

**EFFECT OF STREAMING BY GENDER ON STUDENTS' PERFORMANCE IN
SECONDARY SCHOOL MATHEMATICS: A CASE OF NAKURU DISTRICT,
KENYA.**

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**BY
ANNE CHEPCHIRCHIR BARMAO**

**A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements
for the Award of Master of Education Degree in Curriculum and Instruction of Egerton
University**

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DECLARATION AND RECOMMENDATION

DECLARATION

I declare that this is my original work and it has not been submitted in this or any other form for the award of a degree or diploma in any other university.



Anne Chepchirchir Barmao

CANDIDATE

29/11/06

Date

RECOMMENDATION

This thesis has been submitted for examination with our approval as the university supervisors.

1 

Prof. Helen Omondi Mondoh

Department of Curriculum, Instruction & Educational management
Egerton University, Njoro – Kenya

30/11/06

Date

2. 

Dr. Joseph Bosire

Department of Curriculum & Instruction
Egerton University, Laikipia campus – Kenya

04/12/2006

Date

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DEDICATION

I dedicate this thesis to my husband Dave K. Bowen and our children Harry Kiprotich and Stacy Jebet. Without their love, patience and support; I would never have made it to the completion of this thesis.

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This thesis is as a result of the contributions, criticisms, suggestions, moral and material support of a group of people who made it a success. Hence, I owe them a lot of gratitude.

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ABSTRACT

Mathematics is indispensable for any meaningful scientific progress and development. The subject is also applied to almost all other subjects hence it is offered as a compulsory subject in primary and the secondary school curriculum in Kenya. Despite its importance, performance in the subject among secondary school students in Kenya has generally been poor. Girls in particular perform poorer than boys. There is evidence that boys tend to score higher than girls particularly in mixed sex schools. On the basis of such evidence, some co-educational schools in Kenya have in recent years separated boys from girls in class with the hope that the performance of girls in mathematics might improve. The results of this venture have not been documented. This study was designed to determine the effect of streaming by gender on secondary school students' performance in mathematics. An ex post facto design was adopted to collect the required data on students' performance in secondary school mathematics in Nakuru District. Data was collected through a documentary search of the Kenya Certificate of Secondary Education (K.C.S.E) mathematics examinations results of students for the years 1999, 2000 and 2001 in selected secondary schools in Nakuru District. In addition, mathematics teachers were interviewed. Data was analyzed by use of the statistical package for social sciences (SPSS) version 9.0. Both qualitative and quantitative data were generated hence descriptive (means, standard deviations and Percentages) and inferential (t-test and the one-way Analysis of variance at $\alpha = 0.05$) statistics were used for data analysis and hypothesis testing respectively. The sample of this study comprised of 4 schools, 1489 students and 22 mathematics teachers. The results of the study indicated that streaming by gender in the mixed sex segregated school improved the performance of both boys and girls in mathematics. However, when this performance was compared with that of other boys and girls in the other school types, the results were as follows; boys and girls from the mixed sex normal school performed better followed by those in mixed sex segregated school (where boys are segregated from girls) and lastly those in boys' only and girls' only schools. The results will therefore be useful to policy makers in the Ministry of Education in that they can make policy recommendations on streaming by gender. For example creation of separate classes for boys and girls in coeducational secondary schools and the need to incorporate gender issues in in-service programmes for mathematics teachers. Teachers and co-educational secondary school administrators may also benefit since it will assist them to restructure their schools through streaming by gender.

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CHAPTER ONE

INTRODUCTION

1.1 Background Information

In early civilizations, children were educated informally, usually within the family unit. However as civilizations became more complex, education became more formal, structured and comprehensive. The ancient Chinese and Greek societies initially concentrated solely on the education of males. Plato was apparently the first significant advocate of the equality of the sexes in education. According to him, women in his ideal state would have the same rights and duties and the same educational opportunities as men. The availability of education was gradually extended to women but they were taught separately from men. This trend continued and single sex schools prevailed throughout the reformation period (Wexler, 2000).

Therefore, co-educational schools initially began as boys' schools and eventually girls were admitted into these schools. This was due to civil pressure in favour of higher education for women and the insistence on the rights of women to have equal advantages with men in education. Their efforts were in accordance with the demands made by industrial changes. These changes systematically took from women, their traditional employment in the home and compelled them to seek new occupations in fields initially occupied exclusively by men (Knight, 1999). Consequently, women demanded for equal educational opportunities so as to secure more complete development of their faculties and also equip them for their new positions.

The rapid spread of co-education has aroused intense interest not only among educators but also the public at large. The subject has been discussed from diverse points of view; moral, economic, and educational among others. There has been a significant divergence of opinion as to the wisdom of co-education particularly in secondary schools. These opinions have usually been based on whether the co-educational environment fosters equal treatment of boys and girls (Pamela, 2000). Performance of students in mathematics in these secondary schools has also been an issue. There have been differences in performance between boys and girls with boys performing well especially in mathematics and sciences and girls excelling particularly in languages (Costello, 1991; Garret, 1987).

In Kenya the scenario is the same. An analysis of the Kenya Certificate of Secondary Education (K.C.S.E) examinations results shows that boys perform better in sciences and mathematics while girls outdo boys in arts based subjects and in languages. For instance, the 2003 K.C.S.E. examination results show that, boys obtained a mean score of 22.10 % in mathematics as compared to 16.05 % for girls; while in Kiswahili, the mean scores for boys and girls was 48.56 % and 50.05 % respectively. Table 1 illustrates this difference.

Table 1: Students performance by Gender in K.C.S.E Mathematics Examinations, 2002 – 2005.

Year	Girls		Boys	
	ENTRY	MEAN (%)	ENTRY	MEAN (%)
2002	91,647	16.44	105,471	22.53
2003	95,615	16.05	110,865	22.10
2004	102,041	15.39	119,254	21.34
2005	118,898	12.97	140,414	18.49

Source: KNEC 2003 & 2005 KCSE Examinations Candidates Performance Reports.

The data given in Table 1 shows that the general performance of students in mathematics is poor. Girls in particular perform poorly compared to boys. This implies that the proportion of boys who do well in mathematics in KCSE examinations is higher than that of girls. This suggests that less females than males take mathematics-related courses beyond secondary school education. (Abagi, 1992; 1994; Kyungu, 1998; Makau, 1994; Masiga, 1994). Such a scenario is a source of worry in that more women will be closed out of many educational and career opportunities in higher education. This will in turn deprive the society of the benefits of women’s talents.

Mathematics is offered as a compulsory subject in the secondary school curriculum in Kenya (Republic of Kenya, 1999). This is because; the subject is indispensable if there is to be any meaningful scientific progress and development (Cockroft, 1982). Ndimbirwe (1995) concurs with Cockroft (1982) by arguing that the subject is both academically and vocationally important for both boys and girls. In addition, it is applied in other subjects such as social sciences and arts, government and business transactions (African Curriculum Organisation, 1979; Cockroft, 1982; Mutunga & Breakel, 1992). It is also applied to physical sciences, engineering, biological sciences, medicine, geography, economics, business, management studies household chores among others. Consequently, if students have to be admitted into

competitive mathematics based and lucrative courses at college and university, then their performance in mathematics must improve. This is because jobs and careers in such courses often attract high salaries and status (FAWE, 1998). Further, a numerate population is a prerequisite for future prosperity, hence there is need to mobilize powerful support for encouraging students especially girls to study and perform well in mathematics (Costello, 1991; FAWE, 1998).

In an attempt to improve the performance of girls in mathematics, several studies have been done and recommendations made (Eshiwani, 1975; 1984; Githua, 2002; Spender, 1980). These include teaching these girls through use of the integrated programmed instruction (I.P.I) method (Eshiwani, 1984) and gender sensitive instructional methods and learning materials (Kyungu, 1998; Masiga, 1994); modes of assessment used should not favour boys at the expense of girls; presence of more female mathematics role models in mathematics classrooms and co-operative mode of teaching. Masiga (1994) advocated for the use of sex-neutral media in the teaching of mathematics in Kenyan secondary schools. There is also some evidence that girls in single-sex schools have advantage in mathematics learning over those in co-educational schools (Garret, 1987; Costello, 1991; Githua, 2002). As a result, they recommend that girls be grouped separately for mathematics teaching and learning since girls may be inhibited in the learning of mathematics by the presence of boys.

Consequently, co-educational schools have in the recent years separated boys from girls and both are now being taught in separate classes. However, the implications of this action on student's performance in the subject have not been explored. Further, such separation is likely to lead to declining performance by boys in mathematics (Garret, 1987; Lepore and Warren, 1997; Spender, 1980). They have argued that the presence of girls is necessary in order to promote the positive image of boys. It is against the girls that boys stand out. Given this background, it was important to establish the effect on boys' and girls' performance in mathematics when they are taught in separate classrooms in coeducational secondary schools in Kenya.

1.2 Statement of the Problem

Performance in mathematics among secondary school students in Kenya continues to plummet (KNEC, 2005). Girls in particular continue to perform poorly compared to boys. This means that more girls will be disadvantaged in taking university courses and in career

areas where a good grade in mathematics is required. Many studies have been conducted on girls' performance in the subject and various factors have been identified as responsible for their dismal performance. In particular mixed sex schools where both boys and girls sit together have been criticized for inhibiting the performance of girls in Mathematics (Costello, 1991; Githua, 2002; Pamela, 2000; Spender, 1980). The main argument is that such classroom instructional arrangements favour boys at the expense of girls. As a result, some co-educational schools have separated or streamed classes on the basis of gender with the hope that performance of girls in mathematics may improve. However, there are no documented studies that have been carried out especially in Kenya to ascertain the extent to which this measure has generated any positive results. The lack of this information limits provincial directors of education and mathematics inspectors of schools in advising administrators of co-educational schools on effects of streaming by gender on students' performance in mathematics in Kenya's secondary schools. It was therefore necessary to find out the effect of streaming by gender on students' performance in mathematics, and particularly, the extent to which this measure improves the performance of girls in the subject.

1.3 Purpose of the Study

The purpose of this study was to determine the effect of streaming by gender on students' performance in secondary school mathematics, and in particular the effect on girls' performance in mathematics.

1.4 Objectives of the Study

This study was guided by the following specific objectives: -

1. To determine whether there is a difference in performance in mathematics among students in mixed sex segregated, mixed sex normal and single-sex schools (boys' only and girls' only).
2. To compare the performance in mathematics among girls by school type.
3. To compare the performance in mathematics among boys by school type.
4. To determine whether there is significant improvement in performance in mathematics when students are segregated by gender.

1.5 Hypotheses of the Study

The following null hypotheses were derived from the objectives and statistically tested at $\alpha = 0.05$

- Ho₁: There is no statistically significant difference in performance in mathematics among students in mixed sex segregated, mixed sex normal and single sex schools(boys' only and girls' only).
- Ho₂: There is no statistically significant difference in performance in mathematics among girls by school type.
- Ho₃: There is no statistically significant difference in performance in mathematics among boys by school type
- Ho₄: There is no statistically significant improvement in performance in mathematics when students are segregated by gender.

1.6 Significance of the Study.

The study's main aim was to provide empirical data on effect of streaming by gender on students' performance in mathematics. In the last decade co-educational secondary schools have created separate classes for boys and girls. This has been done with the hope that the performance of students in the K.C.S.E. might improve. Therefore, this study attempted to shed light on the implication of this action on students' performance in the K.C.S.E mathematics examinations.

Information from this study is expected to be useful to teachers and administrators of co-educational schools, as it will assist them to restructure their schools through streaming by gender. Such classroom environments are gender friendly and could help to improve students' interest and performance in mathematics and other subjects in the secondary school curriculum.

Policy makers and the Ministry of Education are expected to benefit from the study, since the results would have implications on restructuring co-educational institutions and making policy recommendations on streaming by gender, something that has not received much official attention.

1.7 Scope of the study

There are many other factors that may affect secondary school students' performance in mathematics; however this study was limited to streaming by gender. This study was confined to a documentary search of students' results in the K.C.S.E mathematics examinations for the years 1999 (in the case of the mixed sex segregated school), 2000 and 2001 in all the public secondary schools in Nakuru District. Nakuru district was selected because it has a good catchment of co-educational secondary schools (mixed sex segregated and mixed sex normal), boys' only and girls' only schools that were targeted for the study. In addition, there is a good transport network in most parts of the district. This facilitated easy accessibility to schools and subsequently respondents so as to collect the required data.

The study focused on national schools. The schools were Kabarak High School (Mixed sex normal), Nakuru High School (Mixed sex segregated), Moi Forces Academy (Girls' only) and Utumishi Academy (Boys' only) This is because the students admitted to these schools are of similar qualifications based on their performance in the Kenya Certificate of Primary Education (KCPE) examination. This provided a basis for generalization of the results. In addition all the four types of public secondary schools that were targeted for this study were represented in this category. The schools are well established and have most of the basic facilities required in the teaching and learning of mathematics. However the performance of students in these schools is poor as depicted by their mean scores which are below a score of 7 (see table 6). Therefore, in terms of curriculum organization, students' academic background, age and social set-up, these schools did not differ very much as to have adverse effects on the findings. Form four students were chosen because they constitute the cohort that had been exposed most to the secondary school mathematics curriculum and had sat for the K.C.S.E examinations. Mathematics teachers were chosen because they taught and interacted with these students in class. They were also responsible for the implementation of the syllabus, hence were in a position to give valid information.

1.8 Limitations of the Study

Due to low funding and less time, the study only focused on streaming by gender in the sampled schools. In addition, this study involved a documentary search of K.C.S.E mathematics results of students in national secondary schools. Therefore, data obtained from this study can only be generalized to other groups and settings with caution.

1.9 Assumptions of the Study

The study was carried out under the following assumptions:

1. That all teachers are well trained qualified and experienced to teach mathematics effectively in secondary schools in Kenya. Therefore the difference in students' performance will only be attributed to streaming.
2. That the Kenya Certificate of Secondary Education (K.C.S.E) mathematics examinations are standardized and are therefore equivalent forms of one another during each subsequent year.
3. That streaming by gender was the main factor affecting students' performance in mathematics and confounding factors were taken care of by the selection of students from the national category.
4. That all respondents gave frank responses indicating their perceptions, feelings and judgement.

1.10 Operational Definitions of Key Terms

The following operational definitions of terms were pertinent to this study: -

Co-education: It is a system of education in which students of both sexes share the same school facilities, educational content and instructional methods and objectives.

School Type: A particular class of public secondary schools that share certain qualities and are different from those outside the class. In this study there are three types of secondary schools namely; mixed sex segregated, mixed sex normal and single sex schools.

Mixed sex segregated school: Referred to a type of co-educational secondary school where boys and girls were taught in separate classes.

Mixed sex normal school: It is a type of co-educational secondary school where both boys and girls were taught in the same classrooms.

Single sex school: It is a type of secondary school for either boys' only or girls' only.

Gender: Refers to sexual classification (Cowie, 1989). In this study, gender referred to differences in sex, either a boy or a girl.

Streaming by gender: Referred to placing students or assigning them to classes based on their sex.

Performance: It is the observable and measurable behaviour of a person in a particular situation or experiment (Burchfield, 1989). In this study, the score obtained by a student in the K.C.S.E mathematics examination was used to indicate performance.

