related to motivation and achievement, *Eurasia Journal of Mathematics, Science & Technology Education*, 4(1), 27-38.

Zanna, M. P., & Rempel, J. K. (1988). Attitude: A new look at an old Concept In Bar-Tal & A. Kruglansk, (Eds.). *The Social Psychology of Knowledge*. New York: Cambridge University Press.

Zaslavsky, C. (1994). *Fear of Math, how to get over it and get on with your Life*. Rutgers University Press, New Brunswick, New Jersey.

## APPENDIX A

## ACHIEVEMENT TEST FOR JUNIOR SECONDARY SCHOOL FORM THREE STUDENTS

**Time allowed**: 1 Hour

**Candidates' number**……

**INSTRUCTIONS:**

- Answer all questions.
- Each question is followed by four options lettered A to D. find the correct option for each question and circle the letter corresponding to the correct option.
- Give only one answer to each question.
- Do all rough work on this paper.

1. A = {1, 2, 3, 4, 5, …, 10}

   B = {5, 6, 7, 8, 9}

   C = {1, 3, 5, 7}

   If B and C are subsets of A, find $B \cap C$.

A. {3, 5}

B. {3, 5, 7,}

C. {5, 7}

D. {2, 3, 5, 7)

2. Write 98 as a prime product of its factors.

A. $2 \times 7$

B. $2^2 \times 7$

C. $2 \times 7^2$

D. $2^2 \times 7^2$

3. Evaluate -4(8 + 2) + 5(3 – 8)

A. -65

B. -15

C. 37

D. 95

4. Round 8921465 to the nearest thousand.

A. 8921000

B. 8921400

C. 8921460

D. 8921500

5. A basket ball field is 100m long and 85m wide. What is the perimeter of the field?

a. 285m

b. 740m

c. 370m

d. 185m

6. Simplify $2^3 \times 2^{-3}$

A 1

B 0

C $2^6$

D $2^{-6}$

7. Amma bought a book for GH¢5.00. She sold it to Grace at a profit of 20%.How much did Grace pay for the book?

A. GH¢4.80

B. GH¢5.50

C. GH¢6.00

D GH¢7.00

8. Simplify $5m + 7n^2 - 4m + 3n^2$

A. $m + 10n^2$

B. $9m + 10n^2$

C. $m + 4n^2$

D. $9m + 4n^2$

9. Express 12 days is to 6 weeks as a ratio in its simplest form.

A 1: 2

B 2 : 1

C 2 : 7

D 7 : 2

10. Write $18_{ten}$ as a base two numeral.

    A. 10010

    B. 1001

    C. 10001

    D. 11011

11. If A = {odd numbers between 0 and 12} and B = {prime numbers between 2 and 10}. Find $A \cap B$.

    A. {2, 3, 5,7}

    B. {1, 4, 6,8}

    C. {5, 7, 9}

    D. {3, 5, 7}

12. Find the angle through which the minute hand of a clock moves from 3. 15p.m. to 3. 25p.m.

    A. 30°

    B. 45°

    C. 60°

    D. 120°

13. A trader buys 12 pens at GH¢ 4.80 and sells them at 48Gp each. Find her percentage profit.

    A. GH¢12%

    B. GH¢15%

C. GH¢30%

D. GH¢20%

The table below shows the amount of rainfall in a town from March 2004 to August 2004.

Use it to answer questions 20 and 21.

| Month | March | April | May | June | July | August |
|---|---|---|---|---|---|---|
| Rainfall(mm) | 103 | 140 | 276 | 457 | 260 | 144 |

