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**INVESTIGATION INTO FACTORS INFLUENCING STUDENTS' POOR
PERFORMANCE IN SECONDARY SCHOOL CHEMISTRY:
A CASE OF NYAMAIYA DIVISION IN NYAMIRA DISTRICT, KENYA**

BY

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**A Research Project Report Submitted to the School of Education
Management, Policy and Curriculum Studies in Fulfilment of the
Requirements for the Award of the Degree of Master of Education
(Curriculum Studies) of Kenyatta University**

Nyang'ai, Ndemo
*Investigation into
factors influencing*



2010/346992

JUNE, 2010

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DECLARATION

This research project is my original work and has not been presented for a degree in any other university.



29/06/2010

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This master of education research project report has been submitted with our approval as university supervisors.



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ACKNOWLEDGEMENTS

My appreciation and gratitude goes to all individuals and institutions who gave great support, advice, guidance, cooperation and encouragement that helped make this project work to be accomplished successfully.

First, I wish to thank the almighty God for providing me with the gift of life, good health, resources and knowledge that were a necessity in carrying out this study right from its beginning to the end.

Secondly, I am grateful to Kenyatta University for giving me the opportunity to pursue this Masters degree course at the institution.

Thirdly, my gratitude goes to Dr. Onyango George and Dr. John Aluko Orodho of the School of Education Management, Policy and Curriculum Studies of Kenyatta University who were my research project supervisors for their time that they spent in giving me the academic advice and guidance on the technicalities that necessitated the carrying out of this research project.

Next, I sincerely thank the headteachers, teachers and students of the respondent schools in Nyamaiya Division in Nyamira District that participated in the study.

I also appreciate the efforts of my parents, brothers and sisters they made in assisting me financially and for the moral support they gave me throughout the entire period of the study.

My gratitude also goes to all my friends and colleagues with whom we shared valuable knowledge in proposal writing, data collection, analysis and report writing. On this particular issue I give special thanks to Ginn Abere Mecha for his tireless effort in helping me in the analysis of the collected data.

Finally I wish to thank my brother Alfonse Mosomi for neatly typing this work and proof reading this report.

I would wish to absolve all individuals and institutions mentioned in this report from any errors of omission or commission, or any interpretational error(s). For these, the researcher remains solely responsible.

DEDICATION

This work is dedicated to Mr. James Ndumu Nyong'o's entire family.

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ABBREVIATIONS AND ACRONYMS

BED	Bachelor of Education
BOG	Board of Governors
BSc	Bachelor of Science
CAT	Continuous Assessment Test
CHEM	Chemistry
CV	Curriculum Vitae
etc	et cetera
HOD	Head of Department
JICA	Japanese International Cooperation Agency
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
KIE	Kenya Institute of Education
KNEC	Kenya National Examinations Council
Kshs	Kenyan Shillings
LTD	Limited
MATH	Mathematics
NGO	Non – Governmental Organization
No.	Number
‘O’ Level	Ordinary Level
PGDE	Post Graduate Diploma in Education
QAS	Quality Assurance and Standards
SI	Standard International
SEMAS	Soroban Education for Mental Arithmetic System.

SMASSE	Strengthening of Mathematics and Sciences for Secondary Education
SPSS	Statistical Package for Social Sciences
TSC	Teachers Service Commission

ABSTRACT

Chemistry is one of the science subjects that is poorly performed by students in Nyamaiya Division in Nyamira District. The main purpose of this study was to identify and analyse some of the factors influencing students' poor performance in chemistry in Nyamaiya Division in Nyamira District. As for the purpose of the inherent problem the specific objectives of this study were: to find out the students' attitude towards chemistry, to establish the chemistry teachers' qualifications, to analyse the availability and use of chemistry teaching and learning resources, to identify the methods of teaching used by the chemistry teachers, and to determine the effect of concepts from chemistry related subjects used in some chemistry topics on students' performance in chemistry in Nyamaiya Division in Nyamira District. Stratified sampling was used to select the schools to constitute the sample while simple random sampling was used to select the student respondents. Six (100%) chemistry teachers and 66 (100%) form four students participated in the study. Questionnaires for teachers and students were used to collect data. The data collected were organized and summarized using tables, pie charts and bar graphs. The data was then analysed and interpreted using descriptive statistics which involved the use of frequencies, mean and mode. The SPSS computer programme was used to analyse the data. The study revealed that although most students considered chemistry to be a difficult subject, their attitude towards it considering its importance in society was positive. Poor performance was found to be as a result of inadequate chemistry teaching and learning resources, inadequate staffing for the subject with qualified and experienced chemistry teachers and laboratory technicians, and also poor performance in chemistry related subjects such as mathematics since chemistry requires a wide range of application of mathematical concepts such as drawing and interpreting graphs as well as use of mathematical tables and calculators in some topics such as gas laws, the mole, energy changes, radioactivity, thermochemistry, reaction rates among others. Therefore to

improve students' performance in chemistry it was recommended that all educational stakeholders, that is, education policy makers in the Ministry of education, KNEC staff, education officers at all levels, school administrators, teachers, parents and students should combine efforts in order put in place mechanisms such as availing adequate chemistry library and laboratory resources, employing qualified laboratory technicians to reduce the few available chemistry teachers' workload for effective teaching, orienting newly employed teachers by those who have been teaching in the schools for some time, exposure of students to more practical work, organizing regular workshops for chemistry teachers especially those facilitated by chemistry examiners, ensuring efficient procurement systems, regular appraisal by headteachers to motivate teachers to work harder, teamwork among science and mathematics teachers to help students on areas that overlap in their subjects, encouraging the poorly performing schools to learn from well performing schools, and regular inspection of schools by the QAS officers. These can help to reduce or eliminate the factors influencing students' poor performance in chemistry in Nyamaiya Division in Nyamira District and extend this to the entire district and the whole country in general.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Science subjects like Chemistry, Physics and Biology are very important in the society. Chemistry is very fundamental in many areas hence done by many students in schools. Many materials around us for instance plastics, fertilizers, tyres, detergents, soaps, perfumes, glass, insecticides, furniture, cloth, building materials, paper, tooth paste, food and many more are the result of one chemical process or another. Chemistry has contributed a lot to modern technology. Through laboratory experiments, chemists have discovered new materials and the chemical processes to produce them in industries. (Ngaruiya et al, 2004).