Public Secondary schools: Secondary schools that are partially supported by the government of Kenya.

Poor performance: It means less than is expected or far below the usual standard. In this study, a student whose performance is poor is one who has attained grade of below C+ or a score of below 7.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In the past decade some co-educational secondary schools in Kenya have created separate classes for boys and girls with the hope that the performance of students especially girls in mathematics might improve (Republic of Kenya, 1999). However, there seems to be lack of studies in Kenya on the effects of this venture on students' performance in the subject. This chapter presents a review of related literature with regard to importance of mathematics and streaming by gender in mathematics. The chapter has specifically reviewed research studies on gender differences that exist in the learning of mathematics. These differences include; differences in cognitive styles, differences in participation, differences in performance, and differences in attitude and confidence levels. The possible explanations for these gender differences are highlighted and then related to the conditions found in Kenyan secondary schools. They include; school variables, teacher –student interaction, learner variables, teaching resources and facilities, teacher qualification, training and working conditions and curriculum. Lastly the chapter presents the theoretical and conceptual frameworks of the study.

2.2 Importance of Mathematics

Mathematics occupies a significant position in society. It provides the society with the most powerful practical tools to tackle all kinds of problems (Cockcroft, 1982). In addition, it provides a highly effective means of presenting information in as concise and precise form as possible; for example, when expressing the results of an investigation. Mutunga and Breakel (1992) reported that mathematics helps to develop powers of logical thinking, which is an important attribute to inculcate in both boys and girls.

Apart from being an independent subject of study, it is applied to other subjects such as social sciences, arts, government and business transactions (ACO, 1979; Cockcroft, 1982; Mutunga & Breakel, 1992). Mathematics is important in the study of sciences (both physical and biological) economics, geography, business and management studies, military and aerodynamic advancements, engineering, and medicine among others. Mathematics is also utilized in carrying out household chores, such as in weighing, measurement in the kitchen and timing in cooking.

According to Kenya Institute of Education (KIE) (1992) mathematics is a distinct subject of study in the curriculum. This is because it assists in the process of producing a person who will be numerate, orderly, logical, accurate and precise in thought (KIE, 1992). The person is expected to be competent in appraising and utilising the mathematical skills in playing a positive role in the development of a modern society. Further, mathematics is a key subject in the enrolment into competitive courses in college and university. Therefore the performance of students especially girls in the subject must improve. Hence teachers and school administrators must provide a conducive classroom environment that would ensure full development of students' potentials in mathematics.

2.3 Gender differences in the learning of mathematics

Various studies centred on gender differences in mathematics have been carried out. These studies concentrated on various aspects of mathematics learning, these include; differences in cognitive styles, participation, performance, attitude, and confidence levels. Various explanations have been put across to account for these differences; for example school variables teacher-student interaction, learner variables, teaching resources and facilities, teacher qualification training and working conditions and curriculum.

2.3.1 Differences in cognitive Style

Scott-Hodgetts cited in Costello, (1991) has argued that gender differences in learning mathematics may be associated with differences in cognitive style. Cognitive style refers to the different ways in which people process information, including perception, storage, transformation and utilization of information from the environment (Husen & Postelthwaite, 1991). Mondoh (2001) has defined cognition as the process of perception, thinking, reasoning, and understanding, problem solving and remembering.

Differences in cognitive styles may provide another perspective of explaining gender differences in mathematics learning. Studies have found that students score differently on different examination items. Some do well in easy items while others on difficult ones (Kakonge, 1980; Mondoh, 1986; Wamani, 1980). Girls in particular achieve higher average scores than boys in primary school tests, which are relatively easy. However both sexes perform poorly in difficult items. Difficult items demand insight and understanding while

easy items, demand care. Thus failure in easy items is likely to be by a mistake (Mondoh, 2001). This view is supported by Fennema and Leder (1990) who found that gender differences in mathematics existed in tasks that required functioning at high cognitive levels. According to them there are gender differences in favour of boys especially in tests that measure problem solving of the most complex cognitive level. This is an indication that the cognitive styles of boys and girls are different.

McCarthy (1981) cited in Mondoh (2001), Bryden (1979) and Husen and Postlethwaite (1991) have attempted to explain the origins of the differences in cognitive styles of both boys and girls. Bryden (1979) singles out differences in cerebral organisation (brain lateralisation) as a possible cause of differences in cognitive styles. According to him the brain is divided into two; the left and the right hemispheres. The left hemisphere controls linguistic skills while the right controls spatial skills. Bryden (1979) further explains that the left side of the brain develops earlier in girls, hence their linguistic superiority. For boys it develops later, but the right hemisphere in them develops earlier giving them greater competence in spatial related activities. Spatial skills or spatial visualization is the ability to visualise movement of geometric figures in ones mind. Hence a person with greater competence in spatial related activities is likely to perform well in science and mathematics. This perhaps explains why boys are likely to be good in science and mathematics, while girls are likely to do well in languages. Fennema and Tartre (1985) differed with Bryden, they argued that a man can grasp language skills just as well as women. On the other hand women can also excel in spatial skills. They continue to argue that while spatial visualisation is positively correlated with performance in mathematics, it does not indicate causation. Hence according to them not all girls are handicapped by inadequate spatial skills. It is only those girls who score low on spatial skills tests.

McCarthy (1981) cited in Mondoh (2001) argues that in addition to brain lateralisation, boys and girls differ in how they process and perceive reality. According to her a combination of perceiving and processing techniques results in the formation of four unique learning styles of people as shown in figure 1.

Perceiving concrete experiencing (CE)

RIGHT BRAIN DOMINANT Quadrant 4 Processing ACTION Quadrant 3	IF Type four <ul style="list-style-type: none"> • Modifying • Shifting • Adapting • Risking • Intuiting • Acting • Collaborating • Innovating • Creating 	WHY Type one <ul style="list-style-type: none"> • Brainstorming • Listening • Speaking • Interacting • Knowing oneself • Understanding & approaching others 	LEFT BRAIN DOMINANT Quadrant 1 REFLECTION Quadrant 2
	BOYS? ABSTRACT GIRLS?		

Figure 1: Four learning styles – The 4 mat-system

Type one learners

These learners perceive information concretely and process it reflectively. They learn best by being personally involved, listening and sharing ideas. Their favourite question is “Why”. Hence teachers need to provide them with reasons for learning a particular concept. Mondoh (2001) argues that such learners should be taught more using group work. In addition girls are more likely to be in this category. However, in Kenya most mathematics lessons are teacher-dominated and individual oriented. This implies that girls are likely to lag behind boys in mathematics.

Type two learners

These are observers and thinkers. They are best taught using the experimental method. However in Kenya, most mathematical lessons are presented theoretically. This is due to the absence of mathematics laboratory in secondary schools (Mondoh, 2001). In addition most schools experience a serious shortage of teaching aids and resources (FAWE, 1997). Lack of practices in mathematics lessons has a negative effect on students’ interest and motivation to study mathematics. The majority of girls are more likely to be in this category (Mondoh, 2001). This may perhaps explain their low participation and performance in mathematics.

Type three learners

According to McCarthy, these learners perceive information abstractly and process it actively. They like trying things out for themselves. Mondoh (2001) says that their favourite question is “How”. Therefore, such learners learn best when they are left to try things out. Teachers need to be aware of this. They should set up for such learner’s relevant “hands on” activities that relate to real life especially those within the context of the student’s own lives and environment (FAWE, 1997). According to Mondoh (2001) this category of students can apply learnt concepts to new situations and cope with lots of homework individually. Such attributes are good for learning mathematics, most boys have them hence the reason why they are better than girls in mathematics.

Type four learners

These learners are risk takers and dynamic. Their favourite question is “IF”. They should be left on their own to teach themselves and others. Self-discovery is the best method for teaching them. This is also another very good attribute for learners of mathematics. More boys than girls fall in this category, hence another reason why boys are likely to perform better than girls in mathematics.

Further, Husen and Postlethwaite (1991) categorised peoples’ way of thinking and learning into ten categories. These include; reflective versus impulsive, serialist versus holist, field-independent versus field-dependence, convergence versus divergence and confidence versus caution cognitive styles. It is important to note that both the teacher and the learner have their own unique cognitive styles. Hence compatibility or incompatibility between their preferred thinking could in away affect performance of a learner in mathematics.

Under the reflective versus impulsive category, the reflective is more careful, conscientious and meticulous (Costello, 1991). Learners who are impulsive are quick to answer questions. Hence reflective learners are likely to make fewer mistakes in arithmetic computations than impulsive learners (Mondoh, 2001). According to her majority of the boys have an impulsive style of thinking while girls have a reflective style. Therefore, girls are likely to perform better in arithmetic computations than boys. There is evidence that some students are less careful and more impulsive than others (Mondoh, 2001). This coincides with many views of how boys and girls behave in mathematics lessons. It also explains some other aspects of gender differences such as the belief that girls may perform better than boys in coursework than in unseen timed examinations.

Holists are learners who think as a whole and have a global description or understanding of a system or structure (Changeiywo, 2000). Serialists on the other hand understand one thing at a time. Costello (1991) and Dembo (1977) argue that such learners understand topics in a bit by bit approach. Scott-hodgetts (cited in Costello, 1991) asserts that learners who adopt a serialist approach to learning are disadvantaged when learning mathematics. Mondoh 2001 contends that as conceptual structures become more complex understanding of relationships becomes central to success and thus a serialist is likely to fall behind. She observes that the majority of girls than boys are serialists, hence the poor performance of girls in the subject.

Field-independence versus field dependence is another dichotomy of cognitive style, which is likely to bring about gender differences in mathematical performance. Students with field-independence cognitive style are insensitive to social environment when learning. They work independently, compete among themselves and are task oriented. Field-dependence students are sensitive to their social environment when learning with others and are affected by feelings and opinions of others. Mondoh (2001) says that field-independent children are superior in mathematics and science than the field-dependent children. Boys mostly adopt a field-independent approach to learning while girls adopt a field-dependent approach. Again, this explains why boys are likely to stay ahead of girls in mathematics.

Under the Convergence versus divergence category, convergence learners are cautious, emotionally inhibited and choose to study science and mathematics. In the divergent cognitive style, learners are more expansive and uninhibited. When faced with problem divergees give a large number of answers that are sometimes bizarre. They normally choose to study humanities. According to Mondoh (2001) most boys are convergees while girls are divergees. This is perhaps another explanation for gender differences in mathematics.

Lastly another dichotomy, which is likely to explain gender differences in mathematics, is the confidence versus caution. A confident learner is a risk taker while cautious learners fear the risk of failure. A learner who is a risk taker is likely to succeed in mathematics. Boys have been observed to be risk takers while girls are careful.

The cognitive styles of both boys and girls are different and can affect students' understanding and performance in mathematics. Therefore perhaps teaching boys and girls mathematics in different classes might help teachers in adjusting their instructional approaches in line with the students' cognitive styles. This study attempted to explore the effects of streaming by gender on students' performance in mathematics.

2.3.2 Differences in Participation

Participation refers to the extent of boys and girls being retained and active in mathematics classes and in mathematics-related courses beyond secondary schools (Abagi & Wamahiu, 1995; Burton, 1996; Wanjiku & Masheti, 1997). The participation of students and especially that of girls has been an issue and a cause for concern in Kenya. There is immense evidence

that a fewer girls than boys participate in mathematics related courses and that girls on average perform poorly than boys (East African Standard, 2000 Feb 25; Eshiwani, 1984; Mureithi, 2000; Mwathi; 2000). It should be noted that participation in class activities by students is important in determining performance of a student in mathematics. There is evidence that more boys than girls are admitted in secondary schools and at the public universities in Kenya (Abagi & Wamahiu, 1995); Kenya's East African Standard, 2000 Feb 25). In addition Mureithi (2000) and Mwathi (2000) assert that there are fewer girls in mathematics classrooms and in mathematics related courses at the post secondary school institutions in Kenya. Further Mwathi (2000) observe that out of 157 mathematics lecturers in public Universities in Kenya only 9 of them were women.

However studies reveal that some of the causes for this gender differences in participation originates from mathematics classrooms (Changeiywo 2000). He argues that in co-educational school systems, male students are more likely to participate in science and mathematics activities and that female student become automatically passive learners in these classrooms. Costello (1991) attributes this to the intense anxiety generated by mathematics among pupils. He observes that girls are more prone than boys. This discourages girls to make contributions to discussions in class for fear of showing up their own inadequacies. Sanga (1982) established that in Kenyan classes, boys have greater interaction with their teachers than girls do. This means that they participate more in classroom discussions and are therefore likely to have greater understanding of concepts in class, hence better performance in mathematics (Kirembu, 1991). As if to support Kirembu, Wanjiku and Masheti (1997) observe that girls may not answer questions as quickly as the boys not because they do not know but because their socialisation does not allow them to even take the risk of being wrong. Further, FAWE (1998) asserts that girls use their school time inefficiently by not participating fully in class discussions. FAWE attributes this to African traditional practices where girls and women are not supposed to enter into discussions with men. They were only supposed to listen. In addition teachers do not make any effort to pull students into discussions when they do not participate. Very often, the teacher wants a quick answer and the fact that the girls are slow in putting up their hands is interpreted to mean that they do not know (Wanjiku & Masheti, 1997). As a result girls lose out on so much and are also not able to share with the rest of the class. Given time, therefore girls will find themselves responding to questions. Wanjiku and Masheti (1997) argue that a gender responsive teacher should be aware that what the girls need is more time and patience. According to them, this will enable

them gain more confidence eroded by their socialisation process. This is even more important in subjects that are considered to be traditionally male for example mathematics.

Girls it appears do not interact more with their teachers and also rarely participate in mixed gender mathematics classes. This implies that they are disadvantaged when learning in such classes and therefore separate classes for them might encourage them to participate in class discussions and share ideas with other students. Hence this study was specifically designed to explore the effects of this separation on students' performance and particularly that of girls.

2.3.3 Differences in Performance.

Performance in mathematics refers to successful attainment and accomplishment in a mathematics examination. It is measured in terms of scores that candidates obtain in an examination. In Kenya, boys continue to score highly in K.C.S.E mathematics examinations compared to the girls. During the 2005 K.C.S.E mathematics examinations, boys scored a mean of 18.49% compared to a mean score of 12.97% by the girls (KNEC, 2005). Eshiwani (1985) and Kirea (1989) observe that gender differences in mathematics performance in primary level are relatively small. These differences increase at the secondary level of education (Makau, 1994; Obura, 1991).

However a careful review of some studies reveals an inconsistency of findings on performance in mathematics between males and females. Few consistent differences in performance in mathematics are found at the early primary school level. Studies have shown that from the beginning of secondary schooling, boys frequently outperform girls in mathematics (Eshiwani, 1974; Fennema & Sherman, 1977; Makau, 1994; Obura, 1991). Fennema argues that these differences are found to be significant at adolescent age which is the age of students who are in Kenyan secondary schools.

Research findings are also inconsistent concerning the effects of single-sex schools on students' performance in mathematics. Some studies (Colley, Comber & Hargreaves, 1994; Mallam, 1993) have found gaps favouring girls in single sex schools, but once these findings were adjusted for socio-economic or ability variables, these differences diminished. For example Harker and Nash (1997) in a longitudinal study of more than 5000 eighth-grade students in New Zealand controlled for individual characteristics such as socioeconomic

status and school type. The researchers confirmed statistically significant differences in favour of girls at single sex schools. However, after applying controls for ability levels and for social and ethnic backgrounds, the differences disappeared.

