GENDER DIFFERENCES IN STUDENTS' ACHIEVEMENT IN CHEMISTRY IN SECONDARY SCHOOLS OF KAKAMEGA DISTRICT, KENYA.

BY:

AKALA JANET BUSOLO

REG. NO. E55/7125/01

A Thesis Submitted to the School of Education in Partial Fulfillment of the Requirements for the Degree of Master of Education of Kenyatta University.

SEPTEMBER, 2010

DECLARATION

This thesis is my original work and has not been presented for a degree in any other university or any award.

Janet Busolo Akala Signature______________________Date:_______________.

We confirm that the candidate under our supervision carried out the work reported in this thesis.

Dr. Nicholas W. Twoli Signature:__________________Date:__________________.

Department of Educational Communication and Technology,

Kenyatta University,

Box 43844,

Nairobi.

Dr. David S. Khatete Signature:_________________Date:________________.

Department of Educational Communication and Technology,

Kenyatta University,

Box 43844,

Nairobi.

Dedication

This work is dedicated to my beloved husband, **Livingston Aswani** for his inspiration, support and commitment to my education. To my children Shelton, Beckham, Owen and Joseph for giving me time to concentrate. Glory and honour to God.

Table of Contents

Abstract

In all developing countries sciences education is being called upon to play an even more important role in the future. More students are needed to become competent in the key science subjects of physics, chemistry, and biology. For an all round contribution, there is need to involve both men and women. This study focused on gender differences in students' achievement in Secondary School chemistry. In addition to the main purpose, the study sought to identify the factors that contribute to gender differences in chemistry achievement levels of students and to provide more and more equal opportunities for studying chemistry and science in general to both boys and girls. The study was a cross-sectional descriptive survey employing correlational methods to investigate gender differences in chemistry achievement levels of girls and boys. The study comprised twelve (12) stratified selected public secondary schools in Kakamega district. A total of 386 students responded to a five-item, chemistry Achievement Test (CHAT) comprising descriptive, mathematical and spatial ability items. The students also responded to the Attitude Sale (AS). The teachers filled the Chemistry Teachers' Questionnaire (CTQ) on the reasons for poor performance of students in Chemistry and their possible solutions. The validity and reliability of the instruments were enhanced by a pilot study and the adoption of some already validated items. A reliability coefficient of at least 0.8 was acceptable for the study. Quantitative data obtained from the CHAT were analyzed using Statistical Package for Social Sciences (SPSS).The statistics derived included percentages, mean, Pearson r, standard deviation, students't' – Test scores and Analysis of variance (ANOVA) values. Pearson product – moment for correlation coefficient was used to determine the relationship between attitude and chemistry achievement. The study revealed the following findings; Gender was strongly associated with Chemistry achievement ($r= 0.9880$, $\alpha > 0.001$). As a result, boys' schools performed better than girls schools. Boys had a stronger affinity and interest towards Chemistry. Teacher and school factors were of little effect on Chemistry achievement with respect to gender. The key recommendation was that measures are needed to be taken as early as possible, probably already in primary education, which aim at the suppression of socialization factors known to lead to the establishment of gender differences in Chemistry achievement. It would be desirable to implement strategies in the curriculum as well as in the pre and in-service training which would help to reduce gender differences in students' achievement in Chemistry.

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter introduces the problem that was investigated by discussing the following: Background to the problem, statement of the problem, objectives of the study, research questions, significance of the study, assumptions of the study, scope and limitations and definition of unique terms used in the study.

1.1 Background to the problem

Until the later half of the twentieth century, the different roles of men and women in society in the western world remained largely unquestioned, although since 1920 women gradually had gained the right to vote and general access to education at all levels. As many women claimed the right to be treated as equals alongside men in all aspects of social, political and cultural life, the demand for further societal changes was evident. Many of these legitimate claims of women began to be constitutionalized in numerous countries in the late 1960s (Kotte, 1992).

Nonetheless, the masked imbalance between the sexes in many fields of employment was not overcome completely. There are relatively few female scientists and engineers at the professional level and even fewer technicians and tradeswomen at the skilled worker level (Kelly, 1978; Keeves and Kotte, 1991). The origins of such differences can be traced back to participation in studying science at school, from the earliest grades onwards. It cannot be ruled out that such differences are generated at an even earlier stage in the socialization process-taking place at home. However, there seems to be little doubt that these differences between the sexes are established and consolidated during formal schooling (Keeves, 1991).

In the economic competitive environment of the developing countries each educational system is expected to 'produce' an optimum number of technologically qualified personnel who are needed by the labour market. This has implications for the planning of the educational system of each country. Not only are more science trained students expected to graduate from high school, but there is also a proportionately higher demand for female students as societies become more responsive to women in Science careers. In the past, many of the more prestigious and more highly paid jobs have gone to men who have been trained in science-based programs, such as medicine, engineering and technology. Since girls have not studied science courses at school to the same extent, as have boys, such occupations have been filled by more men than women (Keeves and Kotte, 1991). Optimizing science (and by extension to Chemistry) achievement and at the same time reducing differences in performance levels between boys and girls may eventually lead to greater economic efficiency within a system. In this process, gender differences can be reduced as increased opportunities become available to girls (Duncan, 1989; Keeves and Kotte 1991). The theme of this research study is timely. Detailed information is needed on how to reduce gender differences in Chemistry achievement and how to improve the achievement level of all students in Chemistry.

The study of Chemistry is important in all aspects of life. In Kenya, Chemistry is among the key subjects used for selective advancement in the education system. However, the teaching and learning of Chemistry in schools is not at its best. Practically, all students believe that Chemistry is important for life after school and yet both boys and girls demonstrate some negativity towards the subject. They perceive the subject as difficult and uninteresting and thus are biased in the selections they make, often not considering the subject requirements needed for future careers.

While most people in our society recognize and appreciate the essential role of chemistry in everyday life, it remains one of the poorly performed subjects in the K.C.S.E national examinations (KNEC, 1995). In addition, gender disparity in performance does exist. The gravity of the problem in performance is shown in table 1.1 below:

Table 1.1 KCSE percentage mean scores in chemistry from 1990 to 1996 at national

Level by gender

Year	**Girls**	**Boys**
1990	26	28
1991	26	29
1992	30	33
1993	29	32
1994	30	34
1995	28	32
1996	23	27

Source: Kakonge (2000)

From Table 1.1 above, a number of observations can be made

- Performance of boys and girls in chemistry over the years has been poor.
- Even though the performance fluctuated over the years, it is evident that gender disparity in performance exists: females continue to score lower than males in chemistry.

Poor performance in chemistry has been attributed to several factors. They include over enrolment, inappropriate syllabus, students' poor attitudes towards the subject and inadequate resources (Twoli, 1986; Orodho, 1996). The ministry of education in Kenya through its various organs has made considerable efforts to curb the above causes. Such efforts have included among others, adequate training of chemistry teachers, and provision of basic teaching materials, organizing for in-service courses for chemistry teachers and in some occasions revision of the secondary school chemistry curriculum. Despite the above efforts, students still perform poorly (KNEC, 1995). This implies that the problem that leads to students' poor performance in the subject has not been adequately addressed. While the above factors may contribute to such performance, there could be yet another critical and key factor that contributes to poor performance in the subject. This is, as proposed by this study, the gender effect. Gender is another factor that has been identified as having some effects on performance of students in science and by extension in chemistry (Twoli, 1986).

As also evident from Table1.1 there exists gender disparity in students' performance in chemistry in Kenya. Several scholars have identified attitude related factors such as low self-esteem, poor self-concept, fear of success, and lack of confidence as having an influence on girls' achievement in mathematics and the sciences (Eshiwani, 1993; Twoli, 1986). Therefore gender effect on chemistry achievement could be attributed to psychological, social and cultural factors. Despite spirited gender awareness efforts, gender disparity in students' performance in chemistry persists. Hence, there is a need to explore more on gender differences in students' achievement in chemistry with a view of suggesting possible intervention strategies. Hence the need for such a study.

1.2 Statement of the problem

The study of Chemistry is important in all aspects of life. In Kenya, Chemistry is a key subject for selective advancement in science and technology and needed for most careers in the education system. These careers include the health sciences (nursing, laboratory technicians, doctors) and engineering. Conditions, which prevail in the education set-up, however, discourage good performance from both boys and girls in science and by extension to chemistry. Works done by Twoli, (1986) and Orodho, (1996) have identified a lack of adequate instructional resources and equipment, poor teacher preparation and remuneration, uninspired curricula and a negative attitude by all stakeholders in education. Even after many attempts have been made to counter these factors, including spirited gender awareness efforts by governments as well as intervention by NGO's, gender disparity in Chemistry performance still persists. This means that the real cause of gender disparity and poor performance in Chemistry have not been identified and therefore necessitating more research. It is in view of this gap, that the researcher felt that gender difference in students' achievement in Chemistry needs further extensive investigation so as to bring about tangible improvements.

1.2.1 Conceptual framework

The conceptual model underlying this study is concerned with the major factors, which have been linked to performance in science and by extension, to Chemistry. Achievement of boys and girls in chemistry involves a number of variables: Resources, motivational orientation of the learner, teacher characteristics and ability of the learner as the main ones. The relationships between these variables can be shown as in Figure 1.1

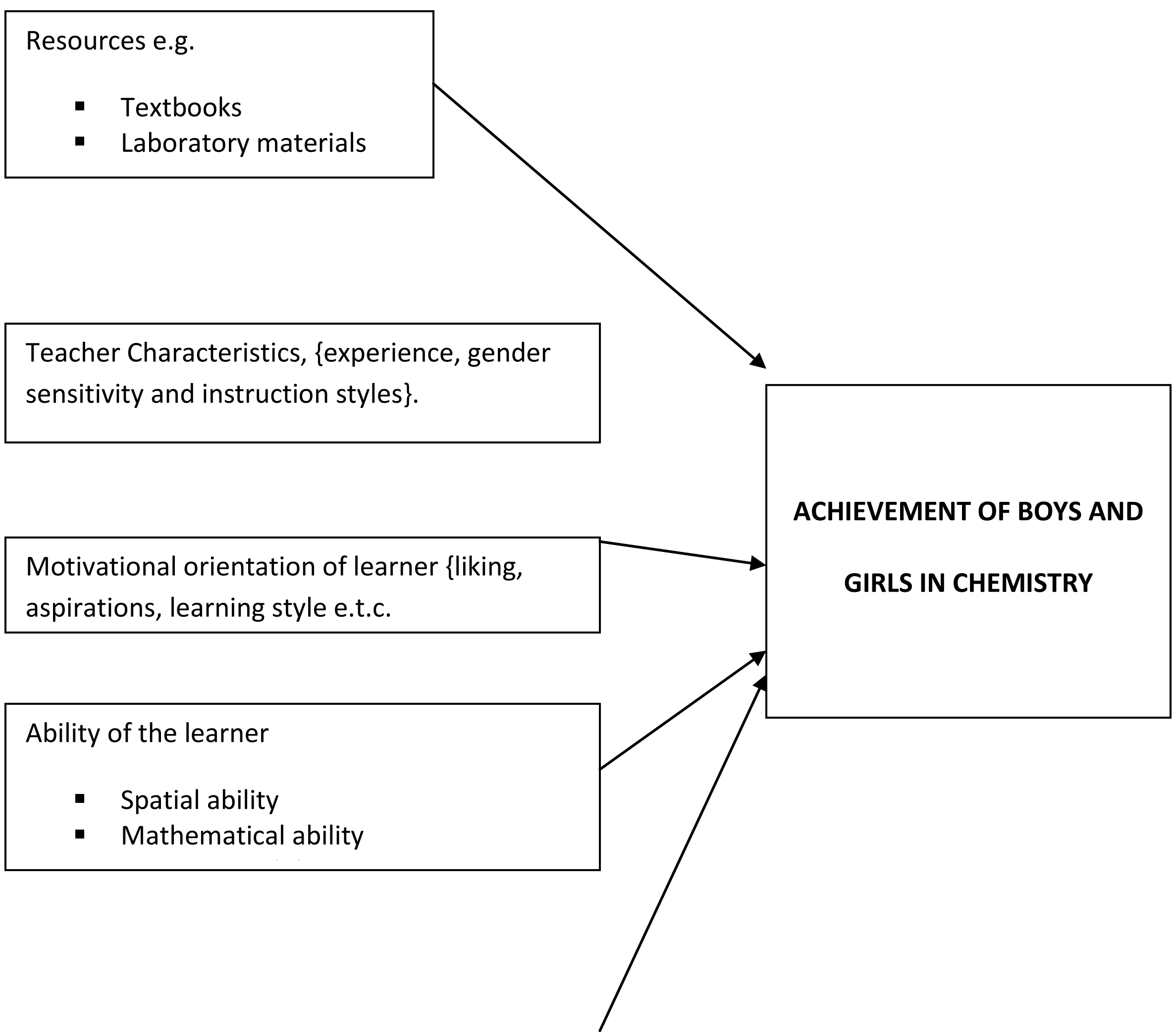


Figure 1.1: Relationship between variables influencing gender differences in Chemistry achievement

Source: Adapted from Kotte (1992)

Availability of resources for both teaching and learning helps students achieve in science (Kelly, 1978). This includes textbooks, laboratory equipments and materials. Teachers on the other hand play an important role in teaching Chemistry and no one will doubt their influence on their students' acquisition of knowledge and skills. The qualification, teaching experience and instruction styles will therefore have an influence on performance in Chemistry.

Learners' attitudes and aspirations towards Chemistry affect achievement in the subject. It is primarily the acquisition of proficiency in a subject that leads to positive attitudes in that subject (Maccoby and Jacklin, 1974). The ability of the learner in terms of how they handle different Chemistry questions also affects performance. Chemistry questions test three important Chemistry ability areas: mathematical, descriptive and spatial.

Figure 1.1 shows the relationships that are hypothesized to exist among the variables influencing gender differences in Chemistry achievement. The head of the arrow symbolizes the direction of the effect. The effects are presumed to be of a causal nature.