14. What is the total amount of rainfall in May, June and July?

A. 993mm

B. 1020mm

C. 930mm

D. 696mm

15. What was the mean rainfall in the town over the six months?

A. 230mm

B. 281mm

C. 366mm

D. 452mm

16. A tank holds 240 litres of water. How much water is in the tank when it is 4/5 full?

A. 60 litres

B. 132 litres

C. 192 litres

D. 240 litres

17. A farmer has 6s sheep and 5g goats. He sells 3s sheep and 2g goats. How many animals are left after the sales?

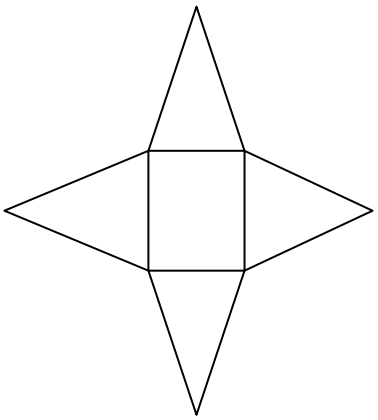
A. 3s – 3g

B. 3s + 3g

C. 9s – 5g

D. 9s + 5g

18. Which solid figure can be made from the net below?



A. square pyramid

B. rectangular pyramid

C. cuboid

D. square prism

19. The isosceles triangle has how many lines of symmetry?

A. 3

B. 4

C. 2

D. 1

20. Which of the following is not a polygon?

A. hexagon

B. Kite

C. Pyramid

D. Trapezium

21. Solve for the value of j, if $\frac{4j}{18} = 6$

A. 23

B. 25

C. 27

D. 29

22. Expand (a+ 4)(a + 6).

A. $a^2 + 10a + 24$

B. 2a +24

C. $a^2 + 6a + 10$

D. $a^2 + 10a + 10$

23. Write the number 54.1 in standard form.

A. $5.41 \times 10^{-2}$

B. $5.41 \times 10^{-1}$

C. $5.41 \times 10^{0}$

D. $5.41 \times 10$

24. The difference between two numbers is 160. If the smaller number is 121, find the other number.

A. 223

B. 271

C. 291

D. 281

25. Simplify $\frac{30}{5(-2)}$.

A. -10

B. -6

C. -3

D. 3

26. Find 12 ½ % of GH¢80.00.

A. GH¢8.00

B. GH¢10.00

C. GH¢12.00

D. GH¢12.50

27. Find the highest common prime factor of 18 and 30.

A. 2

B. 3

C. 5

D. 6

28. Find the perimeter of rectangle with sides 16cm and 22cm.

A. 38cm

B. 64cm

C. 76cm

D. 88cm

29. If $3n^2 + 2 = 29$, what is the value of n?

A. 3

B. 6

C. 2

D. 10

30. Two of the interior angles of a triangle are 36° and 72°. Find the third angle.

A. 69°

B. 75°

C. 108°

D. 72

## APPENDIX B

Scoring key for the achievement test

1. C
2. C
3. A
4. A
5. C
6. A
7. C
8. A
9. B
10. A
11. D
12. C
13. D
14. A
15. A
16. C
17. B
18. B
19. D
20. C
21. C
22. A
23. D
24. D
25. C
26. B
27. B
28. C
29. A
30. D

## APPENDIX C

**UNIVERSITY OF CAPE COAST**

**DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION**

**QUESTIONNAIRE FOR GIRLS**

**INTRODUCTION**

This questionnaire is meant to obtain information about attitudes toward the study of Mathematics. All responses are mainly for research purpose and would be treated confidential. It is therefore hoped that all respondents will co-operate and as much as possible give honest responses.

Please make a tick [√] in the bracket against your response or fill in the blank spaces where necessary.

**SECTION A**

**BIOGRAPHIC DATA**

1. Indicate your school type.

   All-girls ( )

   Mixed ( )

2. What is the sex of your mathematics teacher?

   Male ( )

   Female ( )

**SECTION B**

Each statement on this part of the questionnaire expresses a feeling or attitudes towards mathematics. You are to indicate on a five point scale, the extent of agreement between the feeling expressed in each statement and your own personal feeling.

Key: The five points are

STRONGLY AGREE (SA)

AGREE (A)

UNCERTAIN (U)

DISAGREE (D)

STRONGLY DISAGREE (SD)

Circle the letters or letter that best indicate how you agree or disagree with the feeling in each statement.