Using data from the National Educational Longitudinal study of 1988 in America, Lepore and Warren (1997), found that boys in single sex schools did not increase their test scores more than boys in co-educational schools and that girls experienced no statistically significant positive effects of single-sex school environment. In contrast, Githua (2002) in a study on the factors related to the motivation to learn mathematics among school students in Kenya found that boys in boys' only schools were more motivated during mathematics teaching and learning and are likely to be superior in performance compared to others. However, he did not control for ability level of the students.

It should be noted that studies that have found positive achievement outcomes attributable to the single-sex environment have all dealt with single-sex schools rather than classes. Lee and Lockheed's (1990) study of 1,012 students in ninth-grade Nigerian Public schools measured mathematics performance and stereotypic views of mathematics. They found no significant gender gap between mathematics scores of Nigerian boys and girls once other variables were taken into account. They also found that girls in single-sex schools outperformed other girls in mathematics, while boys in single-sex schools did the reverse. The study was then adjusted for student background, school resources and teacher attitudes. It was found that girls in single-sex schools had a less stereotypical view of mathematics, while boys in single-sex schools had magnified stereotypes of the subject.

From the above studies, there is some inconsistency of findings as to whether single sex education brings about positive achievement in mathematics. Some studies such as (Riordan, 1990) recognized that some single-sex schools are "doing something different" that might be reproduced in the co-educational context. Riordan views policy and training interventions as being valuable. Although studies find that girls view the single-sex schools as more conducive to learning, research fails to confirm significant gain in girls' mathematics performance in the single-sex schools.

2.3.4. Differences in attitudes and confidence. –

Longman (1992) has defined attitude as the way one feels or thinks about something. Longman has also defined confidence as calm and unworried feeling about something based on a strong belief in one's abilities.

Therefore learners who strongly believe that they can perform well in mathematics will not be worried when faced with problems in the subject and are likely to excel in the subject.

Eshiwani (1984) and Kirea (1989) have argued at the upper primary level, boys and girls differences in interest, difficulty and importance of mathematics is very small. However Costello (1991) contends that girls are often unsure about their opinion but boys on the other hand are extremely sure about their opinion.

Costello further notes that at secondary level gender difference in attitudes and confidence towards mathematics increase with that of boys increasing while that of girls declining. Eshiwani (1985) and Makau (1994) assert that especially at age 15 more girls than boys view mathematics as difficult. According to them more boys than girls are likely to overestimate their final grades. Leonard (1995) reported that when a group of boys and girls were asked to complete a mathematical reasoning problem, only a third of them answered the question rightly. Boys believed that they got the answer right despite both boys and girls failing in the question. This is an indication that more boys than girls have a lot of confidence in their performance. Manning (1998) contends that this is likely to translate into more boys than girls excelling in the subject.

Further, most girls believe that mathematics is a difficult subject and that boys are more superior and intelligent hence capable of handling it. (Eshiwani, 1985). As a result, boys perpetuate this myth by ensuring that they excel in areas they consider to be 'masculine' in nature (Namuddu, 1993). Namuddu reiterates that boys would often ridicule girls who dare to venture in to 'masculine' subjects. Leder (1992) adds that more males than females strongly believed that mathematics was more useful to them. From the foregoing, differences in attitude towards mathematics are likely to bring about differences in performance in mathematics.

Studies carried out on attitude towards mathematics indicate that the type of school attended by learners may have an influence in their attitude towards certain subjects. Mallam (1993) found that students in girl's only Nigerian schools strongly preferred mathematics than girls in co-educational Nigerian public boarding schools especially if taught by female teachers. Colley, et al, (1994) did a survey on British students of ages 11 – 12 and 15 – 16 years from single sex girls and boy's schools and co-educational schools. Students were asked to rank their preferred subjects in school. They found that, in the group of learners of ages 11- 12, girls from girls only school strongly preferred stereotypical 'masculine' subjects such as mathematics and sciences than did their co-educational peers. Boys from boy's only schools were also found to strongly prefer stereotypical 'feminine' subjects like music and art more than fellow boys in co-educational schools.

FAWE (1998) notes that lack of subject specialization for teachers at the primary level could bring about differences in attitude towards mathematics between boys and girls. FAWE found that at this level, female teachers were not assigned to teach mathematics or opted out of the subject. This creates an attitude in teachers, parents and students that mathematics and related careers are masculine. Hence girls and women are seen as not capable of performing as well as their male counterparts.

Clark and Gorski (2002) studied the decline of females in technology by surveying on fourth and twelfth grade students. They found that students at grade level twelve answered yes to the questions ' I like mathematics' and 'I am good at mathematics'. The same was the case with students at grade level four, but the number of twelfth grade girls with confidence in mathematics drastically reduced. This study shows the low level of confidence among females in mathematics. This view is supported by Fennema and Sherman (1977) who found that there exists gender difference in the levels of confidence in mathematics. Shields (1991) further attributes the low level of performance in mathematics by females to the low confidence levels and not their ability. Shields argues that confidence helps students to be persistent when faced with a challenge. However females lack persistence due to the low confidence levels, hence do not perform to their highest ability in mathematics. From the foregoing differences in attitudes towards mathematics and confidence levels may be a cause for gender differences in performance in mathematics. As such, mathematics teachers should be aware of this so that they may encourage girls to change their attitude towards the subject and also gain confidence in handling mathematical problems.

2.4 Possible explanations for gender differences in the learning of mathematics.

A large number of factors have been put forward to account for gender differences in mathematics. However this review focused on factors such as school, teacher-student interaction, learner variables, teaching resources and facilities, teacher qualifications, training and working conditions and curriculum.

2.4.1 School Variables —

The type of school that learners attend could in a way account for the gender differences in mathematics performance. This is because, schools handle students differently mostly on the basis of their gender. This is usually done through their organizational structures. (Farrel, 1993; Fennema & Leder, 1990; FAWE, 1998).

Fennema and Leder, (1990) argue that single sex schools have been viewed as reinforcing the belief that males and females have different educational needs. According to them co-education was assumed to be the avenue through which similarity of treatment of the two could be achieved, while the degree to which a community provided for education in sex-segregated settings was considered to be a measure of the extent to which males and females were believed to require different preparations for different adult roles. Eshiwani (1983) pointed out that in co-educational institutions this scenario occurred at a much higher level than in single-sex schools. He further argued that through the hidden curriculum, schools brought social pressures to bear upon boys and girls to conform to masculine and feminine characteristics.

Mathematics is considered a masculine subject (Eshiwani, 1983) hence boys especially in co-educational schools are likely to perform better to prove their masculinity. On the other hand there is pressure on the girls to show femininity and since mathematics is unfeminine, they tend to perform poorly in the subject. As if to support the Eshiwani's view, the academic performance of girls in single-sex schools is likely to be better in mathematics than the performance of girls in mixed-schools (Garret, 1987). Boys on the other hand are likely to do significantly less well in single-sex schools than in mixed schools (Garret, 1987; Lepore & Warren, 1997).

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Findings like these have prompted researchers to call for a reversal of the current state of policy in co-education. Spender (1980) argued that mixed schools are retained in a patriarchal society because of the advantages they give to male students. She argues that the presence of girls is necessary in order to promote the positive image of boys. It is against the girls that the boys stand out. Girls act as a negative reference group. She has therefore suggested that subjects such as mathematics and science should be taught to girls and boys separately in mixed schools. This according to her was likely to improve the performance of girls in mathematics.

However, studies done by Harker and Nash (1997), Lepore and Warren (1997) and Riordan (1990) among others, on whether single sex schooling raises performance have produced conflicting results. Some studies (Fletcher, 1998; Lewin, 1998; Leuer, 1998) found that single sex schooling does not raise academic performance in mathematics. Lewin (1998) argues that single-sex schools for girls essentially are an individual strategy, which helps individuals rather than a systematic attempt to help all students. He found out that whether co-educational, single-sex female or predominantly male had no effect on various standardized measures of general knowledge. In contrast, other studies (Bellman, 1997; Hagan, 1998; Nemco, 1998) found that single sex school results in greater academic performance for girls. They attributed this performance to higher self-esteem and confidence built in a single sex class environment. Nemco, (1998) argues that such an environment encourages females to take “harder” subjects such as mathematics and sciences and perhaps this might explain why girls tend to perform well in mathematics in an all females school. It is noteworthy that most of these studies have been conducted in the United States and the Western countries. In addition findings are conflicting on whether single sex classes raise or have no effect on the performance of students especially girls in mathematics. This necessitated further studies in the area.

2.4.2 Teacher-Student Interaction

The teacher is the most important person for the student. Teachers are often role models and usually students take it that, they are right and wise. Hence, irrespective of the formal organization of the mathematics lessons, teachers play a key role in carrying out school policies. In addition their beliefs are always portrayed in classroom practices (Fennema & Carpenter, 1981; Wanjiku & Masheti, 1997). Wanjiku and Masheti (1997) argue that the

teachers' attitude biases and behaviour will be passed on to the boys and girls. This will in turn contribute to the perpetuation of stereotypes in written and oral text.

Changeiywo (2000) argues that in co-educational schools, there are inherent significant differences in teacher praise, and solicited responses, procedural questions and behaviour warnings based on student gender. According to him, teachers are more prone to ask male students to answer questions and participate in class demonstrations. This is likely to make the female students passive learners in class. Such treatment is likely to make girls develop low self-esteem, loose interest and subsequently perform poorly. Changeiywo (2000) agrees with Fennema and Leder (1990). They found that teachers interact more with boys than with girls, praise and scold boys more than girls and call on boys more than girls. However, they argue that this teacher behaviour may not support the premise that differential teacher treatment of boys and girls causes gender differences in mathematics. This is supported by Koehler (1990) and Eccles and Blumenfeld (1985). They note that there is still no sufficient evidence to allow the conclusion that interacting more or differently with girls and boys is a major contributor to the development of gender differences in mathematics. Instead, Fennema and Peterson (1986) found that the organisation of instruction by teachers made up a pattern of classroom organisation that appeared to favour boys. For example, competitive activities encouraged boys' learning and had a negative influence on girls' learning, while the opposite was true with cooperative learning. They note that competitive activities were much more prevalent than co-operative activities in the classrooms they studied. Hence, such classrooms favoured boys' learning than girls learning.

Similarly, teachers still believe that mathematics and sciences are a preserve of males and do not believe that girls have the ability to study mathematics (FAWE, 1998; Isaacson, 1996). According to FAWE (1998) and Isaacson (1996), teachers consciously or unconsciously discourage girls in mathematics classrooms. For example, they assumed that girls would be unable to answer certain types of questions or perform certain tasks. They often made remarks that indicated that girls are unintelligent and lazy. Hence little is done to encourage and inspire the girls to take mathematics seriously.

Further FAWE (1998) in a study on Female Education in mathematics and Science in Africa observe that teachers treated girls and boys differently and that girls were the ones mostly likely to be disadvantaged in teacher/pupil interaction in the classroom. FAWE (1998) noted

that teachers demonstrated some partiality in questions asked. They asked boys more questions than girls. The quality of questions also varied. Boys were asked questions that required higher order thinking for example explanations, analysis and synthesis while girls were asked lower order questions that involve simple recall of knowledge. It is important to note that questions that require higher order thinking promote more effective learning. This means therefore that girls will lag behind. In addition, the same teachers tend to mark the exercises of whoever has their hands up as having finished their work. Consequently slow students who are mainly girls do not have their work marked in class and thus no individual help when needed. The methods of reinforcement used by teachers for boys and girls during lessons varied FAWE (1997) and Changeiywo (2000) observed that teachers were more likely to use positive reinforcement and praise boys more than they did to girls. This will reinforce in girls the belief that they are less capable. This will in turn negatively affect their self-esteem and confidence, hence their participation and performance in mathematics.

Gordon (1995) asserts that boys can compete with girls on equal terms and that teachers promote this type of contest. However in co-educational schools, teachers give preferential treatment to boys. They are also insensitive to the out-of-school experiences, which girls bring with them to the classrooms. This includes the society's traditional attitudes towards girls and especially regarding ideal behaviour, abilities and characteristics (FAWE, 1998). FAWE observes that in most African traditional society girls are socialized to be obedient and submissive. They were not expected to speak in front of men; this is contrary to the learning behaviour they are expected to adopt in the classroom. Teachers are either unaware of or ignored this problem and did not make any effort to help girls resolve or deal with this dilemma. In a study on female education in mathematics and science in Africa, girls reported that during practicals and group discussions, teachers focused more on boys than girls. Some of the equipment used in the classroom is either unknown or hostile to the girls. In some circumstances, they were not allowed to use the equipment. This denies them the chance to participate in practical work. Girls were also disadvantaged during practicals since their socialization allowed them few chances to handle and experiment with tools outside the home. This made them to be less experienced when it came to learning concepts like making models and nets of solids. As such denying them the opportunity to become familiar with equipment and processes in practical lessons. This further widens the gender disparity in mathematics performance. Therefore, girls are likely to develop a dislike for the subject and consequently perform poorly.

Teachers' attitudes to and expectations of the girls and the boys contribute to the quality of participation and performance of the boys and girls (Wanjiku & Masheti, 1997). According to them if girls are praised for getting an average mark they will be content with it and assume that it is all they can do. On the other hand if boys are reprimanded for average performance they will take the challenge and aim higher. However, Wanjiku & Masheti (1997) observe that in some cases teachers' expectations of boys could lead to disastrous results. For instance, in the case where a boy is expected to do better because he is a boy. This boy could develop a complex that might not be healthy for his emotional development. Hence teachers need to appreciate the different gender needs of boys and girls. As a result, teachers need to be sensitised on gender related issues to re-orient their thinking towards girls' education, especially in mathematics so as to enable them improve their performance.

2.4.3 Learner Variables

The type of school that learners attend together with teacher-student interactions in class could bring about differences in the way boys and girls view themselves as learners of mathematics. Given an opportunity, the path that learners will choose depends on how they view themselves as well as their perception of reality (Fennema & Leder, 1990). Therefore, learners who have the ability to continue learning mathematics but believe that it is not useful to them may drop it or perform poorly in it (Maccoby & Jackline, 1974).

Eshiwani, (1983) found that boys believed that the study of mathematics was appropriate for them since they viewed it as masculine, hence chose to study and performed well in it. Namuddu (1993) observe that this makes the boys to dominate in mathematics classrooms, which they consider a masculine zone. She argues that boys will even ridicule girls who dare to venture into what they consider masculine subjects. Fawe (1998) reiterates by noting that during mathematics lessons boys displayed more confidence when it came to answering questions and carrying out exercises. Fawe observes that boys were more likely to put up their hands to answer questions, get their work marked, ask questions and carry out experiments. This implies that boys had more individual interaction with the teacher than the girls. This perhaps explains why boys are able to stay ahead of girls in mathematics. In contrast, many girls underestimate their own academic ability and subscribe to the view that

even if they succeed in making a career in the disciplines related to mathematics and science; they will not be allowed to attain their full potential in what they perceive as male dominated professions (FAWE, 1998). Girls also see themselves as less competent, particularly with reference to mathematics (Fennema & Leder, 1990). Moreover, an analysis of the data from the National Center for Educational Statistics in America showed that girls in single sex schools on average scored in mathematics a full half-grade above their counterparts in co-educational schools and even scored higher in sciences than girls in co-educational schools when measured by the same tests. The same was not true for boys in single-sex schools: boys in single sex schools actually performed slightly lower than boys in co-educational schools when measured by the same tests.