The application of chemistry has resulted in the development of chemical industries to manufacture a wide variety of goods, which are helpful to man. Common examples of such industries include: petroleum industry, iron and steel industry pharmaceutical industry just to mention a few. People who specialize in chemistry find employment in chemical industries, in medical laboratories and as chemistry teachers. (Muchiri and Maina, 2006)

In Kenya a lot of emphasis has been put on science. The 8-4-4 Curriculum involves preparing pupils for the world of science and technology. Chemistry is a practical subject which equips students with concepts and skills that come in handy in solving the day to day problems in life. Chemistry aims at providing the learner with the necessary

knowledge for the benefit of an individual in their day to day life and for further education. At secondary school level, these aspects are recognized to sharpen the students' practical skills. (Muange, 2004)

Practically everything we use has been transformed from a natural state of little or no utility to one of very different appearance and much greater utility. The process by which natural materials are transformed and a detailed description of such changes is what chemistry is all about. Although chemistry is only part of the production process, it contributes to a very large extent in transforming raw materials to more usable goods.

An understanding of the environment and the changes which are possible in it is an indispensable goal of education. Such an understanding is necessary if the consequences of our actions on the environment are to be known. For instance it is important to know the effect of careless disposal of waste materials as there some which are non – biodegradable for example plastic materials, or some effluents discharged into the environment and washed into water bodies by rain water resulting in water pollution. This can seriously affect human life as well as marine animal and plant life. (Kariuki and Chege, 2006)

Since life involves the use of very small parts of the many materials in man's immediate environment working and fitting together in sequences of changes, everyone has a personal reason for valuing knowledge of such a process to be able to understand how the materials have been manufactured and how they can be improved for a variety of uses and their effect on man's environment.

Chemistry being a practical oriented subject, it requires certain facilities as part of the ordinary tools available to facilitate the teaching and learning of the subject. The facilities include laboratory chemicals and apparatus, textbooks, qualified teachers among others.

In the process of a student's effort to understand properly the processes involved in chemistry, it is necessary for him/her to go through a sequential learning process. The student has to have a clear understanding of the basic chemistry principles and concepts which are done at secondary school level before he/she can proceed to higher levels of learning like universities or other technical institutions.

According to the Ministry of Education's Secondary Chemistry Syllabus (2002), the aims of teaching chemistry are:

- (i) To acquire a systematic body of chemical knowledge and develop an understanding of the concepts, principles, laws, theories and applications of chemistry
- (ii) To develop a scientific attitude
- (iii) To develop a range of skills important for scientific investigations and everyday life
- (iv) To stimulate curiosity, interest and enjoyment in chemistry through methods of inquiry and care for environment
- (v) To develop an understanding of the consequences of chemistry on humans and their environment.

According to the Ministry of Education's Secondary Chemistry Teachers' Handbook,

The general objectives of teaching chemistry are:

- (i) To select and handle appropriate apparatus for use in experimental work.
- (ii) To make accurate measurements, observations and draw logical conclusions from experiments.
- (iii) To observe and appreciate the need for safety precautions during experimental investigations.
- (iv) To understand and appreciate the use of chemical symbols and formulae in writing equations.
- (v) To use appropriate chemical terms and language in describing physical and chemical processes.
- (vi) To identify patterns in the physical and chemical behaviour of substances.
- (vii) To apply the knowledge acquired to promote positive environmental and health practices.
- (viii) To use the knowledge and skills acquired to solve problems in everyday life.
- (ix) To apply principles and skills acquired for technological and industrial development.
- (x) To acquire adequate knowledge in chemistry for further education and for training.

(Ministry of Education, 2006) – Secondary Chemistry Teachers' Handbook.

The difference between aims and objectives lies in the degree of specification with which the statements are made and the point of view from which they are stated. Rowntree (1986:44) defines an aim as a general statement of what the subject or course will achieve perhaps expressed in terms of what the teacher will be presenting to the learner.

In order to achieve the aims and objectives of teaching chemistry it becomes very necessary to consider some important factors such as students' attitude towards the chemistry subject, chemistry teachers' qualifications, chemistry teaching and learning resources, teaching methods used in chemistry, performance of students in other science subjects such as biology, physics as well as mathematics among others.

In order to evaluate whether students have learnt the basic chemistry principles and concepts in preparation for higher skills, students are examined by the Kenya National Examinations Council (KNEC) at secondary school level. For instance to study food science and technology at university, high school students should work hard in the sciences especially chemistry. This is why the Ministry of education is becoming very involved in the administration of the career guidance programmes which involve funding, establishment of effective communication systems, training of guidance and counselling teachers, assessment of performance among others in schools. (Lule and Gitau, 2009).

In the year 2005, a food microbiologist with the East African Breweries Ltd, said that good grades in science subjects are a good starting point for any student wishing to study science oriented courses like Food microbiology. Performance in Biology, Chemistry and Mathematics in Kenya Certificate of Secondary Education (KCSE) examination is a key determinant for admission into such courses at tertiary institutions.