1.3 Objectives of the study

The study was guided by the following objectives:

(a) To identify the differences between boys and girls in Chemistry achievement.

(b) To determine the main factors that are associated with gender differences in chemistry achievement.

(c) To identify attitudinal and aspirational levels of students towards chemistry.

1.4 Research questions

The study attempted to answer the following questions:

(i) What ability differences are there between boys and girls in Chemistry Achievement

(ii) What teacher factors are associated with gender differences in school chemistry achievement?

(iii) What differences are there in attitudinal and inspirational expressions by boys and girls towards learning school chemistry?

1.5 Significance of the study

The findings of the study will be hopefully beneficial to the following:

(a) Chemistry teachers

Teachers are the implementers of any school chemistry curriculum. The research findings will sensitize them on the intervention strategies suggested to help improve achievement of boys and girls in chemistry and in particular close the gender gap in Chemistry achievement.

(b) Chemistry learners

The researcher findings would help secondary school students to identify the particular areas that give them problems in chemistry. They will therefore benefit from the suggestions given on how to improve performance in the different ability areas.

(c) Chemistry teacher trainers

The results of the research will be used to sensitize teacher trainers on how teacher's characteristics affect performance in chemistry and how they can be avoided to help bridge the gender gap.

(d) Text book authors

The findings will enable textbook authors to prepare materials for chemistry learning and teaching devoid of any gender bias.

1.6 Basic assumptions of the study

It was assumed that:

(i) The sample used in this study is representative of the wider population of secondary school students in Kenya.

(ii) There are relationships between variables identified in this study and achievement in chemistry unless otherwise stated.

(iii) All chemistry teachers are trained and effective in their instruction.

(iv) All secondary schools to be investigated adhere to a uniform Chemistry syllabus.

1.7 Scope and limitations

1.7.1 Scope

The study dealt with students and their teachers in stratified randomly selected public secondary schools in Kakamega District. Kakamega district was used because it has a large population comprising a large number of sub-ethnic communities. Hence, socio-cultural differences are many, which have an effect on attitudes of the learners.

1.7.2 Limitations

The following are considered as the main study limitations:

(a) Since the sample respondents were drawn from some selected public secondary schools in Kakamega District the effects found mainly reflected the situation in the district. Hence, the findings may not be representative of all secondary schools in Kenya.

(b) Resources (time and funds) were other limitations of the study. Inadequate time and funds for the programme (one year for the research work) hindered the extension of the research to other parts of the country.

1.8 Definitions of terms

In this study, the following terms were used for the purpose and with the intention as explained below:

Achievement test: Is a test developed and used primarily to find out how much students have learnt in a given domain or area of the curriculum.

Attitude scale: Instrument purporting to measure emotions, values and feelings related to a particular discipline or subject.

Chemistry: Is a branch of science that deals with study of nature and properties of all forms of matter and the various changes that these substances undergo in different conditions.

Gender: Refers to social and cultural construction and representative of being ‘male’ and ‘female’

Science: Is a vast body of connected knowledge of theories and facts developed by scientists through scientific methods.

Spatial ability: The capacity to visualize objects in three – dimensional space. It is a measure of student's ability to think and reason using imagery.

1.9 Organization of the thesis

This thesis has been divided into five chapters. Chapter one outlines the context of the study including the background, statement of the problem, study objectives, research questions, significance of he study, scope and limitations and definition of terms.

Chapter two reviews literature with regard to the study. This is reviewed under four subsections: Factors that influence the learning of Science, gender differences in learning science, Biological and socio – psychological theory.

Chapter three provides the research methodology. It includes the design and location of the study, sampling methods, research instruments and data collection procedures and the rationale for choosing them.

Chapter four presents, analyses, the data collected and discusses the results. The discussions are based on the research questions touching on all variables related to gender differences in chemistry achievements as mentioned in the study.

Finally chapter five summarizes the findings and gives conclusion of the study. Also suggestions for additional research are given. A bibliography and appendices are presented at the end of the thesis.

1.10 Chapter summary

This chapter has conceptualized the problem of the study to the fact that gender could be one of the main causes of students' poor performance in chemistry.

The purpose of the study was to identify the differences between boys and girls in their achievement in chemistry. Other highlights include the background to the study, statement of the problem, its significance and definition of terms used in the study. The chapter also identified secondary school students as the main unit of analysis in the study. Issues relating to gender differences in science achievement are further reviewed in the next chapter.

CHAPTER II

REVIEW OF LITERATURE

2.0 Introduction

Women's struggle to participate fully in most education systems has had along and often bitter history. Women are under represented in science compared to other subjects (Kelly, 1981). The difference in representation of males and females in the scientific community is linked to achievement patterns at secondary school level. In addition, girls generally underachieve in Mathematics and Sciences as compared to boys (Comber and Keeves, 1973; Kelly, 1978). This review is structured according to those components, which as will be shown, are believed to contribute in one way or another to the manifestation of gender differences in science (chemistry) achievement among students.

2.1 Factors, which influence the learning of science (chemistry)

The following factors influence the learning of science (chemistry) in both boys and girls:

2.1.1 Spatial ability and performance in science

The most promising intellectual factor that has influence and may partially explain the male's superior performance in science and mathematics is spatial ability. Spatial ability continues to be the intellectual area in which the strongest and most consistent significant sex differences are found (Haertel et al, 1981). However, the differences are small and many times, variation among girls or boys is greater than the variation between sexes. Though small, there is consensus that there is male superiority in performance on such tasks. According to research, there is a strong relationship between visual-spatial ability and success in science. According to Kelly (1978), when 3-dimentional models were used in teaching general chemistry, final grades improved. Levy and Levy (1978) report that visualization and spatial orientation skills are significantly correlated with final grades in engineering courses since sex-related differences in spatial ability favor boys, this factor gives males and advantage in the study of science, especially in the physical sciences. Girls showed weakness across the framework on questions featuring spatial related ability. Such questions included rotational motion, angles, 2 or 3 – dimensional reproduction or interpretation and graphical skills.

2.1.2 Mathematics as a factor in science performance

Maccoby and Jacklin, (1974); Eshiwani, (1984) show no significant sex difference in mathematical ability up to adolescence (13 – 14 yrs), afterwards, males out perform females on nearly all tasks related to mathematical ability. This is attributed to differences in cultural pressures (Fennema and Sherman, 1978), whose one of its manifestations is math's anxiety, which leads to females' avoidance of mathematics courses. Hence they avoid courses that entail the use of mathematics for example chemistry and physics.

According to the first and second mathematics studies, gender differences were found to be mainly in favor of boys at all age levels (Husen, 1967; Kotte, 1992). Mathematical ability is highly related to science achievement (Fleming and Malone, 1983; Kotte, 1992). Mathematics is therefore a factor in the learning of science as most topics entail the use of mathematics. They include the mole concept; electrochemistry, reaction rates and radioactivity just to name a few.

2.1.3 Motivational Orientations

Sex differences in science performance vary with age levels. The greatest difference is at adolescent age level, which has been explained in part by pre-adolescent boys' attempts to enhance their manliness by achieving in science. It is worth of note that this pattern in sex differences in achievement with respect to age level is paralleled by the motivational orientation of boys and girls.

Sex differences in attitudes, aspirations and other motivational orientations towards science are large in some subject areas than others. Females have more positive attitudinal orientation towards biological sciences while male towards the physical sciences (Comber and Keeves, 1973; Keeves and Kotte, 1991; Postelthwaite and Wiley, 1991; Kotte, 1992). Girls have a positive orientation towards biology because it requires less of Math's and spatial ability. Biology also deals with life's processes, which are related to maternal role, thus biological knowledge is often perceived by females as inevitable in the fulfillment of their motherhood duties. Biology also revolves around the verbal propensities of girls and thus serves as a vehicle for girls increasing interest. Males' positive orientation towards physical sciences has been attributed to the "out of school learning". Many activities in physical science can be learnt outside the classroom, and boys have more opportunities to develop positive attitudes in these areas (Kelly, 1981). Cognitive superiority in males (Maccoby and Jacklin, 1974) is frequently proposed as an explanation for boys more positive orientation towards physical science. It is primarily the acquisition of proficiency in a subject that leads to positive attitudes in that subject. Therefore, boys will hold a more positive attitude towards physical science. Low performance of girls in physical science may be due to low attitudes.

Many girls, who may like science, consider science occupations too demanding to combine with family responsibility. It has also been proposed that females who might have chosen science careers fear hostility from male colleagues (who would normally be the majority).

Social economic status is an important factor when considering the effect of attitudes. Girls' orientation towards science is more positive in relation to boys in disadvantaged communities where as boys orientation towards science is more positive in upper middle class communities (Kotte, 1992).

Poverty restricts a range of experiences that lay the cognitive groundwork for later interest and achievement in science. The findings that girls have more positive attitudes than boys in disadvantaged communities, has implications that girls have more experiences than boys do in this communities. Attitudinal orientations are likely to vary with age. Boys more positive attitudes towards science at adolescence may reflect attempts by both boys and girls to conform to traditional stereotypes of science as masculine domain which is capable of capturing the interest of boys not so much of girls (Keeves, 1973). The sex difference could be a function of changes in learning climate that occur in schools. Girl's function less well with the discovery approach often used in science classes; they prefer verbal information in discovery situations.

Among countries of the world, the greatest male superiority in motivational orientation tended to occur in developed countries, with Japan leading the list. Motivational orientation is a function of age and the gap is widest at adolescence and narrows down as the age increases. Contrary to expectation, motivational orientation to science could be on the increase.

2.1.4 Resources and performance in science (Chemistry)

The types of schools are important for successful learning of science. The secondary system has national, provincial, district, local and private schools. A major characteristic of the schools in the higher level is their enormous resources. These facilities diminish drastically as we go down the type of school hierarchy in Kenya. Associated with low physical resources is teacher quality. Quality teachers with long teaching experience are concentrated in national schools. Though teaching experience does not necessarily 'cause' higher achievement in science (chemistry) as was found by Comber and Keeves, (1973).

In the new curricula, which stress the process of science and emphasize the development of higher cognitive skills the laboratory acquired a central role, not just as a place for demonstration and confirmation but as the core of the science learning process. The laboratory gives the student appreciation of the spirit and method of science, promotes problem solving, analytic and generalization ability and provides students with some understanding of the nature of science. Given that chemistry is essentially a practical subject, any learner who misses out on the practical due to lack of resources is disadvantaged. In fact in Kenya there is a regulation that, no pass in practical, no passes with a credit in the examination.

2.1.5 Teacher characteristics and performance in chemistry.

As teachers, play an important role in teaching science no one will doubt their influence on their student's acquisition of knowledge. Just how teachers and the way they teach chemistry affects the generation, constitution or reduction of gender differences in Chemistry achievement has to be considered. Knowledgeable teachers are less likely to pass on misconceptions, are more confident in imparting information, use less time for preparation, and are able to present a wider range of examples and analogies which may help students to learn and understand a certain topic more easily. Only in some cases does teaching experience produce higher science achievements.

Differences have been shown between male and female teachers with respect to their classroom behavior, expectations of achievement of students, or teaching behavior. If teachers tend to show gender – stereotypical behaviors in the classroom, one would probably see this as an effect of the science teacher being male or female, thereby following his or her own gender-typical role in teaching (Kelly, 1978). For Kelly (1978), there is no empirical evidence that female science teachers produce better results with girls. Infact more secondary school science teachers were found to be male (Keeves and Kotte, 1991).

2.1.6 Teaching and learning styles.

According to Kelly (1981), science is presented in schools in a way suited to boys that to girls. Science curricular are said to be another source of perpetuation of sex stereotyping in schools. Reinforcement of sex-appropriate behaviors results in young girls becoming passive, quite and caring and boys active and alert. The conceptual development of girls is thus, narrowed towards passive reception of information whereas broader, inquiring style is encouraged in boys. Many science subjects are presented in ways which advantage boys, although few teachers would admit to consciously discriminate against girls or other sections of their class. The quality of interaction of science teachers with girls is inferior to that of boys.

A more verbalized approach is likely to be effective when teaching girls. For both boys and girls, discovery-oriented approach is effective when considering high level of cognitive skills. For those teachers who use more of the conventional instructional approaches, a blend with experiential components may increase the level of performance.

According to Walberg (1991), three major approaches are used to instruct students optimally in science; Learner autonomy in science, activity based teaching and original source papers.

2.1.7 Socio-Economic Background

It has long been known that the socio-economic status of the home has a substantial influence on students' achievement in science (Husen, 1967; Comber and Keeves, 1973; Kelly, 1978). Data from both FISS and SISS, revealed a major influence of the family status (Kelly, 1978; Lau, 1986; keeves and Saha, 1991).

Common criteria used for establishing the socio-economic situation of the home were father and mother's education and occupation, the use of dictionaries, or the number of books at home (Comber and Keeves, 1973, Robitaille and Garden, 1989).

Indeed to assess the educational and occupational status of the home renders major problems when these are intended to be compared across schools. This becomes especially true when searching for suitable indicators reflecting the economic status of the home. Despite the differences to measure the socio-economic status of the home, Duncan (1989) was able to show the important effect of socio-economic status on science across many developed and developing countries.

Duncan (1989), in a very comprehensive analysis of data from Botswana; using the FISS test instruments found socio-economic status to be related to achievement in science for boys rather than girls. Further to this, an important factor for the effectiveness of the socio-economic situation of the home in developing countries must be seen in the overall enrolment pattern (Cooksey, 1981)

While there is some indication that in the contexts of money, developing countries socio-economic status seems to favour boys, in that their achievement (in science) is influenced only somewhat positively, much stronger positive effects have been found for male students in industrialized countries (Heynemann and Loxley, 1982).

Finn et al. (1979) reported that lower socio-economic status significantly influenced achievement of boys but not of girls. They argued that differences of socio-economic status were distorted by the fact that girls with a lower socio-economic status who were discouraged by potential science careers because they were not available to them.