From the foregoing discussion, it is not clear which school type or classroom arrangement brings about increased performance in mathematics by students. It seems that boys in mixed schools would perform well to prove their masculinity while girls are likely to perform poorly in the subject. It is however not clear how students would perform in single sex classes. Hence this study sought to examine how students would perform in such classes.

2.4.4 Teaching Resources and Facilities –

Teaching resources and facilities refer to textbook, laboratories, tools, equipments, teaching aids and offices required for effective teaching in mathematics. FAWE (1998) and Sifuna (1989) noted that teacher's effectiveness in teaching is to a large extent influenced by the kind of resources and facilities available in the school. FAWE further notes that the availability of these resources and facilities will determine the teaching methods applied by the teacher. This will in turn influence the level and quality of participation and performance in mathematics by students, particularly girls (Githua, 2002; Muthoka, 1995; Ojiambo, 1996). According to Bennaars, Otiende & Boisvert, (1994) and FAWE (1998), where resources and facilities are inadequate, the teaching approach tends to be teacher centred. Such a teaching approach is boring and bad to teaching mathematics (Shiundu & Omulando, 1992). It kills the interest of students in the subject.

However, where resources and facilities are available, the teaching approach is likely to be learner centred (FAWE, 1998; Sifuna, 1989). In a learner centred teaching approach, a good teacher who is qualified and motivated will lay emphasis on practical activities (Sifuna,

1989). This approach enables the learners to experiment, solve problems, discuss with each other and involved in practical hands-on-activities. This will in turn stimulate their curiosity, imagination and critical thinking (FAWE, 1998). Therefore, mathematics lessons become exciting and captivating to learners and particularly the girls as observed by Benaars et al, (1994).

Farrel (1993) contends that performance of students in developing countries is much more influenced by availability of teaching resources in schools unlike in developed countries where teaching resources are in abundance. Eshiwani (1983) identified physical facilities and resources as accounting for differences in academic performance. In Kenya, most secondary schools lack these teaching resources and facilities (Siringi, 2001). This implies that students' performance in the subject and particularly that of the girls' declines. (Githua, 2002). Hence provision of teaching facilities and resources accompanied with streaming by gender may go along way in improving students' performance and especially girls in mathematics.

2.4.5 Teacher qualification, training and working conditions

The teacher is a crucial factor in the teaching of any subject (Watson, 1993; Ryans, 1969; FAWE 1998). Hence for a teacher to be effective, he/she must create a good rapport with students and organize the subject well. Qualified and experienced teachers are much more likely to sustain students' interest in secondary school mathematics. This will in turn determine the relevance of the subject.

Unqualified and inexperienced teachers are likely to be ineffective (Mwangi, 2000). This will make the students to develop a negative attitude towards the subject resulting in the objectives of the subject not being met. Oenga (1996) observed that teacher training; academic qualifications and experience were likely to bring about variations in academic performance among pupils. In addition Eshiwani (1983) found teacher characteristics to be among the factors that influenced academic success. Teacher qualification was ranked highest. Therefore it is important for issues affecting the teacher to be addressed, as they are likely to affect students' success in mathematics.

In a study on female education in mathematics and science in Africa, the statistics indicate under-representation of women in the teaching profession in general and in the teaching of mathematics in particular. Research indicates that the number of female teachers decrease as one moves up the educational ladder. Kenya is no exception, for example, in an analysis

conducted on the enrolment of second year students in a calculus course in mathematics in one of the Kenyan Public Universities. It revealed that 18.3% of the students were women compared to 81.7% men (Mureithi, 2000). Mwathi (2000) further reiterates that out of 157 mathematics lecturers in all the Kenyan Public Universities, 9 of them were women.

This scenario has a direct negative effect on girls' participation and performance in mathematics. It leads to fewer role models available to motivate girls to continue with study of mathematics. This problem is made worse by the lack of subject specialization for teachers at the primary level. This is because at the upper primary level most female teachers opted out of or were not assigned to teach the subject. This perhaps explains why mathematics is branded as a 'masculine' subject by teachers, parents and students (Murithi 2000; Mwathi 2000, Isaacson 1996). It also explains the notion that girls and women are not capable of performing as well in mathematics as their male counterparts (Mureithi 2000; Mwathi 2000). Therefore female teachers are seen as incapable of teaching the subject as their male colleagues.

Furthermore, female teachers face a special problem when posted to remote rural areas (FAWE, 1998). This is because they may be unable to find accommodation within or near the school. Therefore, safety becomes a source of concern especially when traveling long distances daily. This discourages single female teachers from accepting postings in remote areas, thus further reducing the number of female teachers and hence role models for girls in these areas. Besides these, shortage of female mathematics teachers leads to uneasiness in parents who fear to have their daughters in the company of male teachers for long periods (FAWE, 1998). This is because traditionally among some tribes girls are not allowed to talk among men except in very special cases. In addition, parents harbour fears of sexual harassment or intimacies developing between their daughters and male teachers cutting short their daughter's education.

Another issue that affects the teacher and could affect students' success in mathematics is the lack of and ineffective in servicing of the teachers. FAWE (1998) and Siringi (2001) reported that the in-servicing and training of teachers was ineffective. This is attributed to insufficient resources. As a result the inspectorate, and teacher in-servicing did not function adequately and effectively. Therefore, there is little support available for teachers to help them learn

new methods or acquire new knowledge and no effective means of identifying and rectifying teachers' areas of weakness.

Further inadequate training and in servicing of teachers means that they lack creativity and are not initiative (FAWE, 1998; Siringi, 2001). It also means that they will not improvise where there are no ready-made visual aids. FAWE (1998) in a study on female education in mathematics and sciences in Africa found that most teachers are ignorant of girls' unique problems. Some even lack competence in the use of equipment available in their schools and hence such equipment is not used. FAWE further argues that both male and female students view use of equipment as a male domain. Hence girls as well as boys and even teachers usually expect the boys to work with the equipment while girls watch. From the above, it seems that girls are disadvantaged when learning with boys in the same class. Hence separate classes for girls may help to alleviate this problem.

In many African countries, Kenya included, the teaching profession has a low status. Further, applicants to teacher training colleges are largely made up of those who fail to get in to other more prestigious and lucrative fields of employment (FAWE, 1998; Onyango, 2001). This implies that those who are in the profession are not necessarily the best qualified. In addition the fact that they are in the profession reluctantly means that they are lowly motivated, lack commitment and interest in the profession (Isaacson, 1996; Mugenda, 1995; Sigot, 1987). Such teachers according to Mondoh (1994) are likely to lead to students' failure in their subjects.

Poor remuneration and benefits offered to teachers is another factor that could lead to low motivation and hence low performance of students (Siringi, 2004). Poorly motivated teachers find it difficult to spare time for practical work. Such time is used by teachers on extra-curricular activities intended to supplement their meagre incomes (FAWE, 1998). Further private tuitions in the evening and holidays have become a significant part of school life. Therefore, some teachers have no time for students from poor families (FAWE, 1998). According to FAWE (1998) and Siringi (2001), this led to a high turnover of the best-qualified teachers as they left the profession in search of more lucrative offers. It was also reported that there were few opportunities for teachers' professional promotion and advancement within the educational system. This further lowered their motivation and status of the profession.

2.4.6 Curriculum

The mathematics curriculum can be a cause for gender differences in students' performance in the subject. FAWE (1998) asserts that the curriculum may be irrelevant, gender insensitive and overcrowded. An overcrowded curriculum can lead to inadequate coverage of the syllabus and inadequate attention to difficult topics (Gadgil, 1980). According to Dalizu (1995), Muthoka (1995) and Orondo (1996) syllabus content was a major factor that affected performance in mathematics, English and CRE. They contend that due to the heavy workload, teachers are not capable of effectively covering the syllabus. Especially at the secondary level, teachers complained that syllabuses are long and that there is not sufficient time to cover the syllabus adequately. Therefore, they end up skipping practical work even where equipment is available on the basis that practical work takes up too much class time. Gadgil (1980) reiterates that this was responsible for failures in mathematics.

FAWE (1998) and UNESCO (1999) noted that the curriculum is insensitive to the needs of the communities, which the schools served. Further, the same curriculum is not related to real life situations and the contexts within which the learners function (Siringi, 2001). The school system doesn't provide learner with opportunities to participate in matters affecting them (Siringi 2001). As result students especially girls lack interest in the subject. This can be attributed to girls' socialization, which brings about a limited view of what their future roles can be. These roles are often limited to those of mothers and wives and careers in fields such as teaching, hairdressing, tailoring, secretarial and other support roles in employment (Changeiywo, 2000; FAWE, 1998). The mathematics curricular, rarely attempts to relate what is learnt to any of these roles or careers. Hence most girls tend to consider the subject as irrelevant to their present and future lives, thus perform poorly.

2.5 Theoretical Framework

This study was guided by two theories on the different socialization of boys and girls. The theories are; sex role socialization theory and the school and neighbourhood resources theory. The sex role socialization theory was developed by Thorne (1993). According to this theory, boys and girls interact at school separately from each other in same sex clusters (Thorne, 1993). This theory identifies early childhood socialization especially in the home by parents as responsible for differences in educational experience by gender. The different

socialization processes beginning in the family of origin have brought differences in boys and girls in certain areas. These areas include; difference in self esteem, differences in their opinions about their own abilities and occupational aspirations. Baker and Jones (1993) have argued that the different opportunities that boys and girls are exposed to in the home shape their experiences in their socialization processes and in turn shape how they perform at school.

FAWE (1998) and Isaacson (1996) have argued that parents expect a high performance in mathematics for boys than girls. In addition, due the different sex-role identities and socialization experiences which begin at early stages, girls more than boys tend to be less interested in mathematics, believe that the subject is a “male” subject and are less confident in their mathematical ability hence perform poorly in the subject (Eshiwani, 1983; Garret, 1987; Spender, 1980).

The school and neighbourhood resources theory was developed by Entwisle , Alexander and Oslon (1994). They developed this theory in order to explain gender differences in education and particularly in mathematics performance. This theory identifies the school and resources in the neighbourhood as responsible for gender differences in mathematics performance. Studies indicate that young boys are more encouraged and girls are more discouraged during their exploration of the outside world and neighbourhoods (Bing, 1963; Block, 1983). Bing (1963) reiterates that the gendered play activities may be associated with boy’s superior numerical and spatial ability. Entwisle et al. (1994) further notes that the boy’s greater freedom and independence in outdoor settings could contribute to their greater cognitive growth in mathematics. Kessler, Ashenden, Connel and Dowsett (1985) have argued that the school system, being part of social, structural and political process may produce gender bias especially in the labour market. This bias is evident through the different courses that boys and girls are exposed to, different treatment by teachers and classroom organization at school (Baker & Jones, 1993). The different ways that these learners are treated in school tends to conform to the societal framework. (Kessler et al, 1985). It could also bring about differences in mathematical performance between boys and girls.

Further, Spender (1980) argues that in co-educational schools, the presence of girls is necessary in order to promote the positive image of boys. It is against the girls that the boys stand out. Eshiwani (1983) concurs with Spender and says that since mathematics is

considered a masculine subject, boys especially in co-educational schools are likely to perform better to prove their masculinity. Further, there is pressure on the girls to show “femininity” and since mathematics is “unfeminine”, they tend to shun the subject (Eshiwani, 1983). However, Garret (1983) argues that girls in single sex schools are likely to perform better in mathematics than their counterparts in co-educational schools.

Therefore from the above theories and studies, boys in boys-only schools were expected to perform slightly lower than boys in normal mixed sex schools. However, those from mixed sex segregated streams were also expected to perform slightly lower than those from normal mixed sex streams. In contrast, girls from girls-only schools were expected to perform better than those from normal mixed sex schools. Girls from mixed sex segregated streams were expected to perform better than those from normal mixed sex streams.

In comparison to boys, it was expected that girls from girls-only schools would compete closely with boys from all the three categories of schools. In fact they were expected to do better than boys from mixed segregated streams. However, girls from normal mixed sex schools were expected to perform poorer than boys from all categories of schools. It was hoped however, that those from mixed sex segregated streams would compete closely with boys from mixed sex segregated streams. Figure 2 illustrates the link between performance and streaming by gender.

The following sets of variables in relation to students’ performance in mathematics in the various school types formed the structure of the conceptual framework for the study.

- (i) Streaming by gender: This formed the independent variable for the study. Streaming referred to the act of assigning students to various mathematics classes on the basis of their gender. In the proposed study, streaming in the three types of schools was studied. These were; mixed sex segregated schools, normal mixed sex schools and single sex (boys’ only and girls’ only) schools.
- (ii) Students’ performance in the KCSE mathematics examinations formed the dependent variable. According to Burchfield (1989), performance is the observable and measurable behaviour of a person in a particular situation or experiment. In this study, students scores obtained in the KCSE mathematics examinations were used to indicate performance. The letter grades (A, A-, B+, B, B-, C+... E) in the KCSE mathematics examinations were translated to a twelve-point scale.

(iii) Teacher's qualifications and experiences, students' gender, age and ability, teaching resources and facilities formed the extraneous variables of the study. These variables could positively or negatively affect students' performance in secondary school mathematics. These variables were controlled by the research design. The research design requires that subjects to be included in the sample should be as homogenous as possible. Therefore the national category of schools was chosen. This is because; the mathematics teachers were well trained, qualified and experienced to teach in secondary school. The students were also of similar ability since they were admitted into these schools based on their KCPE results. In addition, the learners are admitted in form one at the age of 14 years; hence by form four a majority of them will be 17 years. Lastly, for schools to become national schools, they must have most of the basic teaching resources and facilities.