According to the current secondary school curriculum, among the three science subjects; Chemistry, Biology and Physics, a student is supposed to select any two of the sciences or all the three depending on the student's ability and interest. However, in all secondary schools in Nyamaiya Division in Nyamira District, the school administrators/

headteachers have made Chemistry compulsory alongside with Mathematics, English and Kiswahili. Thus a student is left to make a choice between Biology and Physics or both in addition to Chemistry. It is the headteachers of the schools responsible for this decision because one of the roles of the headteachers is to interpret the curriculum to their staff, students and the community. (Ministry of Education Science and Technology, Republic of Kenya, 2003).

While releasing Nyamira District 2004 KCSE results analysis, the District Education Officer, noted that the district faced a myriad of challenges which required change of attitude and approach. Among such challenges was the general poor performance in core subjects especially mathematics and sciences.

For instance, in Nyamaiya Division, only three schools managed to attain a mean score of slightly above 4.0000 or a mean grade of D+ in Chemistry in the district in the year 2004. (Ministry of Education Science and Technology, 2005).

In the year 2005, only Physics registered improvement among the sciences. (Ministry of Education Science and Technology, 2006).

The schools which managed to attain the slightly above 4.0000 mean score are the old well established provincial boarding schools such as Nyansabakwa Boys High School, Nyamaiya Secondary and Masosa Secondary School in the division. 12 out of the 15 schools in the division registered a poor performance in Chemistry in the K.C.S.E examinations consistently in the years 2004, 2005 and 2006.

The 2006 K.C.S.E examination was not a true reflection of the district's performance because there were some registration irregularities and hence the examination results were withheld by the Kenya National Examinations Council. Out of the 156 schools in the district, only 30 schools had all their results released. Thus it made it necessary to use the 2006 K.C.S.E Mock Examination analysis in this study to indicate the level of performance in chemistry and mathematics for that year as shown Table 1.2.

The use of the 2006 K.C.S.E mock examination instead of the K.C.S.E examination was justified given that the results in the district's K.C.S.E mock examination were usually not significantly different from those of KNEC's K.C.S.E examination. For instance, from the 2005 analysis of the 2004 K.C.S.E examination, the top ten schools in the district were also the top ten in the district's K.C.S.E Mock examination with only one school just slightly displaced. On the same note, performance in Mathematics, English and Chemistry in KNEC's K.C.S.E remained dismal as in the district's K.C.S.E Mock Examination in the years 2004 and 2005.

The trends in the performance in Chemistry in the recent years for each school in the division can be used to justify the predicted likely low level of performance in the subject by form four students that participated in this study. Even when there was an improvement, it was only by a very small margin. The performance for some schools like Nyameru which at some stage seemed to improve now shows a downward trend from the K.C.S.E results of the past three years. In the year 2009, the school attained a mean standard score of 3.4166 in chemistry and 2.4720 in mathematics. In the same year, Rangeny Girls had a mean standard score of 2.7400 in chemistry and 1.9500 in

mathematics. The same trend is exhibited by Masosa secondary school. Some of the results are shown in Table 1.1.

Table 1.1: Showing KCSE Chemistry and Mathematics Results of Some Schools in Nyamaiya Division.

	YEAR →	KCSE 2007		KCSE 2008	
		CHEM	MATH	CHEM	MATH
1	ETONO	2.2400	1.6400	2.8261	2.7826
2	BOMORITO	1.9700	1.5200	2.0000	1.5200
3	KEMASARE	2.8235	1.9412	2.8372	2.6279
4	MASOSA	5.3520	3.4700	4.4130	3.6200
5	GETAARI	2.4200	1.6200	3.0180	2.4810
6	GIANCHORE	2.0610	1.3630	3.0000	1.9000
7	NYAMERU	4.5000	3.1110	4.3900	4.0000
8	GEKOMONI	2.4676	1.8561	2.7530	2.3510
9	EMBONGA	1.8000	1.1333	2.1670	1.4580
10	RANGENYO	3.2900	2.0500	2.9600	2.1500

Despite the large number of students who sit for the K.C.S.E Examination, only a few students qualify to proceed to higher levels in chemistry related career opportunities such as chemical engineering, veterinary, medicine, pharmacy, teaching sciences among others (Ngaruiya, 2004). This is because majority of the students do not attain the required standards to proceed to higher institutions of learning to pursue the chemistry related courses. Thus it became necessary to investigate the possible causes of poor performance in secondary school chemistry.

Table 1.1: Nyamaiya Division KCSE Analysis of Chemistry and Mathematics Performance