Steinkamp and Maher (1984), in their analysis of relationships between motivation and science achievement described socio-economic status as one key factor. While girls from lower socio-economic homes showed a more pronounced motivation towards achieving well in science, this was also true for boys with higher socio-economic status. They hypothesized that disadvantaged students, i.e. those from homes of lower socio-economic status, probably received less attention from their parents which would imply that less stereotypical attitudes would have been passed on. Hence, disadvantaged boys would not be 'taught' that academic achievement would be something to aspire because it was typically 'masculine'. Likewise, disadvantaged girls would not necessarily be educated to be 'feminine' like get married and give up any career interest such as upper-class girls would, which, in turn, would allow girls from low status homes to more easily show a higher motivation for science.

There is general agreement that socio-economic status operates significantly on science achievement but in many instances this, more often occurs indirectly (Humrich, 1988; Duncan, 1989; Keeves and Saha, 1991).

2.1.8 Career Expectations and Participation Rates

In many developing countries schooling is still regarded as a privilege and unfortunately, this privilege is accorded most commonly to male students (Silver, 1985).

Results from FISS and SISS enabled Keeves and Kotte (1991) to conclude that substantial changes in many industrialized countries in the roles of women and their career expectations had occurred during the period 1970 to 1984. Girls and women are made aware of these societal changes through the media. Paralleled by greater encouragement of parents, peers, teachers, and often-improved employment opportunities more girls intend to resume a science-related career.

In addition, more girls enrolled in science courses in 1983/84 than in 1970/71 (Keeves and Kotte, 1991). However, the ratio of male to female students participating in science appeared to constantly shift towards male students with increasing grade level.

But major differences were not only found to exist between countries but also between the participation rates of students studying biology, chemistry and physics. The biggest gender differences in enrolment were observed to occur in Physics, with, on average, more than twice as many males than females taking Physics courses (Keeves and Kotte, 1991). Also more male students enrolled in upper secondary chemistry courses. For biology, the enrolment patterns were nearly identical for boys and girls. Kelly (1978) speculated that this was probably due to aspects dealt with in biology, which could be of interest to students in general, such as physiological changes during puberty or important facts about food and digestion (‘nurturative aspects’). It remains largely unclear to what extent secondary school students’ decisions to enroll in future science courses are influenced by other factors such as the socio-economic status of the home, student attitudes and values towards science, teaching methods, or teacher characteristics (Keeves, 1988).

2.2 Gender differences in science learning.

Even if learning opportunities and teaching strategies would be equally effective in science instruction for every boy or girl in class a formal test given at the end of a certain curricular sequence would still yield marked differences between boys, between girls and between boys and girls (Husen, 1989). In their review of gender differences Maccoby and Jacklin (1974), discussed some cognitive areas in which such differences have been documented; differences have been documented in general intelligence (IQ). Females perform slightly better on general IQ tests during pre-school years, but males perform better in high school (Haertel et al, 1981). There were no significant gender differences in IQ scores among adolescents (Maccoby and Jacklin, 1974).

Documentation has also been given on gender differences in particular abilities, especially verbal tasks; female superiority in verbal ability has been observed. In addition, male superiority in spatial ability and mathematical ability (Maccoby and Jacklin, 1974) has been observed. According to education research and practice in Kenya, it has been observed that at secondary school level, girls perform better in Biology than boys while boys perform better in physics and chemistry.

According to the First International Science Study (1973), boys scored considerably better than girls in science achievement tests. The largest differences were for physics. The smallest differences were for biology, with chemistry intermediary.

Factors that have been found to be responsible for this scenario has been grouped into two broad categories; those, which stress genetic or biological factors (nature characteristics) and socialization factors or nurture factors.

2.3 Biological explanation of gender differences

If all external influences could be kept constant while teaching Chemistry to students at a certain age level, the question is what are the individual characteristics of students that lead to differences in achievement? Education research and practice have reflected a belief that education – related gender differences are genetic in origin. The general assumption has been that females and males have different intellectual capabilities, so that, for example, males are genetically predisposed to succeed in the physical sciences and mathematics while females are genetically pre-disposed to succeed in biological sciences and humanities.

Sperry and his colleague based on their 'split-brain' neuropsychological experiments, proposed differential functions to each of the two hemispheres of the cortex (Levy and Sperry, 1968; Sperry, 1961). The left hemisphere performs tasks of sequential information processing (linear or verbal information). The right hemisphere on the other hand performs tasks involving simultaneous information. That is, spatial or configurationally information processing (Sperry, 1961).

Further, more right hemispheric functions of the brain seem to mature at an earlier age in boys than in girls. Levy and levy (1978), attributed this to the possible role steroid hormones play in developing the relative maturational rate of the hemispheres. Since gender related differences in spatial ability in favor of boys have been considerably documented in literature This factor, which is said to be biologically based, gives male an advantage in the study of science (chemistry).

However, not all theorists agree that these brain lateralization differences are biologically determined. Levy, (1978) suggests that it is possible that the differences in brain functioning are as a result of culture and training. It could be that male sex-roles encourage and train males to develop right hemisphere functions, whereas female sex- roles have less emphasis in this regard. As a result of experience and practice, males may subsequently tend to develop right hemisphere specialization for spatial problems more than do females.

Another theory links the differences in spatial ability with levels of sex hormones. Spatial ability has been found to decline with high estrogen phase (which is a female dominant hormone at and after puberty; and the hormone levels have been associated with differences in spatial ability of boys and girls at and after puberty. Before puberty there are a few or no sex differences in the quantity of hormones in the two genders. Research on identical and fraternal twins seems to indicate an inheritable component of spatial ability. It has also been proposed that at least one important genetic determiner of spatial ability is sex-linked being carried on the x-chromosome and being recessive. Females have 2-x-chromosomes, which would give rise to the manifestation of the trait (spatial ability). Whenever boys receive a recessive x-chromosome, it would manifest in their behavior since there would be no other x-chromosome that would suppress it. Boys would always receive their x-chromosome from their mothers. Females would receive an x-chromosome from each parent; whereas both sexes are capable of inheriting the trait, the proportions of males who manifest it will be greater than females. It is referred to as Stafford's sex-linked genetic hypothesis. However it fails to explain the late developments in gender differences in spatial ability (why differences should manifest only at adolescence.).

In addition, Maccoby and Jacklin, (1974) found gender differences at various age levels in verbal skills, commonly in favor of the girls. In conclusion, however, many scholars of education have doubted this biological theory. They have given three reasons for doubting the biological explanation for gender differences in spatial ability. They found that the differences are not found in all cultures (Maccoby and Jacklin, 1974). Gender differences could as well be a result of differences in treatment of girls and boys in their early years, in the home and in school. Finally, when deliberate attempts are made to improve spatial abilities of children, there are no gender differences in response. Thus, the case against biological explanations appears strong and this suggests that there are other social and cultural factors working which gives boys some advantage in the learning of science (chemistry).

2.4 Socio – Psychological influences (socialization theory)

Focuses on cultural and environmental influences and argues that socio and cultural forces work to create different experiences and expectations for girls and boys and to communicate to children what behaviors are considered sex-appropriate. It has been found out that parents encourage the development of naturant and interpersonal skills in their daughters and spatial and practical skills in their sons, an emphasis seen to be dictated by culturally determined images of appropriate female and male behaviors.

Sex related differences are strongly influenced by learning and environmental influences (Fennema and Sherman, 1977). Cross-cultural studies have noted that sex differences on certain spatial tests (e.g. the embedded figures test) appear only in highly stratified cultures in which males exercise strong authoritarian control over females. Less structured societies (e.g. the Eskimos where females are not socialized to be more dependent than men, show little differences.

The fact that boys and girls begin to show the greatest differentiation of intellectual functioning at adolescence may suggest that the phenomenon is caused by developmental changes at this time in life. Social theorists have suggested that these changes are primarily the result of boys' and girls' initiation into adult roles, which are dictated by society (Kelly, 1981). It is the time when many girls do develop the 'will to fail' in a society which differentiates roles in terms of gender, it follows that individual behaviors will be influenced by what is considered to be sexually appropriate. Tasks considered not to be sexually appropriate will be ignored in favor of more appropriate or useful tasks. If society deems that science and mechanical activities are the province of males, whereas literature, languages, social studies are the province of females, these judgments will be reflected in the choice of subjects and in the amount of effort expended by boys and girls on these subjects. It is referred to as "culture hypothesis" (Kelly, 1981). It suggests that girls achieve less well than boys do in science because society does not encourage or expect girls to achieve as well as boys in science particularly in physical science. It therefore asserts that, throughout the world in the present –day society, achievement by women is neither expected nor encouraged, nor adequately recognized when it occurs. Women are respected for various achievements through their husbands and children, but direct personal achievement is considered hard and in feminine. In these circumstances, girls reduce their aspirations and fulfill society's expectations of them by under achieving (Kelly, 1981). Culture hypothesis explains that girls are socialized away from science at an early age by virtue of the toys they are given to play with, hobbies they are encouraged in, household jobs, and the masculine image of science and scientists in books, films and television.

According to social learning theory of sex-role socialization, there is a sequence whereby a child advances from dependency and anxiety to acceptable forms of behavior. This is brought about through reinforcement's fear of punishment and mechanism of initiation and identification.

There is evidence that the perception of task as sexually appropriate may mediate behavior by influencing pupil's expectations and the values they place in attaining success on a task. Sex-role socialization has been held responsible for the different ways girls and boys spent their free time. Some kinds of play and games provide a psychological environment in which important cognitive learning can take place. Differences in the kinds of play activities that boys and girls engage in constitute a reward system structured for the maintenance of sex-role stereotypes. In addition, there is a major influence of the family status on students' achievement in science (Keeves and Saha, 1991; Postelthwaite and Wiley, 1991; Kotte, 1992).

2.5 Chapter Summary

In this chapter a review of the current state of knowledge of the research into gender differences in science (Chemistry) achievement has been presented. It is evident that many questions about which gender differences are observed, how these can be explained, and what possibilities exist for minimizing them remain unanswered.

Though many case studies and surveys based on restricted samples gave valuable indications for a possible decrease of gender differences in science achievement, most of the findings and recommendations given by various authors may not be applicable in different countries. The socio-cultural, socio-economic, curricular and school organizational settings between the educational systems as was shown recently by Rosier and Keeves (1991) are too diverse.

It became clear after reviewing the current literature that a number of factors concerning the students' socio-economic situation and home, their attitudes, teacher and teaching related variables, and school-related variables all seem to be interrelated in influencing Chemistry achievement between boys and girls.

CHAPTER III

RESEARCH METHODOLOGY

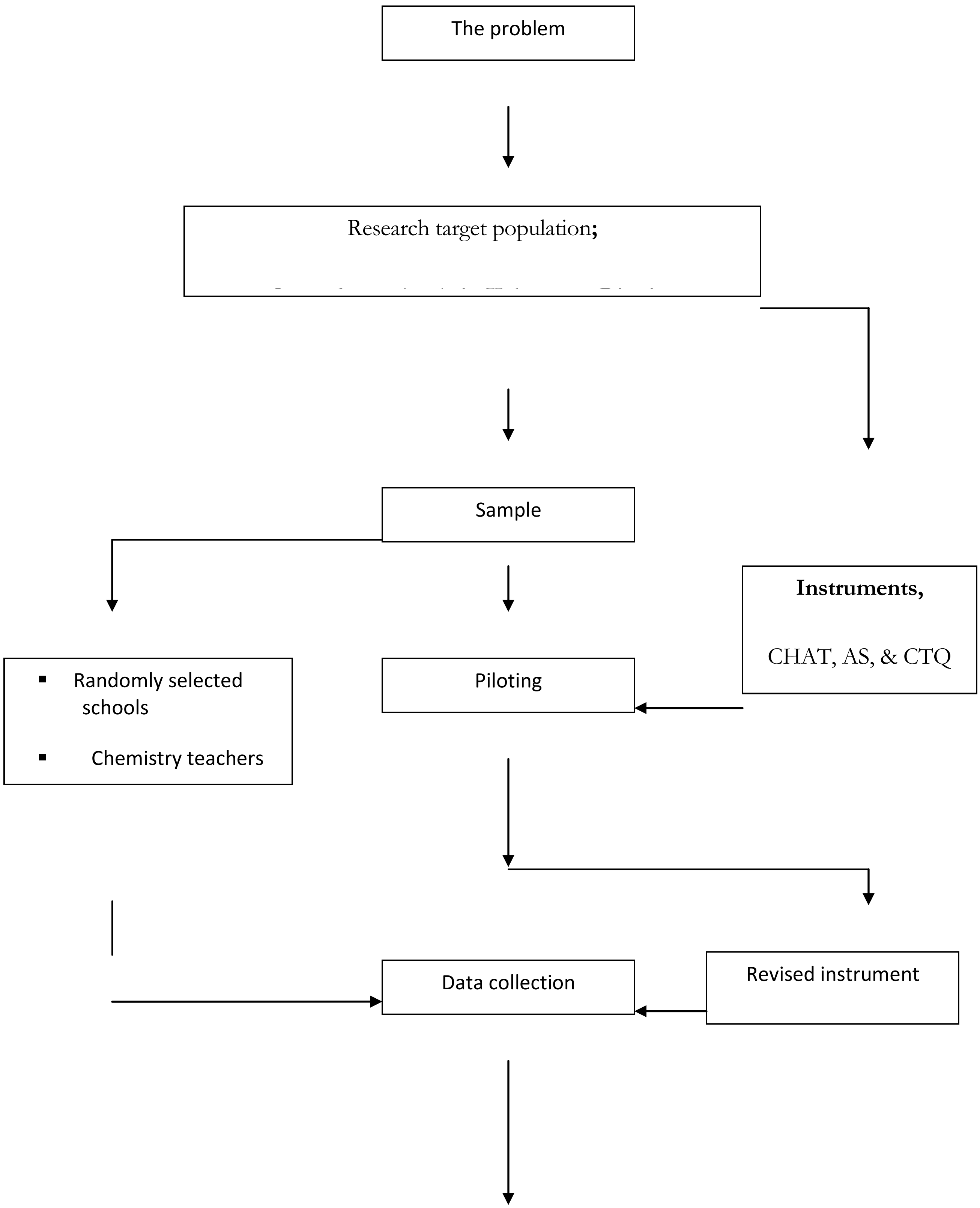
3.0 Introduction

This chapter describes the methodology or the procedures that were followed in conducting this study. The following seven sub headings are discussed:

- Design of the study
- Location of the study
- Study population
- Sampling
- Research instruments
- Variables
- Ethical considerations.