**Example**: I have interest in mathematics SA A U (D) SD. Kofi disagrees with the statement so he circles D.

1. I am always under a terrible tension in mathematics class. SA A U D SD
2. I am sure that I can learn mathematics further. SA A U D SD
3. Boys are not naturally better than girls in mathematics SA A U D SD
4. I do not like mathematics, and it scares me to learn it. SA A U D SD

5. I don't think I could do senior high school

   mathematics. SA A U D SD

6. I am no good in mathematics. SA A U D SD

7. I know I can do well in mathematics. SA A U D SD

8. Girls can do just as well as boys in mathematics. SA A U D SD

9. I feel a sense of insecurity when

   attempting mathematics. SA A U D SD

10. I am sure of myself when I do mathematics. SA A U D SD

11. I think I can handle more difficult mathematics. SA A U D SD

12. I would have more faith in answer to a mathematics problem

    solved by a boy than a girl. SA A U D SD

13. I have a good feeling toward mathematics. SA A U D SD

14. Girls certainly are smart enough to

    do well in mathematics. SA A U D SD

15. I know I will not do well in mathematics. SA A U D SD

16. Mathematics is the subject I fear most. SA A U D SD

17. Studying mathematics is just as good for

    girls as for boys. SA A U D SD

18. Mathematics makes me feel secure. SA A U D SD

19. I would trust a girl just as much as I would trust a boy

    to solve a difficult mathematics problem. SA A U D SD

20. I feel at ease in a mathematics class. SA A U D SD

21. Boys are good in mathematics than girls. SA A U D SD

**Section C**

The following statements indicate the behaviour of teachers toward students, to what extent are these statements true in respect to your mathematics teacher's behaviour? Circle the letter or letters that best suit the extent the statements are true in your case.

**Key** :

Very true: VT

True: T

not sure: NS

not true to some degree: NTS

not true at all: NTA

1. my mathematics teacher makes me feel welcome in the class VT T NS NTS NTA
2. my mathematics teacher is always there to help me when I need him/her VT T NS NTS NTA
3. my mathematics teacher makes me feel unwanted VT T NS NTS NTA
4. my mathematics teacher believes in my abilities VT T NS NTS NTA
5. my mathematics teacher believes that I mean to make an effort VT T NS NTS NTA
6. my mathematics teacher makes me feel as though I do not exist VT T NS NTS NTA
7. my mathematics teacher does not appreciate what I do VT T NS NTS NTA

8. my mathematics teacher expresses her/his appreciation of me even when I try but fail VT T NS NTS NTA
9. I feel free to talk with my mathematics teacher VT T NS NTS NTA
10. my mathematics teacher praises me when I do a good job VT T NS NTS NTA

## APPENDIX D

## UNIVERSITY OF CAPE COAST

## DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION

## QUESTIONNAIRE FOR MATHEMATICS TEACHERS

### INTRODUCTION

This questionnaire is meant to obtain information about teacher qualification, beliefs and views about mathematics and effective pedagogy (methodology) for instructing girls. All responses are mainly for research purpose and would be treated confidential. It is therefore hoped that all respondents will co-operate and as much as possible give honest responses.

Please make a tick [√] in the bracket/column against your response or fill in the blank spaces where necessary.

### SECTION A

### PERSONAL DATA

1. Sex. Male ( ) Female ( )
2. What is your highest qualification?

   Teachers' certificate 'A' ( )

   Diploma ( )

   Bed (Basic) ( )

Others (specify)…….

3. What is your subject of specialization?

   Mathematics ( )

Science ( )

Agriculture ( )

Others specify…….....

4. How long have you taught mathematics in

JSS……..