	YEAR→	KCSE 2002		KCSE 2003		KCSE 2004		KCSE 2005		KCSE MOCK 2006		KCSE 2006	
		SCHOOL	CHEM	MATH	CHEM	MATH	CHEM	MATH	CHEM	MATH	CHEM	MATH	CHEM
1	KEMASARE	3.4667	2.7556	3.9231	2.2391	2.3651	1.8254	2.3878	1.7755	1.7333	2.0000	2.6667	2.2593
2	GIANCHORE P.A.G	2.1515	1.5455	2.6471	2.1765	2.5263	2.0000	2.3036	1.3684	1.4857	1.6666	2.1818	1.7576
3	MASOSA	3.5000	2.8750	4.2245	3.0425	4.1964	2.8036	4.8095	2.2857	6.3404	4.0851	6.2340	3.9583
4	GEKOMONI	2.8310	2.0141	3.4615	2.5128	Y	2.0904	3.1223	1.8211	1.5070	1.3566	2.3017	1.5738
5	NYAMERU	3.4815	3.4815	4.0000	3.2069	3.8846	3.1538	3.6429	2.1071	3.7727	3.3181	4.5349	3.3182
6	RATETI	-	-	2.7059	1.6471	2.7600	2.0400	2.8710	2.0968	3.7000	4.2500	4.0000	3.0562
7	EMBONGA	1.8542	1.3673	2.2679	1.6786	2.8909	1.8182	2.4878	1.4048	1.1904	1.0952	1.6364	1.2727
8	GETAARI	3.2105	2.5658	3.5938	2.5781	Y	Y	2.3214	1.7857	1.6595	2.0212	2.1739	1.7955
9	NYAMAIYA	3.8333	2.2075	3.0488	2.5366	3.9655	2.6897	4.7813	2.7188	4.4761	3.9130	5.5652	3.6521
10	ETONO	2.4444	1.7778	Y	Y	2.4545	1.8636	2.7619	1.7143	1.2400	1.2000	1.8400	1.6400
11	BOMORITO	2.4211	1.8947	1.5882	1.1765	2.2308	1.3462	1.7353	1.0882	1.4800	1.4000	1.2727	1.1667
12	BONYUNYU	2.5238	2.0714	2.3438	1.7813	2.4681	1.6667	1.8889	1.2500	1.2432	1.3513	2.5000	1.4375
13	NYANSABAKWA BOYS	6.6200	4.3600	Y	Y	5.3642	3.5894	4.4885	2.5649	4.2804	3.4268	6.3291	2.7084
14	RANGENYO GIRLS	2.9000	2.2609	3.9231	3.1702	4.4074	3.2593	4.6774	2.7097	2.6764	2.2352	3.8650	2.5484
15	ST. JOHN OKONG'O	-	-	-	-	2.3704	2.5185	1.8039	1.2885	1.9333	1.6666	1.7778	1.4815
	TOTAL	41.2380	31.1771	37.7277	27.7462	41.8842	32.6648	46.0835	27.9795	38.7184	34.9857	48.8792	33.6262
	MEAN SCORE	2.74920	2.07847	2.51518	1.84975	2.79228	2.17765	3.07223	1.86530	2.58123	2.33238	3.25861	2.24175

1.2 Statement of the Problem

Chemistry as a subject done at secondary school level significantly works closely in conjunction with other science subjects mainly Physics, Biology and Mathematics on preparing students for various important career opportunities like medicine, chemical engineering, teaching sciences among others.

Various educational stakeholders like the Ministry of Education Science and Technology, parents, teachers, Non-Governmental Organizations (NGOs) like Japanese International Cooperation Agency (JICA) have tried to address issues related to teaching and learning of Sciences and Mathematics for example, by reducing the content in the syllabus, organizing in-service programmes for Chemistry, Biology, Physics and Mathematics with SMASSE (Strengthening Mathematics and Sciences for Secondary Education) programme sponsored by JICA as an innovation in teaching methodology.

In Nyamaiya Division in Nyamira District some of the schools have been in existence for very many years. Some of the schools are advanced in age, that is, they were established more than 40 years ago and could be expected to perform well in Kenya Certificate of Secondary Education Examinations in all subjects. Despite the rationale for teaching chemistry and efforts made to improve performance by students in the subject, the performance by many students in most schools in Nyamaiya Division in Nyamira District has continued to be poor. This poor performance is attributed to factors which are not clearly known, and as such the problem of poor performance in the subject will persist if the causes are not addressed to avoid adverse consequences on the students in the division. It was the purpose of this study to investigate the factors and their effects on poor performance in secondary schools chemistry.

1.3 Purpose and Objectives of the Study

1.3.1 Purpose of the Study

The main purpose of this study was to identify and analyze some of the factors influencing students' poor performance in chemistry in Nyamaiya Division in Nyamira District. Specifically, the study addressed the following areas as for the purpose of the inherent problem:

- (i) The students' attitude towards chemistry
- (ii) The chemistry teachers' qualifications
- (iii) The availability and use of chemistry teaching and learning resources
- (iv) The methods used in teaching chemistry
- (v) The concepts from chemistry related subjects used in some chemistry topics.

1.3.2 Objectives of the Study

There were five major objectives of this study:

- (i) To find out the students' attitude towards chemistry in Nyamaiya Division.
- (ii) To establish the chemistry teachers' qualifications in Nyamaiya Division
- (iii) To analyze the availability and use of chemistry teaching and learning resources.
- (iv) To identify the teaching methods used in chemistry.
- (v) To determine the effect of concepts from chemistry related subjects used in some chemistry topics on students' performance in chemistry in Nyamaiya Division.

1.4 Research Questions

- (i) In Nyamaiya Division, is the students' attitude towards chemistry positive or negative?
- (ii) Do teachers' academic and professional qualifications as well as teaching experience affect students' performance in chemistry in Nyamaiya Division?
- (iii) Does the availability and use of chemistry facilities such as libraries, laboratories, chemistry equipment, models and teaching aids as well as human resources such as laboratory assistants and heads of science department affect students' performance in Nyamaiya Division?
- (iv) Among the methods of teaching chemistry like lecture, teacher demonstrations, class experiments, outdoor activities and trips, which ones are preferred by teachers in Nyamaiya Division?
- (v) Do the concepts from chemistry related subjects used in some chemistry topics affect students' performance in chemistry in Nyamaiya Division?