3.1 Design of the study

The study design used is a cross-sectional descriptive survey. It was chosen because it involves collecting data in order to answer questions concerning the current status of the subjects of the study. It is also suitable to assess attitudes and opinions about events, individuals or procedures (Gay, 1992: 13). The study had four phases. Phase I involved proposal preparation and the development of research instruments. Phase II was the piloting of the research instruments with an intention to refine and validate them. Phase III was the actual data collection from the sample population. The last phase involved the analysis of data collected after which conclusions and recommendations were made. The process is summarized in figure 3.1



The problem
Research target population;
Sample
Instruments,
CHAT, AS, & CTQ
Randomly selected schools
Chemistry teachers
Piloting
Data collection
Revised instrument

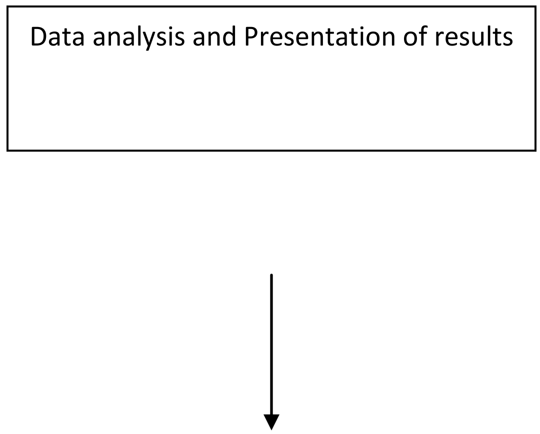


Figure 3.1: Design and Process of the study

Source: Adapted from **Cohen and Manion (1994:89)**

3.2 Location of the study

The study was carried out in Kakamega district of Western province. Western province is among the eight administrative provinces in Kenya and is considered peri-urban. It was used as it is assumed that, as aperi-urban district, it has its population comprising a large number of ethnic communities and races that speak different languages. Because of the above reason Kakamega was purposively chosen. Kakamega district has a population of 603,422 persons and an area of

1,395km2. Private and public secondary schools have been established to cater for this large population.

3.3 Target population

The study comprised some stratified randomly selected public secondary school students and some chemistry teachers in Kakamega district. A list obtained form the provincial education office in Kakamega shows that the district has a total of 62 public secondary schools (see appendix D)

3.4 Sampling and sample size

This section described the sample, techniques used in the sample selection and the methods of determining the sample size used in the study.

3.4.1 Sample description

The primary sources of information in the study were:

(a) Form three students in the stratified randomly selected secondary schools in Kakamega district. Form one and form two was considered not adequately exposed to the secondary school chemistry curriculum. Form four students are considered to be busy preparing for KCSE examinations. Form three class was therefore judged ideal for the study, as the learners will have made a decision to take chemistry at KCSE level.

(b) Some secondary school chemistry teachers in the randomly sampled schools and classes. They were used in the survey, as they were considered instrumental to the implementation of the chemistry curriculum.

3.4.2 Sample selection techniques

This section explains how the sample was obtained. Various sampling techniques were used to select different samples as explained below.

(a) **District**: Kakamega district was selected purposively. It was used as it is assumed it has its population comprising a large number of ethnic communities that speak different tribal and ethnic languages and assumes a variety of socialization modes (Rukangu, 2000).

(b) **School category:** The study was restricted to public secondary schools

(c) **School type:** Stratified sampling technique was chosen because it guarantees desired representation of relevant sub-groups thus increasing the efficiency of the population estimate (Gay, 1992:129).

(d) **Individual schools:** Stratified sampling technique was used to select the schools according to their school type and their performance in the last three years' KCSE examinations in Chemistry. This stratification was done with the view that gender differences in students' achievement in Chemistry may vary with type and performance of schools. The stratification by the school type was as follows: -

   (a) Boys' schools
   (b) Girls' schools
   (c) Mixed schools

These strata were further classified according to schools' previous performance in KCSE examination as follows: -

   (i) Good performing with mean grade of C- and above
   (ii) Poor performing with mean grade of D+ and below.

In each category, two schools were sampled (as shown in table 3.1) using "lucky – dip" type of simple random sampling technique for the categories with more than one school to avoid any bias.

(e) **Chemistry teachers:** Purposive sampling was used to select Chemistry teachers. Those teaching form three were chosen and where there was more than one teacher, professional experience was used as a criterion for selection of the teachers.

(f) **Students:** Simple random sampling technique was used to select the sample of students for the study. The names of students in each class register were written down on pieces of paper and put in a basket. The required number of students was picked randomly from the container. Each time the piece of paper was returned in the basket before the next student was selected.

3.4.3 The sample size

This section describes the methods that were used in determining the sample size used in the study. This includes the number of schools, students and teachers involved in the study.

a) **Number of schools:** Kakamega district has 62 public secondary schools (PDE'S office, Kakamega). Since it is a small population, 20% of it will be adequate to constitute a sample in a study of this nature (Gay, 1992: 137). Thus, 12 public secondary schools were considered in the study as shown in Table 3.1

Table 3.1: Sampling grid for Schools

Performance criteria of schools	Type of Schools (No.)			
	Boys	Girls	Mixed	**Total**
Good performing	2	2	2	**6**
Poor performing	2	2	2	**6**
Total	**4**	**4**	**4**	**12**

Source: Provincial Education Office, Kakamega

b) Number of respondents (Students)

The sample of respondents was determined using the formula adapted from Rukangu (2000) and Mugenda (1999). Thus:

$$n = \frac{Z^2 pq}{d^2}$$

where, n= sample size, f is the function of variable x

Z= coefficient of the standard score in a normal distribution of f(x) (1.96).

P=proportion of the secondary school students who need specific conducive environment in order to master the chemistry content and achieve in the subject. The proportion was taken to be 0.5.

q is1 –p

d = significance level to this study, which was taken to be 0.05

This calculation yielded 386.2 students. For practical reasons, 386 students were involved in this study. The sampling grid is shown in Table 3.2

Table 3.2: Sampling grid for students

School type	Enrolment	Sample students
Girls	3,419	50
Boys	4,605	76

Mixed	15,128	256
Total	**23,152**	**386**

Source: Provincial Education office, Kakamega

3.5 Research instruments

A cross-sectional descriptive survey employing correlation methods was used in order to achieve the objectives of the study. According to Cohen and Manion (1992:83), the collection of data in survey method typically involves one or more of the following data-gathering techniques.

(i) Structured or semi-structured interviews

(ii) Standardized tests of attainment or performance

(iii) Self-administered or postal questionnaire

(iv) Attitude scales.

In response to the above, the present study used three sets of instruments:

a) Standardized tests of attainment or performance.

   This was effected by administering Students' Chemistry Achievement Test

   (CHAT) (Appendix A)

b) Self-administered or postal questionnaires

   In this approach a Chemistry Teachers' Questionnaire (CTQ) (Appendix B)

   was used.

c) Attitude Scales

   An Attitude Scale for the students was also used (Appendix C)

The above instruments were found appropriate for this kind of study as outlined below.

(a) Standardized Tests of Attainment

An achievement test, (CHAT) was found appropriate for this study because it was considered an important tool in correlation research like this one (Gay, 1992)

(b) Self-Administered Questionnaire

The CTQ questionnaire was preferred because it is the best form of survey in an educational enquiry (Cohen and Manion 1994:94). In addition, a questionnaire has the following advantages:

(i) Less expensive (Davidson, 1970:56)

(ii) It permits for collection data from a large sample (Mugenda & Mugenda, 1999)

(iii) It allows the anonymity of the respondent.

(iv) Its more efficient in that it requires less time to administer (Gay, 1992:224)

(v) It is fairly reliable (Cohen & Manion, 1994:272)

(c) Attitude scale

The attitude scale (AS) was preferred because it permits collection of data from a large sample and is fairly reliable.

The instruments were used because of the following purposes: -

(i) Students' Chemistry Achievement Test (CHAT) It was aimed at determining the gender differences in students achievement in Chemistry. It was constructed with some items adapted from KNEC (1995) and FISS (1973). It emphasized three abilities: Descriptive ability, spatial and Mathematical abilities.

(ii) Chemistry Teachers Questionnaire

The questionnaire for the teachers mainly sought information on the reasons why girls generally perform less well than boys in Chemistry and on the ways in which the performance of girls could be improved. In addition, the questionnaires attempted to document the academic and teaching qualification of the teachers, their teaching experience, workload and resources available for teaching Chemistry.

(iii) Students' Attitude Scale

This instrument mainly sought information on the students' attitude towards learning chemistry and their perceptions regarding the level of help that students' had access to private tuition and their career aspirations.

3.5.1 Validity and Reliability

(a) Validity

Content and construct validity of the research tools were enhanced at the design stage since some of the items were adapted from earlier studies by FISS (1973) and KNEC (1995). This strengthened content and construct validity. This stage was followed by a pilot study whose main purposes were to check the appropriateness of the language used in the tools and to conceptualize them for predictability and reliability.

(b) Reliability

Since the student's Chemistry Achievement Test (CHAT) items had dichotomous scores with varied levels of difficulty, its reliability coefficient was determined using

Kuder – Richardson (Formula 20) estimates. This was determined using the formula adapted from Sattler (1988:27). Thus,

$$r_{tt} = \left[\frac{n}{n-1}\right] \left[\frac{S^2_t - \Sigma pq}{S^2_t}\right]$$

Where r_{tt} = reliability estimate

n = number of items on the test

S^2_t = variance of the total test

p = Proportion of respondents getting an item correct

q = Proportion of the respondents getting an item incorrect.

Σpq = Sum of the product of p and q for each item.

Using the above formula, the pilot findings showed a reliability coefficient of 0.846., This coefficient led to the determination of the reliability index of 0.9259, using the formula $r_i = \sqrt{r}$, which was high.

The reliability co-efficient of the non-dichotomous score tools, AS and CTQ were determined using Cronbach coefficient formula as used by Rukangu (2000). Thus,

$$\alpha = \left[\frac{n}{n-1}\right]\left[1 - \frac{\Sigma S^2}{\partial^2}\right]$$

Where, α = Reliability coefficient

n = Number of items in the tool

∂^2 = Variance in the obtained test scores

$\sum s^2$ = Sum of variances of the single items

3.5.2 Piloting of the instruments

The drafted instruments were piloted in one mixed public secondary in Kakamega district in order to refine them and enhance their validity and reliability. The items in the instruments appeared not to have any flaws and thus were retained.

The refined instruments were then administered to the sample respondents in the main study. The process of refinement was necessary due to the following reasons:

(i) Determine the difficulty of the items in the instruments.

(ii) Check the suitability and level of language used.

(iii) Estimate the time allocation for the items and

(iv) Enhance the validity and reliability of the items.

3.5.3 Administration of the research instruments

The pilot study was conducted in one public mixed Secondary school in Kakamega District in the month of January. Thirty (30) students (15 girls and 15 boys) were randomly selected and the CHAT and AS were administered to them. This number was sufficient in order to discover the major flaws in the questionnaires (Sudman, 1976). One chemistry teacher was given the CTQ to fill. The data collected at that stage were analyzed and the results used for appropriate amendment of the instruments. The actual administrations of the research instruments and data collection were conducted in the first term of the school calendar, in the months of January and February 2006. It was preceded by the researcher's preliminary visits to the schools sampled out for the study. During this visits, the researcher sought to accomplish two tasks:

- Strike rapport with the school authorities and to explain the purpose of the study verbally. This was aimed at minimizing Hawthorne effect.
- Make necessary arrangements for the actual administration of the research instruments and data collection.

The instruments were administered with the assistance of chemistry teachers. The study was conducted after school so as not to interfere with students' class time.

3.6 Variables

The following are the main independent variables used in this study. These variables influenced the dependent variables as explained below

(a) Student-related variables

These included gender, their general ability and attitudes.

(b) Teacher-related variables: These variables included gender, academic and professional background, teaching load and teaching experience. Others included main resources used when teaching Chemistry

(c) School-related variables: The school-related variables included school type and resource availability.

The main dependent variables used in this study are achievement in Chemistry and future aspirations in a science related course.

3.7 Ethical considerations

The researcher sought permission from the Western Provincial Director of Education's office to do research in the schools. In each school, permission was sought from the head teacher before involving students and teachers.

3.8 Chapter Summary

This chapter has described the rationale of the design and methods that were adapted for the study. It has looked at the research instruments used and how they enhanced the acquisition of information on gender differences in Students' Achievement in Chemistry. The information that was obtained and how it was analyzed is explained in the next chapter.

CHAPTER IV

DATA ANALYSIS, PRESENTATION, AND DISCUSSION

4.0 Introduction

The main objectives of this study were to: -

(a) Identify the differences between boys and girls in their achievement in chemistry.

(b) Determine the factors that are associated with gender differences in chemistry achievement.

(c) Identify attitudinal and aspirational levels of students towards chemistry.

This chapter analyses, presents the findings and discusses their resulting and associated issues respectively. For systematic presentation and analysis of data, the chapter specifically considers and explains methods of data analysis, student- related variables, teacher and school-related variables and achievement in Chemistry.

4.1 Methods of data analysis.

Analysis of data was based on research questions. Data germane to the study were both quantitative and qualitative. Quantitative analysis involved presentation of statistical data in form of frequency distribution tables whose explanation was mainly based on descriptive and inferential statistics. Quantitative data were analyzed using Pearson product –moment correlation co-efficient, student t-test and one –way ANOVA. Pearson product moment correlation coefficient was used to determine the relationship between students' scores in the attitude scales and their scores in the chemistry achievement test. Students 't' –Test was used to compare the means in students' performance of CHAT between the genders. One-way ANOVA (Analysis of Variance) was used to compare the variance in student performance in the CHAT with school type. The statistical significance of the results were then examined at $\alpha = 0.05$ statistical significance level

Quantitative analysis considered the inferences that were made from the opinions of the respondents. This analysis was narratively presented and where possible in tabular form. Specific analysis for the various variables is presented and discussed in the next sections.