2.6 Conceptual Framework.

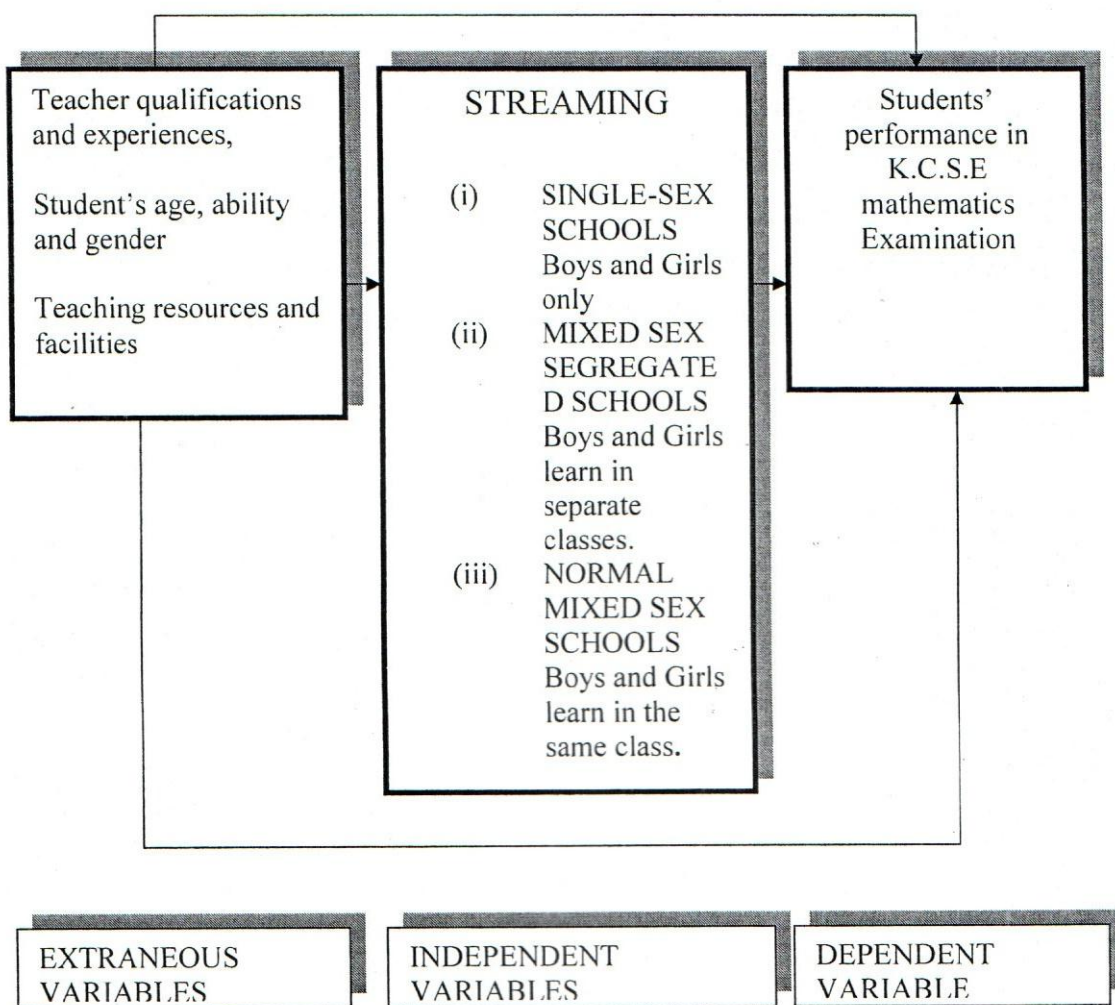


Figure 2 : A diagrammatic representation of the conceptual framework of the study.

This framework shows that the extraneous variables together with the types of mathematics classes that students learn in can positively or negatively affect their performance in K.C.S.E mathematics examinations. The scores obtained by students in the examinations measure this performance.

2.7 Summary

From the foregoing discussion it is clear that there are differences in performance in mathematics between boys and girls in secondary schools. It is also clear from literature that in mixed sex normal schools, girls have not been performing as well as boys in the subject.

Hence, single sex education has been seen as an alternative to improving their performance. However, from literature, it is not clear whether performance of girls improved as a result of this separation. Some studies found that this separation does not raise academic performance in mathematics, while others found that it has brought about some improvement in the performance of girls in mathematics. In addition, most of these studies have been carried out in developed countries with a few in developing countries like Nigeria. No such studies have been conducted in Kenya with respect to the 8-4-4 secondary school mathematics. This pointed to the need for such a study. It was on the basis of this existing gap that the study was carried out.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This study sought to determine the effect of streaming by gender on students' performance in secondary school mathematics. To achieve this aim, data was collected from selected secondary schools in Nakuru District. A documentary search of past records of K.C.S.E mathematics examinations results of students for the years 1999(mixed sex segregated school only), 2000 and 2001 was conducted. In addition, mathematics teachers from the selected secondary schools were interviewed. This chapter describes the research design used, location and population of the study. It also outlines the sampling procedures, sample size, instrumentation and the data analysis procedures.

3.2 Research Design

This study adopted an ex-post facto research by using the causal- comparative design to collect and analyze data. Ex-post facto is used when the researcher does not create a treatment but rather examines the effect of a naturalistic occurring treatment after the treatment has occurred. The researcher then attempts to relate this after-the-fact treatment to an outcome or dependent measure (Kathuri & Pals, 1993). In addition, this design aims at finding out the possible causes of behaviour patterns by comparing subjects in whom it is absent or present to a lesser degree (Borg & Gall, 1996). Three types of schools were used in this study for comparison purposes. These were; mixed sex segregated schools; normal mixed sex schools and single sex school (girls' only schools and boys' only schools).Further, the study examined students' performance in mathematics in mixed sex segregated co-educational secondary schools and then related it to streaming by gender in mathematics classes

3.3 Location of the study

This study was carried out in Nakuru district. The district was purposively selected for two reasons. First, it had a good catchment of co-educational secondary schools, which had streamed classes on the basis of gender (a phenomenon that the study investigated). Secondly, schools within Nakuru district are accessible by basic common means and familiar to the researcher. It was therefore possible to trace respondents and collect the required data within the acceptable time with minimum delay and costs.

3.4 Population of the Study

The target population consisted of form four students who sat their KCSE examinations in the years 1999, 2000 and, 2001 in national secondary schools in Nakuru district. However, the students in the 1999 cohort were from the mixed sex segregated school only. The district had four such schools. These were a mixed sex segregated school (Nakuru High School), mixed sex normal school (Kabarak High School), boy's only school (Utumushi Academy) and girls' only school (Moi Forces Academy). For reasons stated earlier, see (section1.7) national secondary schools in Nakuru district were selected. There were 1231 students in the four schools for the years 2000 and 2001. In 1999 there were 258 students in the mixed sex segregated school hence an accessible population of 1489 students. These groups of students were selected because around this period (2000 and 2001) students in the mixed sex segregated school sat their KCSE examinations after having been taught in single sex classes. In addition students in the mixed sex segregated school sat their K.C.S.E examinations in 1999 after having been taught in normal mixed sex classes.

3.5 Sampling Procedures and Sample Size

Purposive sampling technique was employed to select the schools and students that participated in the study. Purposive sampling technique was used to select all the four national secondary schools in Nakuru district and the cohorts that formed the study population. This technique involves picking cases that are typical of the population being studied (Kathuri & Pals, 1993). Secondary schools in the national category were selected since it is the only category that had all the four types of schools namely: normal mixed sex, mixed sex segregated, boys' only and girls' only schools being represented. It was also the only category of schools that ensured homogeneity, hence enabling the researcher to make comparisons in performance in mathematics based on streaming by gender.

As earlier stated there were 1489 students for the years 1999, 2000 and 2001 in the four national schools selected for the study. All these students formed the student sample for the study. The numbers of students from each category of school were as follows: girls' only (174), boys' only (242), mixed sex segregated (185 girls and 568 boys) and mixed sex normal school (78 girls and 242 boys). This ensured that all the ability levels of the students were taken care of. Further, from the schools' records the researcher found that there was one mathematics teacher for each form four class in the sample schools. There were 14 mathematics classes each year in the schools obtained as follows:

Table 2: No. Of Form Four Streams in each School for the Years 1999, 2000 and 2001.

School	No. of form Four Streams Per Year.		
	1999	2000	2001
Mixed sex Normal	–	4	4
Mixed sex Segregated	6	6	6
Boys' Only		2	2
Girls' Only		2	2
Total	6	14	14

Therefore, the total number of teachers in the years 1999 (mixed segregated school only), 2000 and 2001 were 34 (6+14+14). However, some schools had the same teacher handling a form four class in all the two years or three years in the case of mixed sex segregated school. In addition, during data collection, the researcher discovered that some teachers had been transferred to other schools and a number were not in schools at the time of data collection. Hence the sample for teachers was 22 instead of 34.

3.6 Instrumentation

Tuckman (1972) argues that interviews are used by researchers to convert information given directly by a person into data. He says that interviews make it possible for the researchers to measure what a person knows (knowledge or information), what a person likes and dislikes (values and preferences) and what a person thinks (attitudes and beliefs). Hence, the interview was found to be an appropriate tool for data collection for this study. It was administered to the mathematics teachers in the sample schools.

3.6.1 Teacher Interview Schedule (TIS)

The teacher interview schedule (TIS) contained three items, with the first item being divided into two parts; namely part (a) and (b). Item one focussed on the reasons for creating separate boys and girls classes in co-educational schools. It also focussed on whether this action (streaming by gender) led to an improvement in the performance of students and in particular that of girls in mathematics. Item two was concerned with the difficulties faced by teachers in teaching mathematics that were gender related. Lastly, item three sought to establish from the teachers the measures to be put in place so as to improve students' performance and in particular that of girls in mathematics.

Interviews administered to the mathematics teachers were used to collect additional data on streaming by gender and students performance in mathematics. This data was also used to verify data obtained from the documentary analysis of the K.C.S.E mathematics examination results.

In addition a documentary search of past records of student scores on the K.C.S.E mathematics examinations results was carried out. The examination results were for the years 1999(in the case of the mixed sex .segregated school only), 2000 and 2001 in all the three types of schools. These were; mixed sex segregated, mixed sex normal and single sex schools. The students' scores were recorded in a data sheet.

3.6.2 Validity and reliability of the research instrument

Validity of a research instrument refers to the extent to which the particular instrument measures what it was supposed to measure (Cohen, Manion & Morrison, 2001). Cohen et al, (2001) further defines reliability as the ability of the instrument to yield data that is consistent and replicable over time and groups of respondents.

For this study the researcher developed a teacher interview schedule (TIS). To develop the instrument, the researcher consulted various books on ways of constructing interview schedules. Thereafter, the researcher came up with a draft instrument which was discussed with the research supervisors. The instrument was then revised based on their comments and recommendations.

Greenam, Wu, Mustapha and Ncube, (1998) and Fowler (1994) recommended the use of experts to validate a research instrument. Hence the teacher interview schedule was presented to experts from the Faculty of Education and Community Studies, Egerton University, to check on the content validity. The interview schedule was further revised based on the comments of the experts. This according to Cohen et al, (2001) helps in achieving greater validity of the interview schedule.

To ensure the reliability of interviews, Cohen et al (2001) recommends that they should be highly structured, the words used in questions, order of questions asked to interviewees

should be the same. Therefore, for this study, reliability of the interview was achieved through the construction of an interview schedule for mathematics teachers. The schedule was strictly followed with same words used each time a teacher was interviewed.

Further Borg (1987) and Cohen et al (2001) have argued that the interview schedule should be carefully piloted in order to enhance the reliability of interviews and to guard against bias and any flaws in design. Hence the TIS was pilot tested in one mixed sex segregated school that did not take part in the study. Piloting helped in evaluating and improving the TIS and the procedure for interview. It also assisted the researcher to develop experience in using the TIS before any research data for the main study was collected.

3.7 Data Collection

To generate data required for this study, a research permit was sought after which the researcher visited the sample schools. Dates and time were fixed when the researcher could carry out the research. The researcher visited one school each day. Since the interview required face-to-face encounter, it was conducted by the researcher on the mathematic teachers in each of the sample schools. The researcher interviewed one teacher at a time and the responses recorded in the researcher's note book. In some schools, it was not possible to interview all the teachers since some were busy. Therefore, an appointment was organized with such teachers where the researcher interviewed them at a later date. After the interview, the researcher collected the KCSE mathematics examination results of students for the years 1999 (in the case of the mixed sex segregated school), 2000 and 2001 in all the schools and documented in a data sheet (see appendix A). These were obtained from the examinations departments in the schools. All the collected data was coded for analysis.

3.8. Data Analysis

This study generated both qualitative and quantitative data that were analyzed using both descriptive and inferential statistics. Group comparisons were done using the matrix given in table 3.

Table 3: Data Analysis Matrix

	B1	G1	B2	G2	B3	G3
B1		B1G1	B1B2	B1G2	B1B3	B1G3
G1			G1B2	G1G2	G1B3	G1G3
B2				B2G2	B2B3	B2G3
G2					G2B3	G2G3
B3						B3G3
G3						

B1 and G1 refer to groups of boys and girls in the mixed sex normal school, B2 and G2 refer to groups of boys and girls in the mixed sex segregated school while B3 and G3 refer to groups of boys and girls in boys'-only and girls'-only schools respectively. The mean scores in mathematics for the various groups of boys and girls were used for comparison. In addition the mean scores of students who did their KCSE mathematics examinations in the years 2000 and 2001 were compared with mean scores of students who did their KCSE mathematics examinations in the year 1999, where boys and girls were taught in the same class in the case of the mixed sex segregated school. This was for the testing of hypothesis four.

Data obtained from the teachers' interview were used to supplement the information obtained from the documentary search. Interviews were the means by which more detailed data were obtained. This constituted the primary database. This use of commentary notes derives from Mathiot's (1982) in (Shizha, 2000) self – disclosure technique that assumes that respondents reveal their perceptions of reality by how they talk about the events and people in their lives. The interview was used to elicit such comments. The comments were classified according to the categories prompted by a specific question in the interview schedule. A detailed content analysis on all the written comments was then used for analyzing data so that the voice of the respondents could be heard. Frequencies were derived in order to describe the data. Original comments and observation made by the respondents that were not covered in the interview schedule were kept in the researcher's notebook and used to illuminate results and presentations at appropriate places.

Statistical tests of significance were analyzed using the single t-test and the one-way Analysis of Variance (ANOVA) at $\alpha = 0.05$. To compare whether students in the various groups (see table 2) were statistically different, the single t-test was used. One way ANOVA was used because of its ability to determine whether there were significant differences between two or more groups or samples at a selected probability level (Ary, Jacobs & Razarie, 1972; Mugenda & Mugenda, 1999). It was also used because the groups were compared on only one variable but on different levels (Ary et al 1972). In the study there was one independent variable (Streaming by gender) which was at the nominal level and one dependent variable (performance) which was at the interval level. In order to establish exactly where the mean differences may lie and the direction of the difference, post-hoc multiple comparison tests were performed. Turkey's Honest Significant Difference test was performed. This test was chosen because it provides simple and accurate results. The single t-test was used because the students' scores were taken independently.

Hypotheses one, two and three were done using the one- way ANOVA whereas that of four was done using the single t-test. Data collected was analyzed on computer using the Statistical Package for Social Sciences (SPSS) model 9.0. Table 4 gives a summary of data analysis procedures.

Table 4: Summary of data analysis procedures

HYPOTHESIS	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	STATISTICAL TEST
H ₀ 1: There is no statistically significant difference in performance in mathematics among students in mixed sex segregated, mixed sex normal and single sex (boys' only and girls' only) schools.	Streaming by gender	Performance in K.C.S.E Mathematics examinations	ANOVA 3 group comparison
H ₀ 2: There is no statistically significant difference in performance in mathematics among girls by school type.	Streaming by gender	Performance in K.C.S.E Mathematics examinations	ANOVA 3 group comparison
H ₀ 3: There is no statistically significant difference in performance in mathematics among boys by school type.	Streaming by gender	Performance in K.C.S.E Mathematics examinations	ANOVA 3 group comparison
H ₀ 4: There is no statistically significant improvement in performance in mathematics when students are segregated by gender.	Streaming by gender	Performance in K.C.S.E Mathematics examinations	Single t-test

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This study investigated the effects of streaming by gender on students' performance in K.C.S.E mathematics examinations. Data was collected from mathematics teachers and past records of K.C.S.E. mathematics examination results of students for the years 1999 (mixed sex segregated school), 2000 and 2001. This chapter presents the results of the study. Both the quantitative and qualitative data are presented using relevant descriptive and inferential statistics while the results are discussed thereafter in each respective case.