1.5 Limitations of the Study

There could be many factors that are possibly influencing the poor performance in Chemistry by students in Nyamaiya Division. But all these factors could not be researched on because of:

- a. The inadequate time available for this study.
- b. Financial constraints affected the researcher's responsibility to finance the study.

There was no sponsorship from any organization, individual or institution to finance this project. The researcher's insufficient funds necessitated the use of a small sample size especially the number of students per class from the schools that were sampled in responding to the researcher's questionnaires.

1.6 Delimitations of the Study

- a. The research involved administering of teachers' questionnaires to Chemistry teachers only although in other related subjects like Mathematics, Physics, Biology, and headteachers would yield useful information for their study.
- b. The study focused on public schools only since most of them have been in existence for long and have some stability as they are aided by the government. The sampled teachers and students from the public schools in this study were likely to yield more reliable and consistent results. Thus the private school in the division was excluded in this study.
- c. The students and teachers that were included in the sample were those in session in the respective institutions by the time of the study. Those absent were not included in the sample even though they could have an important input.

1.7 Assumptions of the Study

In this study there were four main assumptions:

- a. The sample population of the schools, chemistry teachers and students were representative of the entire population of all the schools, chemistry teachers and students taking Chemistry in the Division.
- b. All respondents gave honest and accurate information.
- c. The quality of graduate teachers from different training institutions of the same level e.g. universities, was the same.
- d. Selecting students in Form Four to constitute the sample was based on the assumption that they had enough learning experience in terms of subject content and they were mature enough to portray relatively accurate research findings.

1.8 Significance of the Study

By identifying and analyzing the factors causing poor performance in Chemistry in Nyamaiya Division, teachers and other educational stakeholders like students, their parents and school managers can be made aware of the problems causing the poor performance in Chemistry in the division.

Making the educational stakeholders aware of the factors causing poor performance in chemistry in the division will lead to seeking and formulating measures that can be undertaken to control the factors influencing the poor performance in Chemistry by either eliminating the factors completely or reducing them so that performance in Chemistry can be improved.

For instance, the findings will facilitate decisions that need to be made concerning regular in-servicing of teachers to enable them to handle the chemistry subject competently and with confidence.

The findings from the analysis of the data collected from the student and teacher respondents in this study will also serve as a basis for further research in Chemistry e.g. its content and other subject areas especially those related to Chemistry, for instance Mathematics, Physics and Biology. The same findings will also help teacher training institutions to design their training programmes with a view of producing better teachers.

Lastly the findings from this research would reveal the role that school administrators especially headteachers and heads of science department are supposed to play to improve students performance in chemistry, for example by interpreting the curriculum

requirements to teachers and other educational stakeholders on a regular basis and updating them on any changes that take place from time to time during curriculum implementation, availing appropriate facilities and learning and teaching resources necessary for effective curriculum implementation.

1.9 Theoretical Framework

A very important theory in this study is Skinner's Theory of Motivation. Skinner came up with a motivation theory of learning whose central argument was that students' motivation to undertake a task depends on the expected reward. In this regard, a positive perceived reward induces positive motivation and subsequently realizes high achievement. A negatively perceived reward leads to negative attitudes and achievement. It is also implicit that students' high performance is influenced by the teaching experiences of the teacher, available instructional resources and the teaching strategies. The interaction strategies will translate into students' high performance.

1.10 Conceptual Framework

Figure 1.1: The Conceptual Framework of Factors Influencing Students' Performance in Science Subjects and Mathematics.