4.2 Student related variables

In this section emphasis is given to identify and evaluate the effects of students attitudes thought to influence chemistry achievement. Further to this, a student's interest to obtain further chemistry training or to take up a science-related occupation is also examined.

4.2.1 Gender differences on the attitudinal scales

Examining data from the FISS study, Comber and Keeves (1973) were able to show that attitudes had different effects depending on the level of schooling. While attitudes towards science (and by extension to chemistry) and other school- related attitudes are developed during childhood and the years of elementary education, they are shaped considerably during secondary schooling (Ormerod and Duckworth, 1975; Kroeger, 1990). Though this was neither new nor surprising, it was unclear from previous research to what extend gender was influential in this formative process. Students were requested to a number of likert-type items regarding their attitudes towards chemistry. Five response categories were, in general, used: Strongly agree, agree, not sure, disagree and strongly disagree. The scoring scheme employed involved the scoring of a favourable response to an item as ‘5’ a not sure response as ‘3’ and an unfavourable response as ‘1’ The scoring was reversed for negative items. High values indicate a positive or favourable attitude whereas low values represent a negative or unfavourable attitude. Table 4.1 presents the results on the attitudinal scales.

Table 4.1 Statistics for Attitude Scales

Gender	N	Mean Score	SD	SE of mean	Mean difference	t-value	df	2-tail sig
Interest in chemistry								
BOY	206	17.29	6.727	0.2645	1.14	4.31	384	*0.000
GIRL	180	16.15	7.655					
Ease of learning chemistry								
BOY	206	16.59	6.264	0.2610	0.6	2.29	384	*0.000
GIRL	180	15.99	7.456					
Career interest in chemistry								
BOY	206	19.01	6.123	0.225	0.46	2.05	384	*0.000
GIRL	180	18.55	6.155					
Beneficial aspects of chemistry								
BOY	206	18.41	6.346	0.2620	0.51	1.94	384	*0.000
GIRL	180	17.90	7.524					
Non- harmful aspects of chemistry								
BOY	206	18.21	8.124	0.2820	0.41	1.45	384	*0.000
GIRL	180	17.80	8.352					

*Significant at α = 0.05

SD – standard deviation.

It is of interest to discuss each scale separately before providing a summary for all attitudinal measures.

4.2.2 Interest in chemistry

The items of this attitude scale measured the interest students had in chemistry. A higher scale score indicated that students expressed a more positive interest in chemistry. Being a boy rather than a girl led to the expression of a greater interest in chemistry taught in schools and classrooms across all the schools in the study. As a result, boys had a mean of 17.29 as compared to girls (mean=16.15). To determine whether there is a significant difference between students' gender and interest in chemistry, students''t'-values were computed using SPSS program. From table 4.1 it can be noted that, the absolute t-value for this 4.31 ($P > 0.001$) is significant.

4.2.3 Ease of learning chemistry.

In the items for this attitude scale the students were asked whether they perceived learning chemistry as easy or difficult. A higher scale score indicated that the students perceived learning chemistry as easy. Boys perceived chemistry learning to be considerably easier (mean = 16.59) than their female fellow students (mean = 15.99) did. From the t-value, 2.29 ($P>0.001$), there was a significant difference between the gender of student and ease of learning chemistry.

4.2.4 Career interest in chemistry

Students were asked to respond to a set of items showing their interest to pursue a career in chemistry after leaving school. A higher scale score indicated that students expressed an increased interest to resume a career in chemistry. Students' of all schools showed an interest in future chemistry career (grand mean = 37.55). It should be noted, too, that the rejection to engage in a chemistry career was particularly strong for female students (mean of boys =19.00 and mean of girls =18.55). It, therefore, could be speculated that the strong pressure put on students at form three level to engage in chemistry develops a personal antipathy in girls. The pressure would appear to be simply too much for the girls to bear and many would rather opt for a different career. Again the t-value, 2.05 ($P>0.001$) was significant.

4.2.5 Beneficial aspects of chemistry.

This scale was measuring students' values about the beneficial aspects of chemistry. A higher scale score indicated that students held more positive values about the beneficial aspects of chemistry. Gender disparities were found in all the schools as male students expressed a stronger acceptance of chemical benefits (mean = 18.41) than the girls (mean =17.90). This differences were highly significant, $t = 1.94$, ($P>0.001$).

4.2.6 Non-harmful aspects of chemistry.

A higher scale score indicated that students held less negative values about the harmful aspects of chemistry. Girls judged chemistry to cause harm (mean =17.80) as compared to their male counterparts (mean =18.21). But in general, students may have had greater difficulties responding to the items of this scale other than neutrally. This, in part, might have stemmed from the complexity of the attitudinal items as being more difficult to understand. It should be noted that all items of this scale were worded negatively. As a result, most students opted for the not sure-category. From the t-value, 1.45 ($P>0.001$), there was a significant difference between the gender of student and non-harmful aspects of chemistry.

In conclusion, boys were more interested in chemistry, found learning chemistry-related tasks easier, showed a more pronounced interest in following a career in chemistry, and rated chemistry to be more beneficial than their female classmates. It could be expected that the student's primary socialization affected by the socio-economic status might well account for most of the gender differences exhibited with respect to attitudes towards chemistry. On average, boys had a stronger affinity towards chemistry.

4.2.7 Relationships among the attitudinal scales.

As the data in table 4.1 revealed, consistent and sizeable gender differences were found a cross all five scales presented. It would therefore appear justified to conclude that, boys had a stronger affinity towards chemistry. But if this was so, and as at the same time considerable gender differences were found in chemistry achievement favoring the boys, it becomes necessary to look at the linkage between chemistry attitudes and chemistry achievement. Table 4.2 exhibits these correlations.

Table 4.2 Product-moment correlations of gender differences between selected attitudinal scales and chemistry achievement.

Attitudinal scale	Chemistry Achievement	Interest in chemistry	Ease of leaning chemistry	Career interest	Beneficial aspects
Interest in Chemistry	- .42				
Ease of learning Chemistry.	.16	.31			
Career interest	.08	.02	.70*		
Beneficial Aspects.	-.30	.43	.68*	.75*	
Non-harmful Aspects.	-.45	.45	.60	.22	.65*

Notes: *Significant at 0.05 level (2-tailed)

As can be seen, there seemed to be a significant, positive interrelationship of gender differences between ease of learning chemistry, career interest and beneficial aspects of chemistry. With respect to the positive signs of the relationships, it can be noted that the more pronounced gender differences were on ease of learning chemistry, career interest, and beneficial aspects. On the contrary, gender differences on interest in chemistry did not correlate significantly with gender differences on any other attitudinal scale. Another interesting finding was the significant positive relationship between career interest and beneficial aspects ($r = 0.75$).

Finally, consideration should be given to the correlations of attitudinal mean values and gender differences with chemistry achievement. Gender differences on interest in chemistry and non-harmful aspects of chemistry tended to correlate negatively with chemistry achievement ($r = -0.42$ and $r = -0.45$ respectively). A part from this, none of the attitudinal gender differences corresponded noticeably to chemistry achievement.

Interest in chemistry differences did not seem to correspond to chemistry achievement differences at all. This result is, at first glance, surprising because the negative coefficient of $r = -0.42$ indicates that although students expressed an interest in scientific matters their achievement in chemistry was comparatively poor. It might well be that the form of attitudinal items which only allowed students to answer ‘strongly agree’, ‘agree’, ‘not sure’, ‘disagree’, or ‘strongly disagree’ was too crude to pick up subtle attitudinal differences. Another explanation could be that the instruction provided was, in many cases, insufficient to turn a student’s present interest into scientific knowledge and finally higher achievement.

4.2.8 Career aspirations

From a list of career choices, students were requested to select one career choice of what they would like to be when they leave school.

Table 4.3 Career expectations of students

Profession	BOYS		GIRLS	
	N	%	N	%
Teacher	10	4.8	17	10.35
Lawyer	32	15.36	21	11.55
Nurse	7	3.36	98	53.9
Doctor	92	44.16	26	14.3

Politician	6	2.88	3	1.65
Engineer	57	27.36	5	2.75
Other specify	8	3.84	10	5.5
Total	206	100	180	100

From table 4.3, the most popular career choice for the girls was nursing with 53.9% and medicine for the boys (44.16%). A good number of boys (27.36%) also showed an interest in engineering. The least preferred career for both boys and girls was being a politician. In conclusion, marked differences in the types of careers to be pursued by male and female students were noted.

4.3 Teaching and school variables

In the previous section the effects of gender on chemistry –a related attitude was examined. The results discussed below underline the importance and necessity to integrate student, teaching and school variables analytically in order to understand fully the complexity of gender effects on the chemistry achievements. It is made clear that gender differences cannot be examined isolated from all other factors, which are believed to influence achievement in science. As will be seen, gender differences are indeed related to the teaching process in the classroom as well as to the school-specific context in which teaching and learning occurs. Though the students' attitudes towards chemistry and motivation play a cardinal role in establishing differences in chemistry achievement between boys and girls it is also the setting in the classroom and school which helps to increase or decrease gender differences. This is the focus of this section. This section therefore presents the analysis of teaching and school factors based on the data collected using Chemistry Teachers' Questionnaire (C T Q).

4.3.1 Experience of Chemistry Teachers

Experience of a teacher was regarded important for this study since the duration of service as a chemistry teacher exposed them to various aspects of teaching chemistry and skills needed to alter any gender- biased behaviors in the classroom. As research has shown, knowledgeable teachers are less likely to pass on misconceptions, are more confident in imparting information, use less time for preparation, and are able to present a wider range of examples and analogies which may help students to learn and understand a certain topic more easily (Wilson, and Shulman, 1989), only in some instances does teaching experience 'produce' higher chemistry achievement.

Teachers with teaching experience of zero to five years were considered not experienced enough, those with between six to ten years of teaching chemistry were considered adequately experienced while those with more than ten years of teaching were considered very experienced. The findings are shown in table 4.4.

Table 4.4 Teaching experiences of chemistry teachers

Years	Number of teachers	Percentage
0-5	5	41.7%
6-10	3	25%
>10	4	33.3%
Total	12	100

From Table 4.4, 33.3% of the teachers involved in this study were very experienced, 25% were adequately experienced while 41.7% were not experienced enough.

However teaching experience shows an inconsistent picture across the types of schools as demonstrated by the analysis performed on the CHAT. This was also demonstrated by the analyses performed on the FISS and SISS data sets (Comber and Keeves, 1973; Keeves, 1991; Postlethwaite and Wiley, 1991).

4.3.2 Teachers' gender and professional qualification

A number of studies have identified differences between male and female teachers with respect to their classroom behaviour, expectations of achievement of students or teaching behavior (Dunkin, 1985). While a male teacher appeared to raise the achievement level of the class in mixed schools, female teachers seemed to have higher achieving classes in girls' school. But in boys schools there was no sizeable gender effect of the chemistry teacher on the achievement level of the class.

It was also observed that male dominated classes were taught most often by male teachers and likewise, the female- dominated classes were commonly taught by female teachers. Yet teacher gender had no direct or indirect influence on the achievement level of a class.

Table 4:5: Distribution of Chemistry Teachers by academic qualifications and Gender.

Qualification	Subject Combination	Gender	
		Male (%)	Female (%)
Diploma in Education	Chemistry/Biology	31.4	7.2
B.E.D	Chemistry/Physics	16.7	0
	Chemistry/Maths	25	2.5
	Chemistry/Biology	8.6	8.6
	TOTAL	81.7	18.3

The table 4.5 above shows that 81.7% of the teachers were male 18.3% were female.

Teachers' academic and professional qualifications were considered important because academic and professional qualifications are important in determining whether a teacher has been trained in the various methods of teaching. For this study, teachers with a diploma in education were considered qualified, while those with bachelors' degree in education were considered to be highly qualified. The findings are shown in figure 4.1

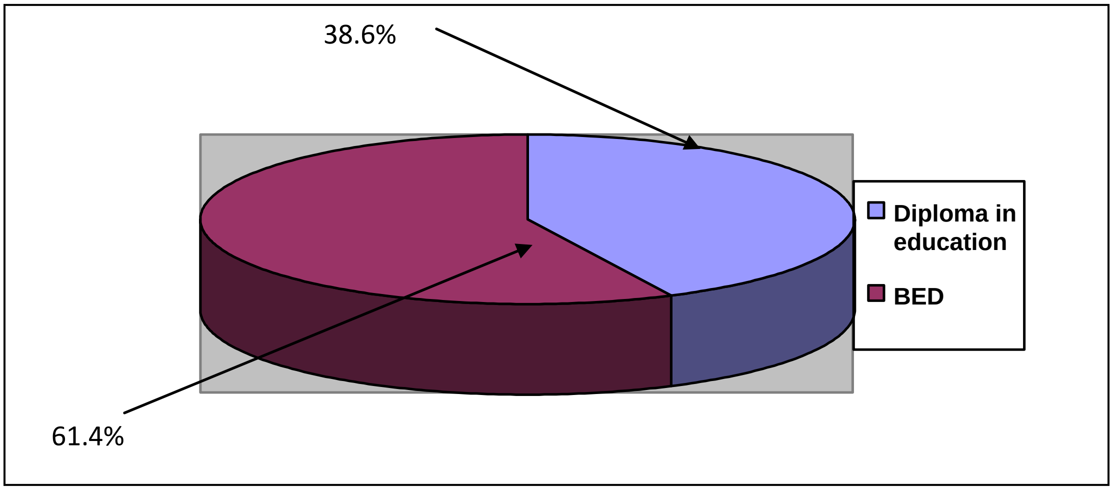


Figure 4.1. Showing percentages of teachers' academic qualification

Figure 4.1 reveal that 38.6% of teachers had a diploma level of education and professional training. 61.4% of the teachers had university education and professional training. The teachers in this study were therefore highly qualified in teaching of chemistry. This observation was in agreement with the assumption that the chemistry teachers were adequately trained.