4.2 Characteristics of Sample.

The schools selected for the study were sampled using the purposive sampling technique. All the four national secondary schools in Nakuru district were selected. The schools are; Nakuru high school (mixed sex segregated school), Kabarak high school (mixed sex normal school), Moi forces Academy Lanet (girls' only) and Utumishi Academy (boys' only). Further a total of 1489 students scores obtained from past records for the years 1999 (mixed sex segregated school only), 2000 and 2001 were included in the study sample.

Table 5: Distribution of Students by Gender in the Sample Schools

School type	Number of boys	Number of girls	Total
Girls' only	-	174	174
Boys' only	242	-	242
Mixed sex normal	242	78	320
Mixed sex segregated (1999, 2000 & 2001)	568	185	753
Total			1489

A total of 22 mathematics teachers were interviewed.

4.3 A Comparison of Students' Performance in Mathematics in Mixed Sex Segregated, Normal Mixed Sex and Single Sex Schools (Boys' only and Girls' only).

In order to respond to this objective the results of students on the K.C.S.E. mathematics examinations for the years 2000 and 2001 were obtained. The results were obtained from four types of schools namely: mixed sex segregated, normal mixed sex, boys' only and girls' only schools. The hypothesis to be tested was that there is no significant difference in performance in mathematics among students in mixed sex segregated, mixed sex normal and single sex schools (boys' and girls' only schools). The results obtained are summarized in Table 6.

Table 6 Comparisons of Mean Scores and SD in K.C.S.E Mathematics Examination Results by School Type (2000 & 2001).

School Type	N	Mean score	SD
Girls' only	174	5.8793	2.8955
Boys' only	242	6.6570	3.4512
Mixed sex segregated	495	6.5475	3.3192
Mixed sex Normal	320	8.6781	2.8184

Results in Table 6 show that in the years 2000 and 2001 the mean score of students in the normal mixed sex school is higher followed by those in boys' only, mixed sex segregated and lastly girls' only. This shows that students in the normal mixed sex school performed better than the other students in mathematics. One-way ANOVA was calculated in order to determine whether the differences in mean scores were significant. Table 7 summarizes the results of the ANOVA test.

Table 7: An ANOVA of the Mathematics Scores of Students in the Various School Types (2000 & 2001).

	Sum of squares	df	Mean score	F	P Value
Between Groups	1248.525	3	416.175	41.525 *	0.000
Within Groups	12297.480	1227	10.022		
Total	13546.005	1230			

* The mean difference is statistically significant at $P < 0.05$ level.

The results in Table 7 reveal that the differences in the mean scores of students in the four types of schools were statistically significant at $p < 0.05$. However this analysis does not show the direction of the difference. Therefore a post-hoc multiple comparison test using Tukey's-Honest Significant Difference (Tukey HSD) was computed in order to determine the direction of the difference and the results obtained are reported in Table 8

Table 8: Post Hoc Comparisons of the Mathematical Mean Scores of Students in the Four Types of Schools (2000 & 2001).

	I) School Type	(J) School Type	Mean difference (I-J)	P Value		
Tukey HSD	Girls' only	Boys' only	- 0.7777	0.065		
		Mixed sex				
		Segregated	- 0.6682	0.079		
	Boys' only	Mixed sex	Normal	- 2.7988*	0.000	
		Girls' only	Girls' only	0.7777	0.065	
			Mixed sex	0.1096	0.971	
			Segregated			
		Mixed sex Segregated	Mixed sex	Normal	- 2.0211*	0.000
			Girls only	0.6682	0.079	
	Boys' only		- 0.1096	0.971		
	Mixed sex normal	Mixed sex	Mixed sex	- 2.1307*	0.000	
			Normal			
		Girls' only	Girls' only	2.7988*	0.000	
			Boys' only	2.0211*	0.000	
	Mixed sex	Boys' only	2.1307*	0.000		
		Segregated				

* The mean difference is statistically significant at $P < 0.05$ level.

From the analysis of the mean differences using Tukey's–Honest Significant Difference (THSD) test in Table 8, it reveals that the mean scores obtained by the students within the following school types were not statistically different at $p < 0.05$.

1. Girls' only and Boys' only
2. Girls' only and mixed sex segregated
3. Boys' only and mixed sex segregated.

However the mean scores obtained by students within the following school types were statistically significant at $p < 0.05$.

1. Students in normal mixed sex school scored significantly higher than those in girls' only school.
2. Students in normal mixed sex school scored significantly higher than those in boys' only school.
3. Students in the normal mixed sex school scored significantly higher than those in the mixed segregated school.

This suggests that students in the normal mixed sex school outperformed other students from the other types of schools in mathematics. Therefore in view of these findings (see Tables 7 and 8) the null hypothesis was rejected. This implies that there is a statistically significant difference in performance in mathematics among students in mixed sex segregated, normal mixed sex and single sex schools (girls' and boys' only).

4.4 Comparison of the performance of girls in mathematics by School Type

The scores obtained by girls in mathematics in K.C.S.E examinations for the years 2000 and 2001 in three types of schools namely; mixed sex normal, mixed sex segregated and girls' only were used to ascertain whether or not there was a statistically significant difference in performance in mathematics among girls in the three types of schools. This was meant to test the hypothesis that there was no statistically significant difference in performance in mathematics among girls by school type. The results obtained are reported in Tables 9 and 10.

Table 9: Mean score and SD in K.C.S.E. Mathematics Examinations Results for Girls by School Type (2000 & 2001).

School Type	N	Mean score	SD
Girls' only	174	5.8793	2.8955
Mixed sex segregated	107	5.9346	3.1571
Mixed sex normal	78	7.7308	2.8498

Results in Table 9 show that the mean scores of girls in the girls' only and mixed sex segregated schools were similar while that of girls in the mixed sex normal school is higher. This suggests that girls in the mixed sex normal school outperform other girls in mathematics. In order to determine whether the difference in mean scores were significant one way ANOVA was performed. Table 10 summarizes the results of the ANOVA test.

Table 10: An ANOVA of the Scores Obtained by Girls in Mathematics by School Type (2000 & 2001).

	Sum of squares	df	Mean square	F	P-value
Between Groups	204.755	2	102.377	11.6350*	0.000
Within Groups	3132.354	356	8.799		
Total	3337.109	358			

* Means statistically significant at $P < 0.05$ level

From the results in Table 10 the F-Values ($F = 11.6350$ at $P < 0.05$) indicates that the mean scores of the girls in the 3 school types were significantly different. In order to determine the direction of the difference, a post hoc multiple comparison test using the Tukey's HSD was performed and the results obtained reported in Table 11.

Table 11: Post Hoc Comparisons of the Mathematics Mean Scores of Girls by School Type (2000 & 2001).

	(I) School	(J) School	Mean difference (I-J)	P Value
Tukey HSD	Girls' only	Mixed sex segregated	-0.0553	0.987
		Mixed sex Normal	-1.8515*	0.000
	Mixed sex segregated	Girls' only	0.0553	0.987
		Mixed sex Normal	-1.7962*	0.000
	Mixed sex Normal	Girls' only	1.8515*	0.000
		Mixed sex segregated	1.7962*	0.000

* Means statistically significant at $P < 0.05$ level.

The results in Table 11 reveal that the mean scores obtained by girls in the mixed sex normal school were significantly higher and different from those obtained by girls in mixed sex segregated and girls' only schools. However the mean scores obtained by girls in mixed sex segregated and girls' only schools were not statistically significantly different. This implies that girls in the normal mixed sex school outperformed the other girls in mathematics, while the performances of girls in girls' only and mixed sex segregated schools in mathematics were similar. Therefore, from the above findings (see Tables 10 and 11) and the foregoing interpretation of the results, the null hypothesis was rejected. This implies that there was a statistically significant difference in performance in mathematics among girls in mixed sex segregated, mixed sex normal and girls' only schools.

This finding agrees with Opare (1996) who found that though girls in general are less likely than boys to choose science and mathematics; those in all a mixed sex school are more likely to do so than their counterparts in girls only schools. The mixed sex class environment tends to encourage girls to study and pass in mathematics. This could be an indication that the mixed sex classroom environment encourages girls to study and pass in mathematics. It could also explain the results of the study, which indicate that girls in mixed sex normal classes perform better than girls in the other types of schools. Knupfer, Rust and Mahaoney (1997) found that mixed sex classrooms are very important in helping boys and girls to learn to work together as they model the behaviour they will need as adults. Besides this, Glockner (1994)

supports mixed sex classes by arguing that boys and girls possess different perspectives and experiences that will help them to grow and mature. Elsewhere, Lepore and Warren (1997) found that the performance of girls in mathematics did not change when taught in single sex classes' from co-educational classes. Riordan (1990) supports this view, he found that girls view the single sex environment as conducive for learning but there is no significant gain in their performance in mathematics in single sex schools. However, this finding contradicts previous research by Githua (2002) and Pamela (2000) who found that the normal mixed sex mathematics classes inhibit the performance of girls in the subject.

4.5 Comparison of the Performance of Boys in Mathematics by School Type.

To achieve the above objective, the scores obtained by boys in mathematics on the K.C.S.E. examinations for the years 2000 and 2001 in normal mixed sex, mixed sex segregated and boys' only schools were used to ascertain whether or not there was a statistically significant difference in performance in mathematics among boys in the three types of schools. The purpose was to test the hypothesis that there was no statistically significant difference in performance in mathematics among boys by school type. The results obtained are presented in Tables 12, 13 and 14.

Table 12: Mean Scores and Standard Deviation (SD) of Boys in Mathematics by School Type (2000 & 2001).

School Type	N	Mean score	SD
Boys' only	242	6.6570	3.4512
Mixed sex segregated	388	6.7165	3.3468
Mixed sex Normal	242	8.9835	2.7450

The results in Table 12 indicate that the mean scores obtained by boys in boys' only and mixed sex segregated schools were similar while those obtained by boys in normal mixed sex schools were relatively higher. This suggests that boys in the normal mixed sex school outperformed the other boys in the other types of schools in mathematics. To determine whether the difference in mean scores was significant one way, ANOVA was computed. Table 13 summarizes the results of the ANOVA test.

Table 13: ANOVA of the Mathematics Scores Obtained by Boys by School Type. (2000 & 2001)

	Sum of squares	df	Mean square	F	P-value
Between Groups	917.259	2	458.629	44.179*	0.000
Within Groups	9021.281	869	10.381		
Total	9938.540	871			

* Means statistically significant at $P < 0.05$ level

Table 13 reveals that the differences among the mean scores of boys in the three types of schools were statistically significant at $P < 0.05$. However this analysis does not show the direction of the difference. In order to determine where the difference in mean scores lie and the direction of the difference, a post hoc multiple comparison test using Tukey's Honest Significant Difference (HSD) was performed and the results obtained are reported in Table 14.

Table 14: Post Hoc Comparisons of the Mean Scores of Boys by School Type (2000 & 2001).

	(I) School Type	(J) school type	Mean difference (I-J)	P value
Tukey HSD	Boys' only	Mixed sex segregated	-0.0595	0.972
		Mixed sex Normal	-2.3264*	0.000
	Mixed sex segregated	Boys' only	0.0595	0.972
		Mixed sex Normal	-2.2670*	0.000
	Mixed sex Normal	Mixed sex segregated	2.2670*	0.000
		Boys' only	2.3264*	0.000

* Mean difference is statistically significant at $P < 0.05$ level.

Table 14 reveals that the mean scores obtained by boys in the normal mixed sex schools were significantly higher and different from those obtained by boys in mixed sex segregated and boys' only schools. However, there are no statistically significant differences in performance in mathematics between boys from the boys' only school and those from the mixed sex segregated school. These findings suggest that boys from normal mixed sex schools

performed better in mathematics than all the others. Therefore the null hypothesis was rejected. This implies that there was a statistically significant difference in performance in mathematics among boys in mixed sex segregated, normal mixed sex and boys' only schools.

This finding is in line with those of Lee and Lockheed (1990), Spender (1980) and Eshiwani (1983). Spender (1980) argues that in co-educational schools, the presence of girls is necessary in order to promote the positive image of boys. Further, Eshiwani (1983) argues that since mathematics is considered masculine, boys especially in normal mixed sex classes will perform better to prove their masculinity. In contrast Githua (2002) found that boys in boys' only classes were more motivated during mathematics teaching and learning. This high motivation has failed to translate into improved performance of boys in an all male's class. This was confirmed in a study by Lepore and Warren (1997). They found that boys in single sex schools performed significantly less well than those in mixed sex normal schools.

4.6 Effect of Segregation by Gender on Students Performance in Mathematics.

In order to respond to this objective, K.C.S.E mathematics examinations results were obtained for the years 1999, 2000 and 2001 in the mixed sex segregated school. Students scores obtained in 1999 were compared with those obtained in 2000 and 2001. This is because in 1999 students did the K.C.S.E. examinations when boys and girls were being taught in the same class. In 2000 and 2001, students did K.C.S.E examinations where boys and girls were taught in separate classes. The purpose was to test the hypothesis that there was no statistically significant improvement in performance in mathematics when students were segregated by gender. The results obtained are summarized in Table 15.

Table 15: Comparison of the Mean Scores and Standard Deviations (SD) of Students in the Mixed sex Segregated School for the years 1999, 2000 and 2001.

YEAR	N	MEAN SCORE	STANDARD DEVIATION
1999	258	5.3992	3.1647
2000	234	6.4957	3.2284
2001	261	6.5939	3.4042

The results in Table 15 indicate that the mean scores of students in the mixed sex segregated school in mathematics were higher when the students were taught separately. The overall results improved from 5.4 in 1999 to 6.6 points in 2001. The mean scores of boys and girls were also compared separately for the three years as shown in Table 16.

Table 16: Mean Score and SD in K.C.S.E Mathematics Examination Results in the Mixed Sex Segregated School by Sex. (1999, 2000 and 2001).

Year	Boys			Girls		
	N	Mean score	SD	N	Mean score	SD
1999	180	6.1222	3.2316	78	3.7308	2.2602
2000	182	6.6044	3.2052	52	6.1154	3.3116
2001	206	6.8155	3.4718	55	5.7636	3.0244

Results in Table 16 indicate that the mean scores of both boys and girls in mathematics were higher when they were taught mathematics in separate classes than when they were taught in the same class. Girls' performance in particular improved significantly after segregation. This implies that streaming by gender in mixed sex segregated schools led to improved performance of both boys and girls in mathematics. To determine whether the above mean scores (see Tables 15 and 16) were significantly different, a single t-test analysis was performed. Tables 17 and 18, summarizes the results of the t-test.

Table 17: Single t-test Results of the Scores Obtained by Students in Mathematics in the Mixed sex Segregated School for the years 1999, 2000 and 2001.

Exam Years	df	t-value	p-value
1999 vs. 2000	490	-3.801*	.000
1999 vs. 2001	517	-4.139*	.000

* Means statistically significant at $P < 0.05$ level

The results in Table 17 reveal that the t-value for 1999 and 2000 ($t = -3.801$) and that of the years 1999 and 2001 ($t = -4.139$) were statistically significant at $p < 0.05$. These results imply

that the performance of students in the mixed sex segregated school had improved. This is attributed to streaming by gender in the school. Further t-tests were computed on results obtained by boys and girls. The results are summarized in Table 18.