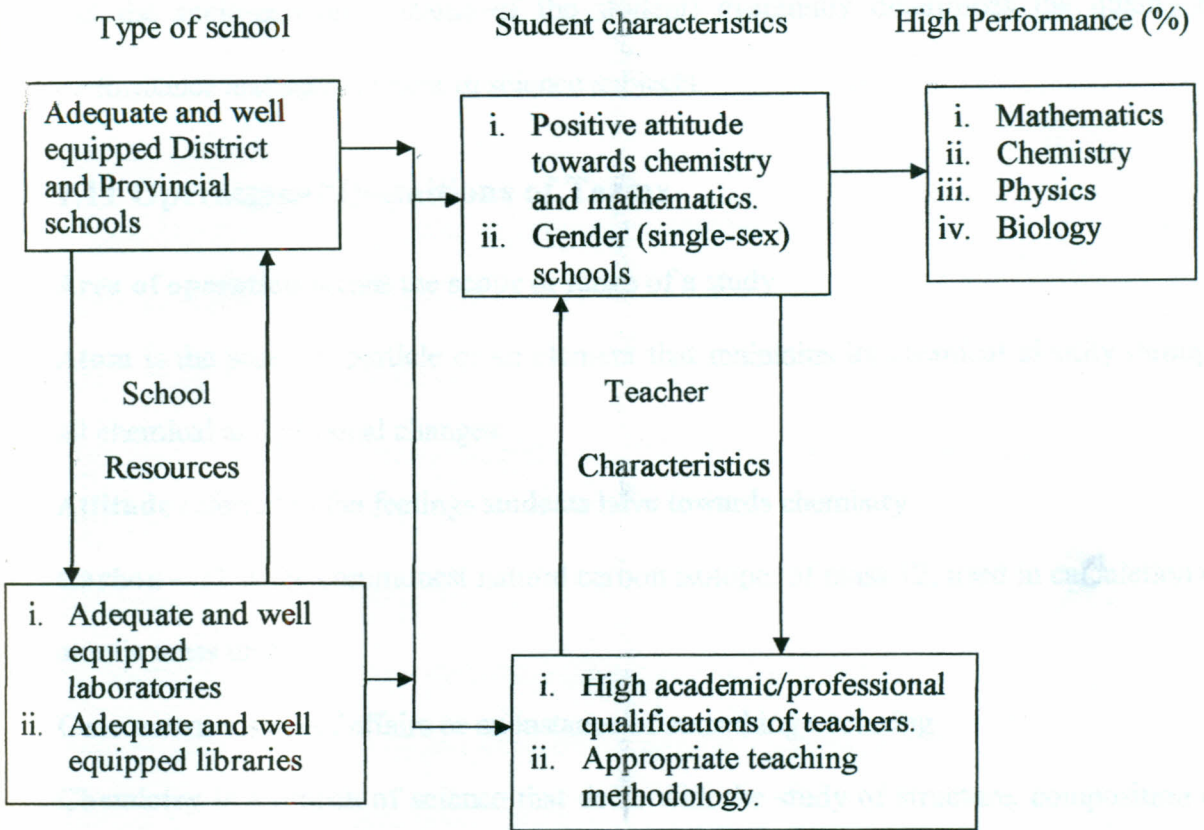


Figure 1.1 illustrates that the four composite variables i.e. type of school, school resources, teacher and student characteristics, influence students' performance in science subjects (chemistry, mathematics, physics and biology). The two composite variables i.e. type of school (whether the school is national, provincial, district, day or boarding), and the school's resources (laboratory, library, textbooks and specimens), have a direct impact on the student characteristics such as attitude towards science subjects especially chemistry and mathematics and also gender (whether a school is a single – sex school or a mixed school). There is also a direct impact on teacher characteristics such as academic and professional qualifications of teachers, as well as appropriate teaching methodology

to motivate learners. In other words, the type of school and school resources determine the type of teaching experience and motivation, and this, in turn, has an impact on the student characteristics. The interplay of the various student characteristics (gender, attitudes towards sciences and mathematics, entering behaviour in terms of KCPE grades, and the socio-economic status of the student) eventually determines the quality of performance and achievement in science subjects.

1.11 Operational Definitions of Terms

Area of operation means the scope or range of a study

Atom is the smallest particle of an element that maintains its chemical identity through all chemical and physical changes.

Attitude referred to the feelings students have towards chemistry.

Carbon – 12 is the commonest natural carbon isotope, of mass 12, used in calculation of atomic mass units.

Case means a state of affairs or an instance of something occurring

Chemistry is a branch of science that deals with the study of structure, composition of substances and the way they behave under different conditions.

Current referred to an ordered movement of electrically charged particles.

Division means each of the separate small groups of individuals such as schools in this case into which a district is divided for administrative purposes.

Electrochemistry is the study of the production of electrical energy from chemical reactions and the chemical changes produced by electric currents.

Element is a substance that cannot be split into two or more simpler substances by any known chemical reactions.

Emerging Issues are formerly concealed points in question, facts or circumstances or important subjects of debate coming to light or becoming known especially as result of enquiry.

Et cetera means and similar things or people

Examination referred to the action of testing or judging by a standard knowledge based on experience. It is the process of testing knowledge or ability by written questions or experimental methods.

Factor is a circumstance, factor or influence contributing to a result.

Field means an area of operation

Form meant a class in a school.

Heterogeneity meant the degree of dissimilarity among cases with respect to a particular characteristic.

Homogeneous means of the same kind

Interest meant a quality exciting curiosity or holding attention.

Isotope referred to each of two or more forms of an element differing from each other in nuclear mass but not chemical properties.

Laboratory referred to the room in a school equipped with apparatus, chemicals and facilities for scientific experiments, research and teaching.

Laboratory Technician is a person who has a wealth of knowledge in chemistry or scientist who prepares and looks after chemicals and apparatus in a science laboratory.

Library is a room or building in a school containing a collection of books for reading, reference rather than for sale.

Mean is the quotient of the sum of quantities and their number; the average.

Means referred to what is meant by a word, action or idea.

Mole the SI unit of amount of substance equal to the quantity containing as many elementary units as there are atoms in 0.012 kilograms of carbon – 12.

Novice means a beginner or an inexperienced teacher.

Nucleus is the positively charged central core/part of an atom that contains most of its mass.

Order referred to a specified sequence.

Performance referred to the marks obtained in a subject such as chemistry or mathematics examinations expressed as a percentage.

Pilot is an experimental undertaking or test, especially in advance of a large one.

Population sometimes referred to as target population is the set of cases that the researcher focuses upon and to which the results obtained by testing the sample should be generalized.

Practical means a teaching/learning approach that stresses the importance of observation and the use of senses in obtaining scientific knowledge. In this method the learners are active participants in the learning process. They manipulate the learning materials and equipment.

Radioactivity is the spontaneous disintegration of an unstable nucleus.

Sampling is the process of selecting a sub – set of cases in order to draw conclusions about the entire set.

Set means a group or collection of things or persons that belong together or have similar interests

Sex referred to either of the main divisions (male and female) into which living things are placed on the basis of their reproductive functions.

SI (Standard International Unit) referred to the international system of units of measurement.

Subject means a field of study.

Teaching Experience referred to the number of years a teacher had taught at secondary level.

Term is a period of about fourteen weeks alternating with a holiday or vacation of about one month, during which instruction is given in a school.

Theory means the teaching/learning which provides a kind of speculative examination, inquiry based on general principles of definitions proceeding to the interpretations in the light of these general ideas. It ignores the use of observation or the use of senses in obtaining scientific knowledge. Learners are passive participants in the learning process.

Thermochemistry is a branch of chemistry that deals with the quantities of heat evolved or absorbed in the course of chemical reactions.

Unit is a quantity chosen as a standard in terms of which other quantities may be expressed.