To find out more on teacher effects and achievement in chemistry, teachers were asked to respond to reasons as to why girls generally scored lower marks in chemistry in national examinations than boys. The results are presented in table 4.6

Table 4.6: Teachers responses on why girls generally score lower marks in chemistry national examinations than boys

REASONS	**SA**		**A**		**NS**		**D**		**SD**	
	N	%	N	%	N	%	N	%	N	%
Girls fear chemistry	6	50	6	50	0	0	0	0	0	0
Girls do not think chemistry is important for their future	0	0	2	16.7	0	0	6	50	4	33.3
Because of household duties girls do not have enough time for homework in chemistry and other subjects	4	33.3	6	50	0	0	2	16.7	0	0
Girls don't like doing experiments	4	33.3	3	25	0	0	3	25	2	16.7
Girls' don't like writing practical reports after experiments and observations	3	25	4	33.3	0	0	3	25	2	16.7
Girls do not ask questions in class when they do not understand	2	16.7	6	50	0	0	4	33.3	0	0
Girls are not very good at practical work	0	0	0	0	4	33.3	6	50	2	16.7
Girls are brought up to believe that chemistry is for boys.	7	58.3	2	16.7	0	0	3	25	0	0

Girls do not like setting up experiments	4	33.3	4	33.3	0	0	4	33.4	0	0
The teaching approaches used do not help girls understand chem.	0	0	2	16.7	6	50	2	16.7	2	16.7
Girls are less determined than boys in solving difficult problems on their own	4	33.3	5	41.7	0	0	3	25	0	0
Girls are less intelligent than boys	0	0	0	0	1	8.3	5	41.7	6	50
Girls do not like handling tools, apparatus and equipment	5	41.7	5	41.7	0	0	2	16.7	0	0
Girls fear mathematics and chemistry involves a lot of calculation	7	58.3	5	41.7	0	0	0	0	0	0
Poor previous fundamental in science and mathematics is responsible for poor performance of girls in chemistry	8	66.7	4	33.3	0	0	0	0	0	0
Girls are generally lazy than boys	0	0	0	0	0	0	4	33.3	8	66.7
Writing balanced equations a problem to girls than boys	0	0	0	0	1	8.3	6	50	5	41.7
Complicated formulae make girls to despair in chemistry	1	8.3	8	66.7	0	0	3	25	0	0
Girls are as hardworking as boys	10	83.3	2	16.7	0	0	0	0	0	0
Girls enjoy practical work	2	16.7	6	50	0	0	0	0	0	0
Girls have enough time to do their homework in chemistry and other subjects	0	0	5	41.7	0	0	0	0	7	58.3

From table 4.6 above responses, 50% of the teachers strongly agreed and agreed that girl's poor performance in chemistry was attributed to the fact that they feared the subject. 83.3% of the teachers strongly agreed and agreed with the reason that girls do not have enough time for homework in chemistry and other subjects due to household duties. This includes household chores performed in the morning before school for the day scholars and after school errands during holidays.

In addition, over 50% of the teachers agreed and strongly agreed with the fact that girls don't like doing experiments, writing practical reports after experiments, and do not ask questions in class when they do not understand. This could be an effect of boys and girls subjective perception of chemistry being a male domain and hence less favorable attitudes towards chemistry of girls.

Over 50% of the teachers disagreed and strongly disagreed with the reason that girls do not think chemistry is important for their future, girls not being good at practical work, girls being less intelligent than boys and girls being generally lazy than boys. Girls are therefore not necessarily cognitively inferior to boys.

However, 50% of the teachers were uncertain as to whether the teaching approaches they used helped the girls understand chemistry.

66.7% and 58.3% of the teacher strongly agreed with poor previous foundation in science and mathematics' and girls' fear of mathematics respectively as other major reasons responsible for poor performance of girls in chemistry. This was collaborated by finding from the CHAT where girls performed poorly in the mathematical and spatial tests.

To find out more from the teachers on how the performance of girls in chemistry could be improved, they were asked to rank 10 statements in order of importance.

A rank order scale was used to determine the most determinant to the least determinant factors. Coding of the factors were that, three factors with the least means constituted most determinant factors, three factors with most means constituted least determinant factors while the in between factors with average means were average determinants. The teachers' responses are summarized in table 4.7

Table 4.7 Teachers' responses on how the performance of girls in chemistry could be improved.

NO	STATEMENT	MEAN	RANK
1.	Make the content of the chemistry syllabus more relevant to the needs of girls	5.25	4
2.	Make chemistry teaching related to the everyday experiences of girls	5.42	6
3.	Encourage girls to do more homework, exercises	4.25	2
4.	Give girls more homework and tests	5.00	3
5	Group girls with boys when teaching chemistry	7.58	10
6	Give girls opportunities to take part in science fairs, exhibitions and competitions	4.08	1
7.	Give girls more information on how chemistry will be useful in their life after school	6.75	9
8.	Use more teaching aids when teaching chemistry	5.33	5
9.	Make teachers to cater for the needs of girls in the learning of chemistry	5.75	7
10	Train teachers to cater for the needs of girls in the learning of chemistry	5.58	8

From the table 4.7 above, the most important suggestion given by teachers which would ultimately impact positively on girls' performance in chemistry was to give girls opportunities to take part in science fairs, exhibitions and competitions which had the least mean of 4.08. The teachers also strongly felt that the girls should be encouraged to do more experiments (mean= 4.25) and be given more homework (mean =5.00). These suggestions enhance the general ability of the students, which was another main predictor of success in chemistry. These steps if taken will help prevent achievement differences in chemistry as well as gender differences from being established.

The least important suggestions were to group girls with boys when teaching chemistry

(Mean= 7.58), give girls more information on the usefulness of chemistry (mean = 6.75) and train teachers to cater for the needs of girls (mean =5.58). From research, there was no evidence for the assumption that boys and girls could not achieve equally well in chemistry. However, it would still be wise to apply different educational measures separately to boys and girls in school with a hope to reduce gender differences. Even if boys were found to hold more positive attitudes towards chemistry, this does not necessarily mean that it would be unwise to develop female-specific strategies aimed at stimulating the girls' attitude towards chemistry or teaching girls separately from boys.

4.3.3 School science facilities

Science facilities at school in general were of importance for chemistry achievement. However, the use of school laboratories for chemistry teaching did not have a big impact on the achievement level. This should not be misinterpreted in that way that science laboratories do not help or enrich teaching chemistry at secondary school level. This could be attributed to the fact that the chemistry test administered was testing students' theoretical knowledge for which learning and experimenting in a school laboratory would be of assistance. Hence school science facilities would become of importance mainly when testing practical skills and not for paper-and-pencil chemistry tests. However, in all the schools differences seemed to exist in the number of laboratories per school and indirectly, in the type of equipment. Some schools were not sufficiently equipped in their science laboratories. Table 4.8 shows the number of science laboratories available in the schools.

Table 4.8 Number of science laboratories

Number of science laboratories	Number of schools	Percentage (%)
1	5	46.7
2	4	33.3
3	3	25.0

46.7% of the schools only possessed one science laboratory, which was not sufficiently equipped. On the other hand, 33.3% of the schools possessed two science laboratories (one for Physical and the other for biological science). 25% of the schools possessed three laboratories.

4.3.4 Availability of resources

Availability of resources was ascertained so as to establish whether they indeed had an impact on achievement of boys and girls in chemistry. A sharing ratio, of less than 1:3 denoted available and sufficient, greater than 1:3 denoted available and insufficient and nil for non-existent were used to establish resources status in schools. The only resource that was shared one among three students was textbooks and only in seven schools the other resources were insufficient as the sharing ratios were more than 1:3. Schools that had computers, radios and television used them for other purposes other than as chemistry resources. The summarized statistics are presented in the table 4:9

Table 4:9 Availability of teaching resources

RESOURCE	AVAILABILITY SUFFICIENT (RATIO	NOT SUFFICIENT	NOT AVAILABLE

	1:3)	(RATIO –1:3)	(NILL)
Text books	7	5	0
Charts	3	6	3
Models	0	3	9
Computers	0	1	11
Television	0	2	10
Radio	0	4	8

The findings from table 4.9 indicate that except for textbooks in seven schools and charts in 3 schools, the rest of the resources are insufficient. Resources that could be availed from the local environment were lacking for example charts and models. This can be interpreted to mean that, teachers were either not innovative or lazy and could not produce them locally and yet they were all trained.

4.4 Achievement in Chemistry

This section presents the analysis of the data obtained from the students' chemistry achievement test (CHAT)

4.4.1 Differences between Boys and Girls in Chemistry Achievement.

The study involved 206 boys and 180 girls. Table 4.10 shows the scores, frequencies and means obtained in the CHAT by gender.

Table 4.10 Students' scores in the CHAT by gender

Ge	T	Scores and frequency								MEAN	
	M	0	1	2	3	4	5	6	7		
B	X	25	14	22	16	15	18	42	54	**4.3009**	
	Y	2	12	12	45	33	41	30	51	**4.4531**	
	Z	3	9	15	42	36	40	19	42	**4.3952**	**13.1492**
G	X	14	12	13	6	17	12	34	72	**4.9252**	
	Y	3	24	30	32	33	37	12	9	**3.3440**	
	Z	5	20	32	13	32	37	33	8	**3.8333**	**12.1029**

Pearson correlation coefficient, r = 0.9882 (α 0.001)*

*Significant at α = 0.05

Legend; Ge = gender, B= boys, G girls, X= Descriptive ability test, Y= Mathematical ability test, Z= Spatial ability test, T= test, M=Marks

On computing the Pearson product moment Correlation coefficient (r) of the scores obtained from the boys and girls, a value of 0.9882 at α 0.001 was yielded. This shows that the r-value is significant at 0.05 significant levels. Thus, there is a strong positive correlation between gender and student's performance in the subject.

From table 4.10, it can be noted that boys obtained higher mean scores in both mathematical and spatial ability tests. For the verbal ability test (X) the boys and girls obtained mean scores of 4.3009 (n=206) and 4.9252 (n=180) respectively. For the mathematical ability test (Y), boys attained a mean score of 4.4531 and girls, 3.3440. For the spatial ability test (Z), boys attained a mean score of 4.3952 and girls, 3.8333. In order to test whether there is a significant difference between students' gender and performance in chemistry in the three sections of the CHAT, students 't'-values were computed using SPSS program. The results of the descriptive ability test, mathematical and spatial ability tests are presented in table 4.11.

Table 4.11 Student's t-value for the Chemistry tests

Gender	N	**Mean score**	SD	SE of mean	Mean difference	t-value	df	2-tail sig
Descriptive ability Test (X/ 7)								
Boys	206	**4.3069**	2.7076	0.189	-0.6243	-2.21	384	0.0000*
Girls	180	**4.9252**	3.2542	0.243				
Mathematical ability test (X/7)								
Boys	206	**4.4531**	2.1071	0.147	1.1087	5.48	3.84	0.0000*
Girls	180	**4.3440**	2.0273	0.151				
Spatial ability test (X/7)								
Boys	206	**4.3952**	2.1703	0.151	0.5622	2.30	384	0.0000*
Girls	180	**3.8330**	2.5942	0.193				

* Significant at α =0.05

From table 4.11, it can be noted that, the absolute t-values for the verbal ability test, mathematical ability test and spatial ability test, 2.21 (P>0.001), 5.48 (P>0.001) and 2.30 (P>0.001) respectively are significant. Thus, there was a significant difference between the gender of student and performance in chemistry achievement test. Boys performed significantly higher than girls did except for the descriptive ability test. This has been the case in national examinations. This could be attributed to the proposed differential functions to each of the two hemispheres of the cortex. The left hemisphere, which matures at an earlier age in girls than in boys, would rather perform tasks of sequential information processing (verbal information) and hence gender differences were found in favour of girls on verbal abilities. Further more, right hemispheric functions of the brain seen to mature at an earlier age in boys than in girls and hence gender related differences in spatial and mathematical ability were largely in favour of the boys. It could also be attributed to the environment-cultural hypothesis or socialization theory. The above sex differences could be a result of societal or cultural expectations for boys and girls. As a result, the high rate of socialization brings about superiority of girls in descriptive ability tasks and vice versa. This implies that girls need to be given special attention while being taught mathematical and spatial ability aspects of chemistry. In addition tests should be balanced and follow a specification grid so that it does not test on one ability area.

4.4.2 Relationship between school type and achievement in Chemistry

Three school types were considered in the study: boys, girls and mixed schools. The overall means scores of the CHAT (X/20) for the school types are shown in table 4.12.

Table 4.12 Means scores of the various school types

	School Type		
	Girls	Boys	Mixed
Mean Score of CHAT (X/ 20)	9.3611	12.1691	9.6196

From table 4.12, it can be noted that boys' schools had a higher mean score than that of girls' and mixed schools. This probably could be attributed to a more pronounced motivation towards achieving well in chemistry by the male students. This is well explained by the attitude hypothesis. Girls perform less well than boys in Chemistry because girls have less favourable attitudes towards Chemistry. Males' positive orientation towards Chemistry has been attributed to the students' primary socialization. In addition, the low performance of girls in Chemistry may lead to low attitudes. In order to determine the difference in the means for the school types, one-way analysis of variance (ANOVA) test was performed. The SPSS output results are shown in table 4.13.

Table 4.13 Analysis of variance (ANOVA) results for school types

Source	df	Sum of squares	Mean squares	F-ratio	F-prob
Between groups	2	661.5427	330.7713		
Within groups	383	4870.1284	12.7157	26.0128	0.0000*
Total	385	5531.6711			

*Significant at 0.05

From table 4.13, it can be observed that the F-value 26.0128 (P>0.0001) is significant. Thus, there was a significant difference in the mean scores between boys' and girls' school types. The boys' schools performed significantly higher (12.1691) than the girls' schools (9.3611). They also show that there was a significant difference in the mean scores between the girls' (9.3611) and mixed school types (9.6196). This significant difference in the performance could be attributed to the 'school hypothesis'. Chemistry may be presented in schools in a way more suited to boys than to girls. In addition, the masculine image of Chemistry may have been perpetuated in the schools, as 81.7% of the teachers were predominantly male. Also availability of resources and teacher quality could also account for these differences.