**SECTION B**

Each statement on this part of the questionnaire expresses a perception about junior high school female students. You are to indicate on a three point scale, your view about the belief expressed in each statement. Make a tick [√] in the appropriate column.

| No. | Statement | Agree with the statement | Think boys and girls are equal in this respect | Believe the opposite is true for this statement |
|---|---|---|---|---|
| 1 | Girls are less likely to work hard in mathematics if they dislike the subject than boys. | | | |
| 2 | Girls have lower perceptions of their abilities than boys | | | |
| 3 | Girls work less independently in math than | | | |

| | | | | |
|---|---|---|---|---|
| | boys. | | | |
| 4 | Girls show less ability in math than boys. | | | |
| 5 | Girls are less willing to work hard in math than boys. | | | |
| 6 | Girls demonstrate less interest in math than boys. | | | |
| 7 | Girls are less likely to imagine themselves pursuing mathematics careers. | | | |
| 8 | Girls do not see math as important for their future careers. | | | |
| 9 | Girls are more willing to attribute success in mathematics to luck than boys. | | | |
| 10 | Girls achieve lesser in math than boys. | | | |

**SECTION C**

The statements in this section indicate various methods/strategies used in the classroom. Indicate on the three point scale your view about the statements.

| No. | Statement | Agree with the statement | Think boys and girls are equal in this respect | Believe the opposite is true for this statement |
|---|---|---|---|---|
| 1 | Girls tend to learn better in a competitive environment. | | | |
| 2 | Girls families are more likely to encourage them to pursue in mathematics in senior high school than are boys families | | | |
| 3 | Girls require more encouragement to participate in mathematics class than boys | | | |
| 4 | Girls do not respond better to criticisms like boys | | | |
| 5 | Girls need more praise than boys to stay motivated | | | |
| 6 | Girls learn better in cooperative activities | | | |
| 7 | Exposure to same-sex role | | | |

| | | | | |
|---|---|---|---|---|
| | models is important for girls than for boys | | | |
| 8 | Girls need more encouragement to solve problems independently | | | |
| 9 | Linking mathematics concepts to real- world situations has a greater impact on motivating girls than boys | | | |
| 10 | Peers have a greater influence on girls' decisions to pursue advanced mathematics in the senior high school than they do in influencing boys' decisions | | | |

## APPENDIX E

Kuder Richardson (K-R) 21 formula for calculating reliability (r) is

$$r = \frac{k}{k-1}\left[1 - \frac{\bar{x}\left(k - \bar{x}\right)}{ks^2}\right]$$

where:

k is the number of test items,

$\bar{x}$ is the test mean,

$s^2$ is the variance of the scores on the test.

The achievement test has thirty (30) items with mean ($\bar{x}$) = 16.64 and standard deviation (s) =5.21.

$$r = \frac{30}{30-1}\left[1 - \frac{16.64(30 - 16.64)}{30(5.21)^2}\right]$$

$$r = 1.0345\left[1 - \frac{16.64(13.36)}{30(27.1441)}\right]$$

$$r = 1.0345\left[1 - \frac{222.3104}{814.323}\right]$$

$$r = 1.0345\left[1 - 0.273003\right]$$

r= 1.0345(0.726997)

r= 0.7520784

therefore the reliability of the achievement test is 0.752

## APPENDIX F

The formula for calculating the effect size is

$$d = t\sqrt{\frac{n_1 + n_2}{n_1 \times n_2}}$$

where

t is the calculated t-value,

$n_1$ is the sample size of the first population,

$n_2$ is the sample size of the second population.

Using the mean performance of girls according to the subject majors of their teachers as an example, we have t = 11.74, $n_1$ =159 (the number of girls taught by teachers with mathematics majors) and $n_2$ = 103(the number of girls taught by teachers who majored in other subjects. so

$$d = 11.74\sqrt{\frac{159+103}{159\times 103}}$$

$$d = 11.74\sqrt{\frac{262}{16377}}$$

$$d = 11.74\sqrt{0.015998}$$

d= 11.74(0.1264832)

d = 1.485.

Therefore the effect size is 1.485