LITERATURE REVIEW

2.1 Introduction

Any factors that hinder good performance in Chemistry will always be of great concern to educational stakeholders because of Chemistry as a science or a field of knowledge concerned with ideas relating to the behaviour of matter, and although some of these concepts are abstract, their application has had a concrete impact on human life and generally man's environment, (Hein, 1986).

Thus, there will always be efforts made to try and emphasize the main purpose of including chemistry in the school curriculum, i.e. the training in the scientific methods and procedures for a student to be able to have skills of following a sequential order of steps in solving problems not only in the area of chemistry but also in solving social problems. And to achieve this, any constraints in the process must be identified first and then means to eliminate or reduce them sought.

It is especially important that special reference be made to the status of educational technology in developing countries like Kenya because most schools and colleges in these countries are poorly equipped, both in terms of physical facilities and in terms of the quality of teachers, (Rao, 1975).

2.2 Students' Attitude Towards Chemistry and Performance in

Chemistry

One of the most important determinants of effective study is the students' attitude or preposition towards his/her work, intentions, and expectations. One who sees that learning of certain material is related to the attainment of hi/her goals has a more favourable attitude towards studying that material and makes a greater effort to remember it than the one who does not recognize its relevance. The very act of wanting and trying to remember something because one sees the value of doing so is a prerequisite to successful study.

If the student considers the work the work as nothing but drudgery, if his/her intention is simply to complete assignments as quickly as possible in order to have the matter over with, and if his/her expectation is that nothing worthwhile will result from his/her efforts, not much will be expected from him/her. About 90% of a student's excelling academically comes from a positive attitude towards learning. Combined skills and knowledge contributes to only 10% of a student's academic excellence. (Osindi, 2009).

Teachers and learners generally perceive science to be difficult. Many teachers' morale is low because they are overworked and paid poor salaries. Teaching science requires more input than other subjects because the teacher has to prepare for practical work and to care for equipment and the laboratory, yet they have the same number of periods and classes as teachers of other subjects.

University lecturers explain to students policy issues and career choices related to Mathematics. The students are helped to fight habits and practices that hinder the understanding of Mathematics and hence science subjects which require Mathematical skills. These habits include low self-esteem, lack of interest, school traditions and absenteeism.

It is widely recognized that science is alien to many Third World Pupils. This has been attributed to inadequate perceptions of science and to the difference between school and local knowledge. There are enormous gaps in the perception of science: traditional ideas of skill – learning among adults and children.

Once the excitement that surrounds the release of Kenya Certificate of Secondary Education (KCSE) results has subsided, it leaves teachers and students in rural areas a dejected lot. Except for a few of the schools, KCSE performance in science subjects especially Chemistry is usually unimpressive. As a result, parents accuse school headteachers and teachers of incompetence, laxity and for letting their children down.

It is important to note that most teachers in district rural schools are as hardworking and committed as urban, provincial and national ones. Many students who join the schools failed in their Kenya Certificate of Primary Education (KCPE) examination and were unable to join their preferred provincial and district schools. The students go to school with a negative attitude and are a big challenge to teachers and administrators. (Ministry of Education, 2001).

There is urgent need for career guidance in schools to assist students make responsible decisions regarding careers they wish to pursue after school or training in an educational institution. In producing and providing educational and vocational information, cooperation between national actors is required, among other factors. Systematic evaluation of the quality of guidance is often lacking, quality standards do not exist, and evaluation and feedback information is gathered from the service users. Furthermore, information on the status of guidance on which national decision – making is based has been found inadequate. (Lule, 2009).

Girls in mixed schools fare worse in sciences. Gender stereotyping is the major contributing factor to the glaring performance gap between boys and girls in sciences and mathematics, a researcher says. Each year, once the Kenya Certificate of Secondary Education (KCSE) examination results are announced, the gap between the two sexes in science and mathematics is always a hot debate, as leaders and educationists lament the poor results in the subjects.

A senior lecturer in Department of Curriculum and Instruction at Egerton University now says the poor results in the subjects by girls may be attributed to gender polarization and perception towards the subjects. “Girls are expected to be passive and subjective, and more interested in people than ideas,” says the don in her research report.

At the same time, girls have consistently perceived that mathematics and science subjects are not of much use in their future careers. Apparently, they have increasingly shown a more negative attitude towards sciences and mathematics.

But the role of gender stereotyping, according to the researcher, is mostly observed when boys and girls learn together in mixed schools. In such scenarios, there is a clear relationship between gender vis-à-vis student performance and subject preference. In mixed schools, boys outperform girls in science and mathematics. On the other hand, girls in single-sex schools performed better in the subjects than boys in single-sex schools.

It can also be noted that in single-sex girls' schools, the mathematics and science classes are livelier, more co-operative, and that the students have a better working relationship. Thus, it would seem, girls in mixed-sex schools suffer the negative influence of gender stereotyping, which is hypothesized to influence their performance.

Girls in mixed-sex schools report feeling uncomfortable in the masculine environment, and adopt a passive role in class, fearing ridicule for giving wrong answers and asking 'foolish' questions. Girls feel that teachers may be insulting and humiliating them, or that these teachers do nothing to prevent the boys from misbehaving in class.

Another major problem for girls is that the science syllabus and textbooks are 'sexist'-with most examples being masculine in nature. Man is portrayed as the best, while 'he' is the dominant pronoun in the books. A good chemistry book should have theoretical work based on concepts and principles in accordance with modern teaching ideas, and requirements in the latest syllabuses but should also have the older meanings for those teachers who prefer them, (Njeru, 2004)

Good chemistry books should have a wide selection of questions taken from recent examination papers of the major examining bodies to be used both for learning and revision. The many labelled diagrams should ensure that the descriptive parts of the text are readily understood and should provide students with a model for their own diagrams, (Atkinson, 1974).