4.4.3 Item – specific Differences

Though gender differences were found in Chemistry achievement, these were measured using a core test. This, implicitly, excludes another likely source for the manifestation of gender differences namely the gender specifity of the individual test items. As could be expected from related research, boys appear to respond differently to certain questionnaire items than girls (Erickson and Erickson, 1984). Hence, in the following attention will be given to shed some light on the aspect of item – specific differences in Chemistry achievement.

It has been shown that gender differences vary between school types. Thus, it is safe to infer that gender differences even exist at the level of the individual items. It can be hypothesized that boys and girls score differently on different items or, in other words, the item specificity accounts for gender disparities as the content of an item may 'appeal' to boys in a different way than to girls.

However, this study does not focus on identifying possible patterns among items, which effect boys' and girls' chemistry achievement differently. While this could be a worthwhile research topic in its own right, in this study the emphasis is placed on explaining the observed gender differences in Chemistry achievement with Chemistry achievement as the composite of Chemistry sub scores.

It is considered of value to illustrate the existence of gender differences with the three items in the CHAT.

Table 4.14 Analysis of students' performance on Achievement Test

Item characteristics	Item One	Item two	Item three
% Correct	80.52	50.25	43.26
% Incorrect	19.48	49.75	56.74

% Absolute gender difference	18.9	32.50	26.75
Item easier for…	♀	♂	♂

Notes:

♂boys

♀ girls

% Correct presents the percentage of students who wrote the correct answer category. Likewise, the percentage of students giving incorrect answer is given as % incorrect. The % absolute gender difference is the percentage difference between boys and girls scoring the right answer while the direction of this difference is indicated by ♂(more male students score correctly than female students) or ♀(more female students score correctly compared with male students).

From Table 4.14, it can be observed that students performed well in majority of the questions. Item 3 was poorly done. 43.26% of the students managed to answer it correctly. The item tested on the spatial ability of the learners. Spatial ability continues to be the intellectual area in which the strongest and most consistent significant sex differences are found (Haertel, 1981). Item one on the other hand was well done with 80.52% answering the question correctly. Item one was a relatively difficult one for the boys and it tested on the verbal or descriptive ability of the learners. Girls performed better on this item, which could be attributed to their superiority in verbal ability (Maccoby and Jacklin, 1974).

50.25% of the students managed to get item two right. The item tested on the mathematical ability of the learners. From research, mathematical ability is highly related to Science achievement (Fleming and Malone, 1983). From the above examples, it can be concluded that there are considerable differences in the scores of boys and girls at the item level.

4.5 Evaluation of major findings (Discussion)

It became apparent that gender differences varied between the student level and the different types of schools.

(a) Student-level factors

From the analysis of the student level factors it was possible to see the importance of chemistry-related attitudes in their effect on chemistry achievement in the schools investigated. The findings suggest that gender-typed attitudes were, indeed, conditional for gender differences observed in Chemistry achievement. Here, similar findings from the analysis of the educational system in Botswana made by Duncan (1989) were found to hold true. Further to this, the analysis presented in this thesis lent support to the statement, also made by Kotte 1992, that teaching and school factors were less influential on Chemistry achievement.

(b) Teaching and school variables

Teaching experience and qualification, sex of teacher, availability of science laboratories and associated resources were of little effect on chemistry achievement. This underlines similar results from the FISS and SISS studies made by Kotte (1992).

(c) Achievement in chemistry

The finding that gender differences in Chemistry achievement were, in general, always in favour of boys underlined similar results from the FISS and SISS studies made by Kotte (1992). This finding also underlines similar results from the FISS study made by Comber and Keeves (1973). The boys also performed significantly higher than the girls in the mathematical and spatial ability items while girls performed significantly higher than boys in the descriptive ability questions. These findings are in line with findings of Maccoby and Jacklin (1974) who found gender differences at various age levels in verbal skills, commonly in favour of the girls. Male superiority in performance on tasks involving mathematical and spatial ability has also been documented (Maccoby and Jacklin, 1974).

Boys' schools also performed better then girls' schools. Kelly, in her research on the effects of co-educational versus single sex education using data from the FISS study, summarized that " the proposition that girls achieve better in science in girls – only schools than in co-educational schools must be rejected" (1978, p.70). These results are in support of her findings.

4.6 Chapter summary

This chapter has presented the data, analyzed, interpreted them and discussed the results in relation to the set research objectives. The main general finding was that gender differences in chemistry achievement were identified. In all instances female students were clearly disadvantaged. Specifically, the following results were found related to gender differences in chemistry achievement.

- While chemistry achievement varied considerably between the boys and girls, in nearly all instances female students are clearly disadvantaged. Boys performed better than girls in mathematical and spatial ability tests. On average, boys had a stronger affinity and interest towards chemistry.
- Gender was strongly associated with chemistry achievement.
- Teacher and school factors were of little effect on chemistry achievement.
- One possible reason why girls score lower marks in Chemistry National examinations than boys is because of the negative attitude they tend to have towards the subject.
- Performance of girls in chemistry could be improved by encouraging girls to take part in chemistry related experiences on their own.

  The next chapter (chapter V) presents the summary, conclusion and

  recommendations arising from data analysis.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS.

5.0 Introduction.

After an introduction to the issue of gender differences in science education and chemistry achievements (chapter 1), the current state of research was described from which the specific research questions were derived and postulated (chapter 2). The research methodology, (chapter 3) as well as presentation, analysis and interpretation of data has also been discussed (chapter 4).

This chapter gives a summary of the findings after which conclusions, recommendations and suggestions for further additional research are made.

5.1 Summary of the research findings

The findings were summarized in an effort to achieve the study objectives. The study revealed the following findings that are summarized as per the research objectives.

5.1.1 Student – level variables

Consistent and sizeable gender differences were detected across the five attitude scales examined. It was the boys who voiced a stronger acceptance of Chemistry. Boys were more interested in Chemistry, found learning chemistry related tasks easier, showed a more pronounce interest in starting a career in Chemistry On average; boys had a stronger affinity and interest towards chemistry and rated Chemistry to be more beneficial than their female classmates. It would therefore appear justified to summarize that on overage, boys had a stronger affinity and interest towards Chemistry. This agrees with Comber and Keeves (1973) who found that males have more positive attitudinal orientations towards the physical sciences. Kelly (1981) also, proposed the ‘attitude hypotheses. Girls perform less well than boys in science because girls have less favorable attitudes towards science.

5.1.2 Teaching and school variables

(i) Teacher and school factors (e.g. teaching experience and qualification, sex of teacher, availability of science laboratories and associated resources) were of little effect on chemistry achievement.

(ii) Teachers cited the following reasons as being strongly associated with girl's poor performance in chemistry national examinations. They include; girls' fear the subject chemistry, girls do not have enough time for homework in chemistry and other subjects due to household duties, girls do not like doing experiments, writing practical reports and do not ask questions in class when they do not understand.

(iii) General ability was another main predictor of success in chemistry. It is for this reason that teachers considered the following factors that enhance general ability as important solutions to improving girls performance in chemistry: give girls opportunities to take part in science fairs, exhibitions and competitions, encourage them to do more experiments and give them more homework.

5.1.3 Achievement in Chemistry

(i) Gender had a remarkably intense effect on chemistry achievement with gender differences favouring the boys still substantial (mean of boys = 13.15 and mean of girls = 12.10). As a result, gender was strongly associated with chemistry achievement ($r = 0.9880$, $\alpha > 0.001$). The finding that gender differences in Chemistry achievement were, in general, always in favour of Boys or male – dominated classes underlined similar results from the FISS study made by Comber and Keeves (1973).

(ii) There was a significant difference between gender and students' performance in chemistry. The boys performed significantly higher than the girls in the mathematical and spatial ability items while girls performed significantly higher than boys in the descriptive ability questions.

(iii) There was a significant difference in the performance of chemistry achievement test (CHAT) between school types. Boys' schools performed better then girls' schools.

5.2 Conclusion

From the aforementioned findings it can be concluded that there, is a positive correlation between students' gender and achievement in chemistry.

5.3 Recommendations of the study

The study therefore recommends that:

i. Since there is a positive relationship between gender and achievement in chemistry, steps should be taken to prevent achievement differences in chemistry as well as gender differences from being established at an early stage within the process of formal schooling. As was shown, gender differences in chemistry achievement apparently 'increase' during schooling, meaning that measures need to be taken as early as possible, probably already in primary education, which aim at the suppression of factors known to lead to the establishment of gender differences in chemistry achievement. It would be desirable to implement strategies in the curriculum as well as in the pre-and service training, which would help to reduce gender differences.

ii. Educational planners, however should note that it would seem legitimate to recommended that students, parents, and teachers be made more aware that although boys and girls apparently held gender- typical attitudes towards chemistry there was no evidence for the assumption that boys and girls could not achieve equally well in science. Carrying this statement further, it would be unwise to apply different educational measures separately to boys and girls in school hoping to reduce gender differences. Even if boys were found to hold more positive attitudes towards chemistry, this does not necessary mean that it would be wise to develop female- specific strategies aimed at stimulating the girls' attitudes towards chemistry or teaching girls separately from boys.

iii. The Kenya National Examinations council and other examination bodies should take into account the issue of gender differences in setting chemistry items.

iv. The Kenya institute of Education, chemistry authors as well as chemistry teachers should design chemistry textbooks devoid of any gender – typical behavior or gender bias.

5.4 Suggestions for further research.

- Since the sample respondents were drawn from some selected public secondary schools in Kakamega district of western province, the effects found may mainly reflect the situation in the district. Hence, the findings may not be representative of all secondary schools in Kenya. Thus, this study needs to be replicated in other parts of Kenya in order to get a better general picture of the whole country. This will facilitate better decision-making as regards relationship between gender and achievement in chemistry.
- The study evaluated on the aspect of gender differences in students' achievement in chemistry. Another study can be carried out to investigate gender differences in mathematics, biology and physics achievement

BIBLIOGRAPHY

Cohen, L and Manion, L. (1994). **Research Methods in Education**, 4th Ed. London: Routledge

Comber, L.C. and Keeves, J.P. (1973) **Science Education in Nineteen Countries**. **International Studies in Evaluation** 1. Almqvist and Wiksell, Stockholm.

Cooksey, D. (1981) **Social class and academic performance: a Cameroun case study. Comparative Education Review**, Vol. 25, No. 3, pp. 403-418.

Davidson, J.(1970). **Outdoor Reaction Surveys: The design and use of questionnaires for site surveys.** London: Countryside commission.

Duncan, W. (1989) **Engendering School Learning. Science Attitudes and Achievement Among Girls and Boys in Botswana. Studies in Comparative and International Education, No. 16. Institute on International Education,** University of Stockholm, Stockholm.

Dunkin. M. J. (1985) **Teacher Sex and Instruction. International Encyclopedia of Education,** pp 5032-5035. Pergamon press, Oxford.

Erickson, G. L. and Erickson, L. J. (1984) **Females and Science Achievement:**

Evidence, Explanations, and Implications. Journal of Science Education, Vol. 68, No2, pp 63-89.

Eshiwani, G.S. (1984) **Factors influencing performance among Primary and secondary school pupils in Western province of Kenya:** A policy study. Kenyatta University.

Eshiwani, G.S (1993) **Mathematics education in Kenya since independence.** East African Publishers, Nairobi.

Fennema, E. and Sherman, J. (1977) **Sex-Related Differences in Mathematics Achievement, Spatial Visualization and Affective Factors.** American Educational Research Journal, Vol.14,pp 51-71.

Fennema, E. and Sherman, J.(1978) **Sex Related Differences in Mathematics Achievement and Related Factors: A further Study.** Journal for Research in Mathematics Education, Vol.9,pp.189-203.

Finn, J. D. and Kotlewski, L. and Reis, J. (1979) **Sex differences in educational attainment:A cross-national perspective.** Harvard Educational Review, Vol. 49.11pp.477-503.

First International Science Study. 1973.

Fleming, M.L. and Malone, M.R. (1983) **The relationship of student characteristics and student performance in science as viewed by meta-analysis research.** Journal of Research in Science Teaching, Vol.20,pp.481-495.

Gay, L (1992). **Educational research. Competencies for Analysis and Application.** 4th

Edition. New York Macmillan

Haertel, G.D Walberg, H.J, and Pascarella, E.T. (1981) **Early adolescent sex difference in science learning: Evidence from the National Assessment of Educational Progress (NAEP).** American Educational Research Journal, Vol.18 No. 10, pp.329-341.

Heynemann, S. P. and Loxley, W. A (1982) **Influences on academic achievement across high and low income countries, a reanalysis of IEA data. Sociology of Education,** Vol.55, No. 1, pp. 13-21.

Husen, T.(ed.) (1967) **International Study of Achievement in Mathematics. A comparison of Twelve Countries.** Volume 11.Almqvist and Wiksell, Stockholm.

Husen, T. (1989) **Talent, Opportunity and Career.** Volume 11. Almqvist and Wiksell, Stockholm.

IEA **(International Association for the Evaluation of Educational Achievement) (1988) Science Achievement in Seventeen Countries.** A preliminary Report. Pergamon Press Oxford.

Kakonge, E. (2000). **"Gender differences in Science subjects in Secondary schools in Kenya.An investigation of entries, attainment and teachers perspectives'.** Paper presented to the Women Educational Researchers of Kenya (WERK) Association meeting held at the Kenya Safari Club on 3rd November 2000.

Keeves, J.P. (1991) **Changes in Science Education and Achievement,** 1970 – 1984. Pergamon Press, Oxford.

Keeves, J.P. and Kotte, D. (1991) **Sex Differences in Science Education:** 1970 to 1984.

Keeves, J. P. (1988) **Sex Differences in Ability and Achievement**. Allmqvist and Wiksell, Stockholm.