Table 18: Single t-test of the scores Obtained in Mathematics in the Mixed Sex Segregated Schools by Sex for the years 1999, 2000 and 2001.

Exam years	df	BOYS		df	GIRLS	
		t-Value	P-Value		t-Value	P-value
1999 vs 2000	360	-1.425	.155	128	-4.822*	.000
1999 vs 2001	384	-2.021*	.044	131	-4.436*	.000

*Means statistically significant at $P < 0.05$ level

An examination of the results in Table 18 in the case of girls indicates that the t-values of years 1999 and 2000 ($t = -4.882$) and that of the years 1999 and 2001 ($t = -4.436$) were statistically significant at $p < 0.05$. The girls scored higher in separate classes compared to when they were taught together with boys in the same classes. This suggests that the performance of girls in mathematics had improved. This improvement could be attributed to streaming by gender in the mixed sex segregated school. The results further indicate that in the case of boys, the t-value of the years 1999 vs. 2000 ($t = -1.425$) was not statistically significant at $p < 0.05$ while that of 1999 vs. 2001 ($t = -2.021$) was statistically significant. This implies that whereas both boys and girls improved in performance in mathematics, girls benefited most as a result of streaming by gender. Therefore the hypothesis that there was no statistically significant improvement in performance in mathematics when students are segregated by gender is rejected.

Earlier studies, notably Costello (1991), Garret (1987) and Githua (2002) have argued that girls are motivated and therefore have advantage in learning mathematics in single sex classes. This is translated into a better performance in the subject. The findings of this study are consistent with their findings. The study found that the mean scores of girls in mathematics increased when they were taught in separate classes from boys. This finding, however contradicts Lepore and Warren (1997) who found that girls experienced no statistically significant positive effects of single-sex environment.

In addition, this study found that separation by gender in mathematics classes led to improved performance of boys in the subject. However the improvement was not statistically significant. This finding is in line with Lepore and Warren (1997), who found that boys in single sex schools did not increase their mathematics test scores more than in mixed sex classes. The results contradict those of Lee and Lockheed (1990) who found that the performance of boys when taught in single sex classes is likely to decline.

4.6.1 Comparisons of the performance in mathematics of the various groups of boys and girls in the three types of schools.

The study compared mean scores obtained in mathematics by various groups of boys and girls in the three types of schools. The study further compared mean scores obtained in mathematics by boys and girls within the same type of school (see table 19). The matrix shown on Table 19 was used as a guiding frame in computing and comparing the results.

Table 19: Data Analysis Matrix

	B1	G1	B2	G2	B3	G3
B1		B1G1	B1B2	B1G2	B1B3	B1G3
G1			G1B2	G1G2	G1B3	G1G3
B2				B2G2	B2B3	B2G3
G2					G2B3	G2G3
B3						B3G3
G3						

The mean scores and standard deviations of these groups of boys and girls are presented in Table 20.

Table 20: Mean score and SD in K.C.S.E. Mathematics Examinations results for the various groups of boys and girls in the three types of schools.

School type		N	Mean score	SD
Mixed sex normal	B1 (Boys)	242	8.9835	2.7450
	G1 (Girls)	78	7.7308	2.8498
Mixed sex segregated	B2 (Boys)	388	6.7165	3.3468
	G2 (Girls)	107	5.9346	3.1571
Single sex	B3 (Boys)	242	6.6570	3.4512
	G3 (Girls)	174	5.8793	2.8955

The results in Table 20 indicate that in the case of boys, the mean score obtained by those in the mixed sex normal school was higher followed by boys in mixed sex segregated and lastly boys in the boys' only school. In the case of girls, the results indicate that girls in the mixed sex normal school obtained the highest mean score followed by girls in the mixed sex segregated school and lastly girls in the girls' only school. This suggests that boys from the mixed sex normal school performed better in mathematics followed by boys from the mixed sex segregated school and lastly those from the boys' only school. Further, the results suggest that girls from the mixed sex normal school out performed other girls in K.C.S.E mathematics. They were followed by girls from the mixed sex segregated school and lastly girls from the girls' only school. To determine whether the differences in mean scores were statistically significant, single t-tests were computed and results summarised in Table 21.

Table 21: Single t-test of Mean Scores Obtained by Sex and School Type (2000 & 2001)

Groups	t-value	d.f	P- value
B1 vs G1	3.472*	318	0.001
B1vsB2	- 8.843*	332	0.000
B1 vs G2	9.128*	347	0.000
B1 vs B3	- 8.207*	482	0.000
B1 vs G3	11.118*	414	0.000
G1 vs B2	- 2.500*	464	0.013
G1 vs G2	- 3.980*	183	0.000
G1vs B3	- 2.487*	318	0.013
G1 vs G3	- 4.715*	250	0.000
B2 vs G2	2.165*	493	0.031
B2 vs B3	- 0.214	628	0.830
B2 vs G3	2.855*	560	0.004
G2 vs B3	1.850	347	0.065
G2 vs G3	- 0.150	279	0.881
B3 vs G3	- 2.422*	414	0.016

*Means statistically significant at $P < 0.05$ level.

The results in Table 21 indicate that there were statistically significant differences between the following groups of students.

1. Boys and girls in normal mixed sex schools.
2. Boys in normal mixed sex and mixed sex segregated schools.
3. Boys in normal mixed sex and girls in mixed sex segregated school.
4. Boys in normal mixed sex and boys' only schools.
5. Boys in normal mixed sex and girls in girls' only schools.
6. Girls in normal mixed sex and boys in mixed sex segregated schools.
7. Girls in normal mixed sex and girls in mixed sex segregated schools.
8. Girls in normal mixed sex and boys in boys' only schools
9. Girls in normal mixed sex and girls' only schools.
10. Boys and girls in mixed sex segregated schools.

11. Boys in mixed sex segregated sex and girls in girls' only schools.
12. Boys in boys' only schools and girls in girls' only schools.

The results further indicate that there were no significant differences between the following groups of students.

1. Boys in mixed sex segregated and boys' only schools.
2. Girls in mixed sex segregated and boys in boys' only schools.
3. Girls in mixed sex segregated and girls in girls' only schools.

The results suggest that there are statistically significant differences in performance in Mathematics between boys and girls within the same type of schools. Boys scored significantly higher than girls in mixed sex normal, mixed sex segregated and single-sex schools. This suggests that despite the type of school and Mathematics classes that learners are taught in, boys continue to perform better than girls. This finding is in line with Eshiwani (1984) who found that at the secondary level of education, boys frequently outperform girls in Mathematics. Makau (1994) and Obura (1991) further agree with this finding. They found that these differences begin to appear at upper primary school level and increase at secondary school.

The performance of boys and girls in the mixed sex normal school was higher compared to the others. The results indicate that they scored significantly higher than boys and girls from mixed sex segregated and single sex schools. Spender (1980) in Garret (1987) and Eshiwani (1983) argue that the presence of girls in mixed sex normal schools is necessary in order to promote the positive image of boys. Eshiwani (1983) further argues that since mathematics is considered masculine, boys in such schools are likely to perform better to prove their masculinity. This may perhaps explain why boys performed better in the subject than other boys and girls in the other types of schools.

In addition Opere (1996) found that girls in mixed schools are more likely than their counterparts in a pure girl's class to choose science and mathematics. This implies that mixed sex schools encourage girls to study and pass in mathematics. This may perhaps explain why girls in the mixed sex normal school were superior in performance in K.C.S.E mathematics followed by those in mixed sex segregated and lastly those in girl's only school. It could explain why boys in the normal mixed sex school were superior followed by those in

mixed sex segregated and lastly those in boys' only schools. Therefore these findings agree with Garret (1987) and Opare (1996). However they contradict those of Githua (2002) and Pamela (2000) who found that the normal mixed sex mathematics classes inhibit performance and especially that of girls in mathematics.

4.7 Teachers Views about streaming by Gender in Mathematics Classes.

Teachers play a vital role in carrying out school policies. Fennema and Carpenter (1981) have argued that their beliefs are always reflected in classroom practices. As such, this study was interested in finding out the teacher's views about streaming by gender in mathematics classes. In order to solicit their views, mathematics teachers were interviewed. The interview specifically focused on; the reasons for creating separate boys and girls classes in co-educational schools, the effect of this action on students' performance and especially of girls in mathematics, difficulties faced in teaching mathematics that are gender related and lastly the measures to be put in place so as to improve students' performance in mathematics.

4.7.1 Reasons for Creating separate Boys and Girls Classes in Co-educational Schools.

Teachers were asked to give reasons for segregating students by sex in mathematics teaching and learning. Table 22 gives a summary of the teacher's responses.

Table 22: A summary of Teachers Reasons for creating separate Boys and Girls Classes in Co-educational schools

Reasons	F	% *
To avoid mischief among students in class as a result of adolescent behaviours.	18	82
To avoid domination by boys in class	15	68
To improve performance	13	59

* Cannot add up to 100% due to multiple responses

Results in Table 22 show the reasons that have led co-educational secondary schools to create separate classes for boys and girls. The majority (82%) of teachers stated that mischievous

behaviour among some students in class was one of the reasons that led to creation of separate classes for boys and girls.

According to the teachers, this behaviour is associated with adolescence. Teachers observed that in co-educational schools boy\girl relationship was prevalent. It led to students of opposite sex wasting time trying to impress and outdo each other on non-academic activities. For example, often girls would be found making their hair, applying make-up whenever the teacher was not in class. This finding is in line with Burton (1996) who observed that girls at adolescence perceive their femininity, which they would like to preserve. Their motivation to learn mathematics could easily decline especially if the subject is perceived as a male domain. In addition Costello (1991) argued that at secondary school self-image becomes more important for boys and girls alike, and it is often pressure from friends and classmates, which determine how this image develops. He further argues that femininity is a priority for any girls and hence being good in mathematics may be termed as unfeminine. This could explain the relatively lower girls' performance in mathematics compared to boys in the normal mixed sex school. Besides this, Eshiwani (1983) found that boys at secondary school consider mathematics as masculine. Hence, there is pressure on them from peers to excel in the subject to prove their masculinity.

Domination by boys was indicated as prevalent in normal mixed sex mathematics classes. Table 22 indicates that 68% of the teachers had this observation. Teachers observed that where boys were sure of answers to questions asked in class, they didn't hesitate to answer. This is more pronounced especially in the national category of schools where learners are of higher academic abilities. Gordon (1995) is in agreement with the teachers when suggesting that boys dominate in classroom activities more than girls in secondary schools. FAWA (1997) supports Gordon (1995) by observing that during lessons, boys displayed more confidence when it came to answering questions and carrying out exercises. They were more likely to put up their hands to answer questions, get their work marked, ask questions and carry out experiments. French and French (1984) in Hitchcock and Hughes (1990) further support this view. They observed that mixed gender classes were often dominated by small groups of boys. This according to Jewitt (1996) can be attributed to the socialization process. He argues that from birth boys more than girls are encouraged to be more independent and adventuresome.

Table 22 also indicates that 59% of the teachers felt that separate classes for boys and girls were created so as to improve students' performance in mathematics. They felt that these classes helped to boost student's confidence in learning especially that of girls. The fear of the opposite sex was also removed. This finding is in line with Stipek (1984) who found that boys felt that girls were a hindrance to their concentration on studies. Assessment of performance Unit (APU, 1982) in United Kingdom is also in agreement with the teachers by suggesting that girls are disadvantaged during instruction in mixed-sex classrooms. Hopp (1994) further suggested the creation of single-gender labs. According to her, it was the best way of avoiding the problem of boys handling the equipment and girls being the observers. However Mael (1998) found that this is only beneficial to some students. Further, he found that women in single sex post-secondary institutions were more likely to aspire to higher degrees than females in co-educational institutions. Other researchers (Knupfer, Rust and Mahaoney, 1997) disagree with the above findings; they found that co-educational classrooms are important in helping students to learn to work together while modelling the behaviour they will need as adults. Gloeckner (1994) agrees with their view by arguing that males and females have different perspectives and experiences that will help them to grow and mature.

4.7.2 Effect of Streaming by Gender on Student' Performance in Mathematics

This study was interested in finding out whether in the opinion of teachers, streaming by gender-improved students' performance in mathematics and especially that of girls. Table 23 shows the views as expressed by teachers.

Table 23: Can streaming by Gender Improve Students Performance and Especially that of Girls in Mathematics.

Statement	N	%
Yes	13	59
No	6	27
Undecided	3	14
Total	22	100

Majority (59%) of the teachers were of the opinion that streaming by gender improves students' performance and especially that of girls in mathematics. This indicates that separate mathematics classes for boys and girls favour students and especially girls in learning the subject. This agrees with Bellman (1997) and Hagan (1998) who note that single sex classes result in greater academic performance of girls. They attributed this performance to higher self-esteem and confidence built in these classes. Sadker and Sadker (1994) is also in agreement with these views, they found that girls in single sex schools achieve more, have higher self esteem and are more interested in subjects like mathematics and science. Nemco (1998), Gerrity (1994) concur with Sadker and Sadker (1994) by arguing that such classes encouraged females to take 'harder' subjects such as mathematics. In particular Gerrity (1994) reported that females in single sex schools take mathematics and science courses at double the national average. This may explain why the performance of girls in mathematics in the mixed sex segregated school improved after streaming by gender.

However, 27% of the teachers indicated that streaming by gender alone could not improve student's performance and especially that of girls in mathematics. The teachers indicated that negative student's attitude and especially that of girls towards the subject led to the lower performance in mathematics. Negative attitude lowers their motivation to learn the subject and their mathematics self-concept. Githua (2002) argues that these are critical in determining students' performance in mathematics. Lastly, 14% of the teachers were unsure whether streaming by gender improves students' performance in mathematics. This may be an implication that these teachers had no experience of teaching mathematics in mixed sex normal classes and could not give a concrete answer.

4.7.3 Gender-related difficulties faced by teachers in teaching mathematics.

Teachers were further asked to indicate the difficulties they faced in teaching mathematics that were gender related. Table 24 gives a summary of their responses.

Table 24: A summary of the Teachers Responses on the Gender-Related Difficulties faced in teaching of Mathematics.

Difficulties	F	% *
Individual differences in class	18	82
Negative student's attitudes towards the subject	15	68
No difficulties	5	23

* Cannot add up to 100% due to multiple responses.

Results in Table 24 indicate that teachers experienced some gender-related difficulties in teaching mathematics in secondary school classes. Individual differences in mathematics classes, and negative students' attitude towards the subject were the most notable ones.

Most (82%) of the teachers felt that individual differences such as different rates of grasping mathematics concepts between boys and girls in class as one of the difficulties. The teachers indicated that boys were faster than girls. This meant that they experienced problems in trying to keep up with their speed of learning. As earlier observed by Gordon (1995) boys dominated in mathematics classes. This implies that teachers experienced pressure especially from the boys to move faster. Consequently, girls who are slower lagged behind.