Keeves, J.P. (ed.) **Changes in Science Education and Achievement,** 1970 – 1984. Pergamon Press, Oxford.

Keeves, J.P. and Saha, L.J. (1991) **Home Background Factors and Education Outcomes.**

Keeves, J.P. (ed.) **Changes in Science Education and Achievement,** 1970-1984. Pergamon Press Oxford.

Kelly, A. (1978) **Girls and Science. An International Study of Sex Differences in School Science Achievement.** International Association for the Evaluation of Educational Achievement, IEA Monograph Studies No. 9. Almqvist and Wiksell, Stockholm.

Kelly, A. (1981) **The missing half. Girls and Science Education.** Manchester University Press, Manchester.

Kenya National Examinations Council (1995). 1993 and 1994 KCSE Chemistry Report, Nairobi: KNEC.

Kroeger, J.E. (1990) **An Investigation of the Effects of a Non-Sexist Curriculum on One Preschool Groups Sex-Role Stereotypical Behaviour.** ERIC database, ref. ED320688

Kotte, D. (1992) **Gender Differences in Science Achievement in 10 countries,** 1970/71 to 1983/84

Lau, M. Y. (1986) **The relationship of parental attitudes and of the socio-economic status of students to students' attitude towards mathematics.** Unpublished M. Ed.Dissertation, University of Hong Kong, Hong Kong.

Levy, J. and Levy, J.M. (1978) **Human Lateralization from head to foot: Sex-related factors Science,** Vol. 200, pp. 1291-1292.

Maccoby, E.E. and Jacklin, C.N. (1974) **The Psychology of Sex Differences.** Stanford University Press, Stanford, C.A.

Mugenda, O.M. and Mugenda, A.G. (1999) **Research Methods: Qualitative and Quantitative Approaches.** Nairobi; Act Press.

Ormerod, M. B. and Duckworth, D. (1975) **Pupils' Attitudes to Science:** A Review of Research. National Foundation of Educational Research, Slough, England.

Orodho, A.J. (1996). **Factors determining achievement in Science Subjects at Secondary School level in Kenya.** Unpublished Ph. D thesis KU (BER)

Postelthwaite, T.N. and Wiley, D.E. (1991) **Science Achievement in Twenty- Three Countries,** Pergamon Press, Oxford.

Robitaille, D. F. and Garden, R. A. (eds.) (1989) **The IEA Study of Mathematics II: Contexts and outcomes of School Mathematics.** Pergamon Press, Oxford.

Rosier, M. J. and Keeves, J.P. (1991) **Science Education and Curricula in Twenty – Three countries.** Pergamon Press, Oxford.

Rukangu, S.M. (2000). **"Pupils development of Spatial ability in Mathematics"; An issue of learning environment in selected secondary schools in Kenya.**

Kenyatta University, Ph. D. Thesis, unpublished.

Sattler, J.M. (1988). **Assessment of children,** 3rd ed. San Diego: Jerome M. Sattler, Publisher

Silver, P. (1985) **Sex Equity in Educational Employment.** Husen, T. and Postelthwaite, T. N. (eds) International Encyclopedia of Education, pp. 4550-4555. Pergamon Press, Oxford.

Sudman, S. (1976). **Applied sampling.** New York: Academic Press

Sperry, R.W. (1961) **Cerebral organization and behaviour.** Science, Vol. 133,pp. 1749-1757.

Steinkamp, M. W. and Maehr, M. L. (1984) **Gender differences in motivational orientations toward achievement in school science: A quantitative synthesis**. American Educational Research Journal, Vol. 21, pp. 39-59

Twoli, N.W. (1986) **Sex Differences in Science Achievement among secondary school students in Kenya.** Flinders University, South Australia, Unpublished ph. D Thesis.

Walberg, H.J. (1991) **Improving School Science in Advanced and Developing Countries.** Development Psychology, Vol. 1.pp.47-54.

APPENDIX A

CHEMISTRY ACHIEVEMENT TEST (CHAT)

INSTRUCTIONS: ANSWER ALL QUESTIONS IN THE SPACES PROVIDED.

TIME: 45 MINUTES

1. Starting with copper; metal describe how a solid sample of copper (II) carbonate can be prepared. (3marks)
2. In an experiment; ammonium chloride was heated in a test-tube. A moist red litmus paper placed at the mouth of the test tube first changed blue then red. Explain these observations (3mks)
3. An organic compound of 84.90% carbon and 15 .10% hydrogen. Its vapour density is 35. Calculate the molecular formula of the compound. (4 mks)
4. An analysis of a sulphide of copper gives the following results.

   Mass of copper = 1.0g (relative atomic mass 64)

   Mass of sulphur = 1.0g (relative atomic mass 32)

   Derive the correct formula of the sulphide. (3 marks)

5. Atom A has 4 electrons in its outer shell and atom B has 7 electrons in its outer shell.

a) Which type of bond are A and B most likely to form when they combine?

b) Using the outer electrons, sketch the structure of the 'molecule' of the compound formed between A and B.

c) Give the formula of the compound in terms of A and B.

d) Would you expect the compound in aqueous state to be an electrolyte?
Give a reason.

APPENDIX B

CHEMISTRY TEACHERS QUESTIONNAIRE ON GENDER DIFFERENCES IN CHEMISTRY ACHIEVEMENT.

INTRODUCTION

Girls' participation and performance in science education is a powerful determinant of national economic development and social well-being (Kotte, 1992). Chemistry is one of the key science subjects used for selective advancement in the education system in Kenya. Unfortunately, there seem to be a gender gap in participation and performance in Chemistry. This study hopes to identify some of those factors, which influence achievement in school Chemistry with a view to suggesting intervention strategies where they warrant. To help in doing this, I request you to fill in this questionnaire as honestly as you can. The information you give will be kept confidential and will be used for this study only. Thank you in advance.

SECTION 1: BACKGROUND INFORMATION.

1. Name of school……………………………………………………………………
2. Gender (i) female ☐ (ii) Male ☐one)
3. Type of the school

   Boys ☐ Girls ☐ Mixed ☐

4. Professional Qualifications:

   (i) B.E.D ☐

   (ii) B.S.C ☐

   (iii) DIP ED ☐

   (iv) S.I ☐

(v) Other (specify)

5. Number of years of teaching experience

6. What other classes do you teach chemistry?

Form 1 Form 2 Form 3 4

7. Number of science laboratories in your school.

1 2

8. Main resources you use when teaching chemistry.

Text books [ ] charts [ ] models [ ]

SECTION II: QUESTIONS

a) Girls generally score lower marks in Chemistry National Examinations than boys.

Below are some of the reasons given for this. Against each reason are letters SA (for Strongly Agree); **A** (for Agree) **NS** (Not Sure), **D** (for Disagree); and **SD** (for Strongly Disagree). Tick the appropriate box.

REASONS	**SA**	**A**	**NS**	**D**	**SD**	
9. Girls fear chemistry						
10. Girls do not think chemistry is important for their future						
11. Because of household duties girls do not have enough time for homework in chemistry.						
12. Girls don't like performing experiments.						
13 Girls do not like writing practical reports after experiments and observations.						
14. Girls do not ask questions in class when thy don't understand.						
15. Girls are not very good at practical Chemistry						

16. Girls are brought up to believe that chemistry is for boys

17. Girls do not like setting up experiments

19. The teaching approaches used do not help girls to understand chemistry

20. Girls are less determined than boys in solving difficult Problems on their own.

21. Girls are less intelligent than boys

22. Girls do not like handling apparatus, tools and equipment

23. Girls fear mathematics and chemistry involves a lot of Calculations.

24. Poor previous foundation in science is responsible for Poor performance of girls in chemistry.

25. Girls are generally lazy than boys.

26.Writing balanced equations is a problem to girls than boys.

27.Complicated formulae make girls to despair in chemistry

28. Girls are as hardworking as boys.

29.Girls enjoy practical work.

b) Below are 10 statements on how the performance of girls in chemistry could be improved. Rank the statements in order of importance by writing the numbers 1 to 10 in the boxes. For example, write 1 for the statements you think is the **MOST IMPORTANT** and 10 for the **LEAST IMPORTANT.**

☐ Make the content of the Chemistry syllabus more relevant to the needs of girls.

☐ Make Chemistry teaching related to the everyday experiences of girls (cooking, farming e.t.c)

☐ Encourage girls to do more experiments.

☐ Give girls more homework, exercises and tests

☐ Group girls with boys when teaching Chemistry in mixed schools.

☐ Give girls opportunities to take part in science fairs, exhibitions and competitions.

☐ Give girls more information on how Chemistry will be useful in their life after school.

☐ Use more teaching aids when teaching Chemistry.

☐ Make teaching aids when teaching Chemistry.

☐ Make teachers appreciate the differences that girls and boys bring to the learning of Chemistry.

☐ Training teachers to cater for the needs of girls in the learning of Chemistry.

APPENDIX C

ATTITUDE SCALE FOR STUDENTS (AS)

Instructions

We are interested in how you feel about the Chemistry you are doing at school. Answer the questions as honestly as possible. Your answers will be used for this research only and no other person will see it.

Section 1: Personal and general information.

1. Name of your school………………………….. Your class………………………………..

2. Type of school: Boys ☐ Girls ☐ Mixed ☐

3. Sex: 1. Girls ☐ 2. Boys ☐

4. Do you get private tuition in Chemistry?

   Yes. ☐ No. ☐

SECTION II

Read the following statements about Chemistry. Against each statement are letters **SA** (for Strongly Agree), **A** (for Agree), **NS** (for Not Sure), **D** (for Disagree) and **SD** (for Strongly Disagree). Tick the right letters depending on what you feel about each statement.

a) Interest in Chemistry

5. I like Chemistry

[SA] [A] [NS] [D] [SD]

6. Chemistry is an enjoyable school subject

[SA] [A] [NS] [D] [SD]

7. The Chemistry taught at school is interesting.

[SA] [A] [NS] [D] [SD]

8. The teacher makes Chemistry lessons interesting.

[SA] [A] [NS] [D] [SD]

b) Ease of learning Chemistry

9. Chemistry is a difficult subject.

[SA] [A] [NS] [D] [SD]

10. Chemistry is difficult when it involves calculations.

[SA] [A] [NS] [D] [SD]

11. Chemistry is difficult when it involves handling of apparatus.

[SA] [A] [NS] [D] [SD]

12. There are too many facts to learn in Chemistry.

[SA] [A] [NS] [D] [SD]

c) Career interest in Chemistry

13. Working in a Chemistry laboratory would be an interesting way to earn a living.

[SA] [A] [NS] [D] [SD]

14. In the future most jobs will require knowledge of Chemistry.

[SA] [A] [NS] [D] [SD]

15. People who understand Chemistry are better off in society.

[SA] [A] [NS] [D] [SD]

16. It is important to know Chemistry in order to get a good job.

[SA] [A] [NS] [D] [SD]

17. In my future career I would like to use the Chemistry I learned at school.

[SA] [A] [NS] [D] [SD]

d) Beneficial aspects of Chemistry

18. Chemistry is useful for solving the problems of everyday life

[SA] [A] [NS] [D] [SD]

19. Chemistry is very important for a country's development.

[SA] [A] [NS] [D] [SD]

20. Money spent on chemistry is well worth spending.

[SA] [A] [NS] [D] [SD]

21. Scientific inventions improve our standards of living

[SA] [A] [NS] [D] [SD]

22. Chemistry will help to make the world a better place to live in.

[SA] [A] [NS] [D] [SD]

e) Non-Harmful aspects of Chemistry

23. Chemistry has ruined the environment.

[SA] [A] [NS] [D] [SD]

24. Much of the anxiety in modern society is due to Chemistry.

[SA] [A] [NS] [D] [SD]

25. Scientific inventions have made the world too complex

[SA] [A] [NS] [D] [SD]

26. Science and technology are the cause of many of the world's problems.

[SA] [A] [NS] [D] [SD]

SECTION III

27. What would you like to be when you leave school? Tick one

Teacher ☐

Lawyer ☐

Nurse ☐

Doctor ☐

☐

Politician

Engineer ☐

APPENDIX D:

LIST OF PUBLIC SECONDARY SCHOOLS IN KAKAMEGA DISTRICT AS AT 25/01/2010.

1. Kakamega Boys
2. Matende Secondary
3. Shieywe Secondary
4. Bishop Sulumeti Girls
5. Shikomari Secondary
6. Shikoti Mixed
7. Shikoti Girls
8. Ebuchinga Secondary
9. Ebinzo Secondary
10. Eshisiru Secondary
11. Indangalasia Secondary
12. St. P. Emulaha
13. Ematiha Secondary.
14. Matioli Secondary
15. Shibeye Secondary
16. Ingotse Boys.
17. Shinoyi Secondary
18. Shanjero Secondary
19. Shipalo Secondary
20. Malimili Secondary
21. Shabwali Secondary
22. Shidodo Secondary
23. Shagungu Secondary
24. Lugala Secondary
29. Handidi Secondary
30. Shandereme Secondary
31. Mukhuru Secondary
32. Lunyu Secondary
33. Sidikho Secondary
34. Lusumu Secondary
35. Sivilie Secondary
36. Lutaso Secondary
37. Navakholo Secondary
38. Namundera Secondary
39. Namirama Girls
40. Sisokhe Secondary
41. Chebuyusi Boys
42. Shichinji Secondary
43. Musingu Boys
44. Eregi Girls
45. Shitoli Secondary
46. Lirhembe Academy
47. Lirhembe Girls
48. Lusiola Secondary
49. Musali Secondary
50. Shikunga Secondary
51. Bushiangala Secondary
52. Makhokho Secondary

25.	Museno Secondary	53.	Musoli Girls
26.	Mukhonje Secondary	54.	Shimanyiro Secondary
27.	Lirhanda Girls.	55.	Imbale Secondary
28.	Shibuye Girls.	56.	Imalaba Secondary.
57.	Shivagala Secondary	60.	Mahira Secondary
58.	Shikokho Secondary	61.	Tombo Secondary
59.	Lugusi Secondary.	62.	Malava Girls

Source: PDEs, Office, Kakamega