Another difficulty that teachers gave was that some students had a negative attitude towards mathematics. This was given by 68% of them, who felt that, since mathematics was a compulsory subject in the secondary school curriculum, some students were not doing it because they wanted but because they were forced. This led to the negative attitude of these students towards the subject. This implied that such students lacked interest and dedication in the subject and therefore poor results. This is in agreement with Owino (1999) who observed that students, who have been forced to take a subject, developed a negative attitude towards it. Lastly 23% of the teachers indicated that they experienced no difficulties in the teaching of the subject. This may be an implication that either these group of teachers taught students who performed very well in mathematics examinations or were simply not interested in the subject. Lack of interest in the subject could be as a result of some teachers being in the

profession since they had nothing else to do. Such a teacher is likely to yield poor results as observed by Mondoh (1994).

4.7.4 Strategies/Solutions towards Improving Students' Performance in Mathematics

The study was interested in finding out from the teachers, ways through which the performance of students in mathematics could be improved. Table 25 gives a summary of their suggestions.

Table 25: Suggested Ways towards Improving Students' Performance in Mathematics.

Suggestions	F	% *
Streaming by gender in mathematics classes	16	73
Symposium for students	13	59
Counselling	11	50
Restructuring the syllabus to allocate enough time for each topic	9	41
Provision of teaching aids textbooks	7	32
Mark students work promptly	5	23

* Cannot add up to 100% due to multiple responses.

A majority (73%) of the teachers believed that when boys and girls are taught in separate classes their performance is likely to improve. Burton (1996) contends that, students of opposite sex waste a lot of time in class trying to impress and outdo each other on non-academic activities. This implies that separate classes for both boys and girls might enable them to concentrate on academic activities and therefore likely to lead to an improvement in their performance. This finding supports Tidball, (1973) who reported that attendance at single sex schools motivates many females to enrol in more advanced mathematics and science courses at double the national average. Sadker and Sadker (1994) asserted that girls in single sex schools achieve more, have higher self-esteem, and are more interested in subjects like mathematics and science. Further, 59% of the teachers were of the opinion that students should be exposed to more mathematics symposiums; while 50% of them suggested that counselling for students could lead to improved performance in the subject. The teachers

said mathematics symposiums exposed students to a lot of practice and techniques of tackling problems in mathematics. This is an indication that students did not have enough practice in solving problems in the subject. This is in agreement with KNEC (2003) report, which observed that students lacked enough practice and that this contributes to poor performance. The teachers also indicated that counselling of students by the mathematics teachers and use of guest speakers who excelled in the subject would help improve performance. According to them counselling would help students recognize the importance of the subject and consequently have a positive attitude towards it.

Restructuring the syllabus so as to allocate enough time for each topic was another suggestion that teachers gave. This was given by 41% of the teachers. They complained that the form three syllabus was long and that there was lack of sufficient time to cover it adequately. This may be an indication that some topics in mathematics such as those in the form three syllabus were not adequately covered by the teachers due to lack of time. This could also imply that students were denied enough practice in solving problems in certain topics in form three mathematics. Lack of practice could contribute to poor performance (KNEC, 1999).

Another suggestion that teachers gave was that, the school administrations should provide a variety and enough books and teaching aids. This was given by 32 % of the teachers. This may be an implication that some teachers recognized the importance of a variety of teaching aids and text books in improving performance in mathematics. According to them, teaching aids help in translating the abstract and theoretical concepts into reality. These findings concur with FAWE (1998) who observed that teaching methods employed by teachers to teach mathematics in secondary schools are to a very large extent influenced by the kind of resource and facilities available in the school. FAWE (1998) noted that where the teaching resources and facilities are inadequate, the teaching approach tends to be teacher-centred. According to them such an approach is bad to the teaching of mathematics. It kills the interest of students in the subject. However where the teaching resources and facilities are available and adequate, the teaching approach is learner-centred. Such an approach emphasizes practical activities where learners solve problems, experiment, discuss with each other and are involved in practical hands-on-activities. This in turn stimulates curiosity, imagination and critical thinking. Hence the lessons become exciting and captivating to the learners especially the girls. This is in line with Githua (2002) who observed that students especially girls learn mathematics best when they experience the subject in natural settings.

Lastly 23% of the teachers suggested that students' work should be marked promptly. This may imply that some teachers were lazy and took a very long time to mark students' work. This according to Githua (2002) lowers the students' motivation to learn mathematics. Consequently their performance is likely to decline.

Teachers were further asked the ways through which the performance of girls in mathematics could be improved. Table 26 shows their responses.

Table 26: Suggested Ways of Improving Girls Performance in Mathematics.

Suggestions	F	%
Positive teachers feedback	17	72
Have more female role models	13	59
Should be taught more using group work	7	32

* Means cannot add up to 100% due to multiple responses

Majority of the teachers 72% were of the opinion that teachers' feedback could assist in improving the performance of girls in mathematics. They indicated that girls were more adversely affected by negative comments from their teachers. Such comments are likely to affect their attitude and motivation to learn the subject in a negative way. Their suggestion is in agreement with Githua (2002) who found that teacher' feedback impacts strongly on students' motivation to learn the subject. It also agrees with Koehler's (1985) study in U.S.A which revealed that though teachers' feedback is an important factor that contributes to students' motivation to learn mathematics, it can be both facilitating and debilitating and can bring about gender difference in learning mathematics. Therefore, teacher' feedback to learners should be given with utmost care.

Another suggestion that was given by the teachers was that, there should be more female role models (59%). They indicated that female teachers should teach girls mathematics. This, according to them would help to demystify the belief that girls are intellectually incapable of studying a 'difficult and task oriented' subject such as mathematics. This is in line with FAWE (1997) and UNESCO (1998) who argued that when female teachers teach girls the subject their confidence in it improves.

Teachers also suggested that girls should be taught mathematics more using group work (32%). They indicated that girls feel comfortable working on mathematical assignments where they can discuss with their friends. This could imply that some teachers were using instructional approaches, which were not compatible with the cognitive styles of the learners. This could lead to learners especially girls becoming frustrated during mathematics instruction. Such frustration could impact negatively on their performance. This agrees with Mondoh (2001) who suggested that girls learn best by interacting and discussing with others in groups. She suggested that instructional procedures should be restructured to incorporate group activities so as to benefit the girls.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study aimed at determining the effect of streaming by gender on students' performance in secondary school mathematics. Chapter one provided the background information to the study while chapter two presented a review of related literature, theoretical framework and the conceptual framework of the study. Chapters three and four were concerned with the research methodology and the analysis of the results respectively. Two measurements tools were used in this study. Mathematics teachers were interviewed and a documentary search of the K.C.S.E mathematics results of students for the years 1999, 2000 and 2001. This chapter presents a summary of the findings; the conclusions reached and provide recommendations and suggestions for further research.

5.2 Summary

In the past decade co-educational schools have separated boys from girls in mathematics classes. This has been done with the hope that students' performance and especially that of girls in the subject might improve. The main objectives of the study were:

- To determine whether there is a difference in performance in mathematics among students in mixed sex segregated, mixed sex normal and single-sex schools (boys' only and girls' only)
- To compare the performance in mathematics among girls by school type
- To compare the performance in mathematics among boys by school type
- To determine whether there is statistically significant improvement in performance in mathematics when students are segregated by gender

Literature reviewed indicates differences in performance in mathematics as observed by the Kenya National Examinations Council's reports. Further, there are differences in performance between boys and girls in co-educational schools in Kenya. However, there exists conflicting findings on whether separation of boys from girls in mathematics classes improves performance. Some studies indicated an improvement in performance, while others found no change in performance. In addition a majority of these studies were conducted in

developed countries with a few in Africa. No such study has been conducted in Kenya with respect to the 8-4-4 secondary school mathematics, hence need for such a study.

An ex-post facto research was adopted for this study. The specific design that was used is the causal-comparative design. The performances of students in KCSE mathematics examinations in three types of schools were compared. The types of schools were mixed sex segregated, mixed sex normal and single-sex schools (boys' only and girls' only). In addition the performance of boys and girls within each type of school was also compared. Data was collected through a documentary search of the K.C.S.E mathematics examination results for the years 1999 (mixed sex segregated school only), 2000 and 2001. An interview was also conducted on the form four mathematics teachers in the sample schools. The sample consisted of 1489 students and 22 mathematics teachers.

5.3 Summary of the Major Findings.

There were four hypotheses set for this study. All of them were rejected. The study provided evidence that there was a statistically significant difference in performance in mathematics among students in mixed sex segregated, mixed sex normal and single sex (girls' only and boys' only) schools. The study revealed that boys and girls from the mixed sex normal school performed better than other students in K.C.S.E mathematics examinations. In particular, girls from the same school performed better than other boys and girls from mixed sex segregated and single sex (boys' only and girls' only) schools.

The study also established that boys from the mixed sex normal school performed better than those from mixed sex segregated and boys' only school. The presence of girls could have contributed to this performance since they wanted to prove their masculinity. They believed that they could not fail in the subject, which they considered masculine in nature.

Further, the study revealed that girls from the mixed sex normal school outperformed other girls in K.C.S.E mathematics examinations. Despite the fact that studies have shown that such schools inhibit the performance of girls in the subject, the results indicate otherwise.

The study established an improvement in performance in mathematics when students were segregated by gender. The mean scores obtained by boys and girls in the mixed sex segregated school were higher after separation in class. This can be attributed to a favourable

classroom environment that was created as a result of separation. The fear of the opposite sex due to boy/girl relationship was removed.

The majority of the mathematics teachers interviewed agreed that streaming by gender in co-educational schools could help improve performance in general. However they were quick to point out that this alone could not guarantee improved overall performance in mathematics. According to them, students must develop a positive attitude towards the subject for performance to improve.

5.4 Conclusions

The following conclusions have been reached from the analysis of the data from the previous chapter.

- 1) Students from the mixed sex normal school outperformed other students followed by those in boys' only, mixed sex segregated and lastly those in girls' only school. Teachers in the mixed sex normal school attributed this performance to abundance of teaching facilities and resources in the school. They also pointed out the strict discipline and supervision by both the administration and teachers as another factor that led to the good performance. This minimized mischief as a result of adolescence, hence ensuring that students concentrated on academic activities.
- 2) Girl's from the mixed sex normal school performed better followed by those in mixed segregated and lastly those in girls' only school. This could mean that the normal mixed sex classroom environment encouraged girls to study and pass mathematics. This contradicts earlier studies that found that girls from mixed sex normal classes perform poorly than other girls in the subject. Teachers in the school attributed this to strict discipline which minimized mischief due to adolescent behaviour
- 3) Boys from the mixed sex normal school performed better than the other boys followed by those in mixed sex segregated and lastly those in boys' only schools. Boys from mixed sex normal and mixed sex segregated schools could have performed better as a result of the presence of girls in these schools. This is because there was pressure on them to prove their masculinity. This is more prevalent in mathematics which boys view as a masculine subject.

- 4) There is statistically significant improvement in performance in mathematics when students are segregated by gender. This was shown by higher mean scores obtained by both boys and girls in the mixed sex segregated school after being taught in separate classes. Single sex mathematics classes helped to minimize mischievous behaviour as a result of adolescence, hence creating a favourable classroom environment.
- 5) The majority of the mathematics teachers interviewed agreed that streaming by gender in co-educational schools could result in improved performance not only in mathematics but also in the other subjects. However, they pointed out that this alone couldn't lead to improved performance. Lack of variety of teaching resources and students' negative attitude to the subject were some of the factors they indicated could lead to poor performance. Therefore, school administrators should provide a variety of mathematics teaching aids and textbooks in their schools. This could help translate the theoretical and abstract concepts into reality. Counselling, especially on the importance of the subject should be intensified. This could help in changing the students' attitude towards the subject.

5.5 Implications of the Findings

There are a number of implications that can be inferred from this study. Although streaming by gender led to improved performance of girls in the mixed sex segregated school, this performance is lower than that of girls in the mixed sex normal schools. However their performance is similar to that of girls in girls' only school. This suggest that the mixed sex normal school could be doing something different that can be reproduced both in mixed sex segregated and girls' only schools. Teachers pointed out strict supervision of students, a high degree of discipline in the school and abundance of teaching resources. Strict supervision and a high degree of discipline could in a way make students concentrate more on academic activities hence their better performance in mathematics.

From the study, it is evident that there is a statistically significant difference in the performance of boys and girls in all the three types of schools. Boys perform better than girls. This means that despite the type of school that learners attend, boys continue to outperform girls in mathematics. The findings have shown that boys from mixed sex

segregated, mixed sex normal and single sex schools perform better than girls from the schools in mathematics.

The findings have also shown that since mathematics is offered as a compulsory subject in the secondary schools curriculum, some students were doing it yet they did not like the subject. Therefore they developed a negative attitude towards it. This could contribute to poor performance.

5.6 Recommendations

In view of the conclusions, the following recommendations were made.

1. The results of the study showed that streaming by gender in mathematics improves the performance of students in the subject on the KCSE. In view of this secondary school administrators of co-educational schools should allow teachers to teach mathematics to boys and girls in separate classes. This classroom arrangement will help in enhancing students' performance in mathematics especially that of girls.
2. Majority of the teachers indicated that streaming by gender alone might not improve the performance of students in mathematics. In view of this, teachers should strive to change the attitude of students towards the subject. This can be done through equal treatment of both boys and girls while teaching and also avoiding as much as possible gender stereotyped statements in class.
3. In-service courses are necessary if teachers have to teach mathematics well and further help to change students' attitudes towards the subject. This will help the teachers to acquire practical skills that would assist in developing appropriate ways of handling boys and girls in mathematics classes. Such courses would assist in updating teachers on the emerging gender issues in mathematics education. These are necessary in exposing them to new ways of handling boys and girls in the subject.
4. Mathematics teacher-training programmes in both colleges and universities should be reviewed so as to incorporate gender issues. This would assist teacher trainees in equipping them with skills to appropriately handle boys and girls in mathematics teaching and learning.
5. School administrators should make an effort of increasing mathematics counselling sessions to students. This could be done by establishing guidance and

counselling desks within schools and inviting guest speakers who have excelled in the subject. By so doing, the negative attitude towards the subject might change hence encouraging learners to work hard and pass in it. It will also help in motivating them to cultivate a better self-image of themselves.

5.7 Suggestions for further Research

During the course of this study, certain issues came into light, which may warrant further research. These are:

1. The study was limited to streaming by gender in mathematics classes; hence research can be extended to other subjects of the secondary school curriculum.
2. The study was also limited to the category of national secondary schools in Nakuru District. A similar study could be extended to other school categories. These are: Provincial district and private secondary schools.
3. The study indicated that use of group discussions in teaching girls mathematics would help to improve their performance. Therefore, there is need to determine whether this method would yield any positive results.
4. Further studies should be conducted to determine whether streaming by gender helps in further reducing the gender disparity in performance in mathematics.

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APPENDIX B: INTERVIEW SCHEDULE FOR MATHEMATICS TEACHERS

The purpose of this study is to investigate the effects of streaming by gender on students' performance in secondary school mathematics. You have been selected among others to participate in the study. Your opinions are extremely important. Kindly answer the following questions as honestly as possible. Your answers will be very useful in assisting us to understand this learning activity.

1. In the recent past, some co-educational secondary schools in Kenya have created separate classes for boys and girls.
 - (a) What reasons do you think might have led co-educational secondary schools to create separate classes for boys and girls?
 - (b) Is such an arrangement likely to improve the performance of students especially girls in mathematics.
2. What difficulties do you face in teaching mathematics that are gender related?
3. What measures can be put in place so as to improve performance in mathematics in general, and for girls in particular?

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