Syllabus formulators and publishers should make their materials gender sensitive. With very few female teachers in science and mathematics, the researcher feels that girls lack role models who could nurture and boost their interest in the subjects. She has called for the increased employment of teachers in the subjects.

Every student has a favourite subject. It is also true that most students have some subjects they feel are just meant to give them a hard time; given a chance, they would not hesitate to scrap the offending subject from the curriculum.

There are many reasons why a student would hate a subject, the major ones being a teacher's approach to teaching and learning, the learner's natural abilities, discouragement or encouragement from parents and former students, or just baseless myths. As many students progress in their school lives, their dislike (or hatred) for certain subjects becomes more intense as the exposure to more knowledge in the subject increases.

The self-defeating attitude of hating a particular subject can haunt a student for years. Many students find themselves trapped when they have to miss a chance to pursue a career of choice because of their dismal performance in a loathed subject.

Scoring grade E in one subject and passing in the others however colourfully irrevocably taints one's CV and can have long-term negative consequences. Consider, for instance, a student who may love physics, mathematics and biology, but hate chemistry. For such, a career in medicine may be a pipe dream.

2.3 Chemistry Teacher Qualifications and Students' Performance in Chemistry.

Some chemistry topics are not only considered difficult to teach, but also lead, by their nature, to different opinions on how they should be presented to students, and only a competent, well trained chemistry teacher can teach such topics effectively, (Guilleman, 1981).

Sciences involve the use of many theories. Only a competent trained teacher will understand that the test of a theory is that it should be useful and should lead to correct predictions than rival other theories.

A quality/trained chemistry teacher contributes positively to effective chemistry teaching-learning process by easily overcoming the major problems of any science teacher, (Richardson, 1975).

Educational management has no choice as to whether to train employees or not. All employees, regardless of their previous training, education and experience must be given further training and development. This is because the competence of workers will never last forever, due to such factors as curriculum and technological changes, transfers and promotions. It is important for educational managers to note that if no definite

programme of training is planned, then there will be a higher training cost not only because employees will take too long to learn the required skills, but also because of the likelihood that they will not learn the best methods for their specific assignments. (Okumbe, 1999).

Some of the major problems of any chemistry teacher include; the sequence of the subject content to be followed, what to do with chemistry related courses, what to do with college entrance examinations, how to teach to allow pupils to learn with a “Sense of discovery” or appreciation and insight, how to keep himself/herself informed about new books and teaching materials, etc.

A number of points that qualify a good chemistry teacher are:

- Subject matter proficiency
- Methodology and class or laboratory management skills
- Awareness of the contribution of chemistry to the society
- Professional growth
- Personality and
- Physical endurance

(Twoli, 2006)

The demands on the teacher change considerably during his/her career. In view of the continuous renovation and development of teaching knowledge and of the constant change taking place within education systems, it does not seem possible to equip the teacher trainee during the short years of pre – service training with all the knowledge and skills required for an entire professional life.

If education is to meet both the rapid requirements of and the demands for new curricula and methods of teaching, it becomes increasingly difficult to solve the problem of providing quality and quantity through the traditional patterns of teacher education. There is, therefore, an urgent need for a comprehensive policy that will consider the ways and means of increasing the supply of teachers and renewing their training in such a way as to enable them to face the challenge of changing needs. In – service teacher education when considered in its various forms offers a potential solution. (Olembo, 1992).

Regular in-service courses are very essential for science teachers to equip them with the most current and relevant science skills, science being a wide dynamic area of knowledge. It is especially useful for secondary school teachers among them Chemistry teachers to receive some guidance in what this entails and how to humanize their science teaching for better understanding of the subject matter by the students, (Newton, 1988).

It is important to note that the smaller the pupil-teacher ratio, the higher the annual cost per pupil and in most cases most schools have a high pupil-teacher ratio due to the cost involved in training quality teachers, (Pumfrey, 1991).

2.4 Availability of Chemistry Teaching and Learning Resources and Students' Performance in Chemistry

The nature and quality of curriculum offered in a school is closely related to the resources which are available and, most importantly, how well they are used. The four main resources essential to get work done are: material resources, human resources, financial resources and time. Some of the principles that need to be applied in management of the resources include: identifying and using appropriately all possible resources, making

maximum use of the available resources, seeking and manufacturing where possible local resources and carefully monitoring and controlling the use of the resources.

However, school managers and teachers in most schools have many constraints which include: shortage or lack of storage facilities, lack of skills and expertise needed to identify and use resources properly, inadequate sources of supply of required resources, insufficient means of transport to distribute the resources, lack of skills in how to manage time and space effectively, insufficient financial provision, and inappropriate and unimaginative training of teachers. (Ministry of Education, 1997).

The careful storage of chemicals and apparatus is particularly essential for a school that has limited funds for purchasing them. It is a valuable procedure for all schools since a tidy laboratory area can encourage an attitude of mind supportive of a logical approach to investigation. It is important to recognize that any article, which has to be replaced, is using money that could have been used to purchase additional apparatus or materials. (UNESCO, 1980)

Financial constraints are evident in many schools, and finance to a great extent controls the amount and quality of the equipment for any Chemistry laboratory, (Archenhold, Jenkins, Wood-Robinson, 1978). Thus the cheap equipment is not always cheap in the long term policy. For instance, some commercial chemicals may be cheap, but for most experimental purposes in any laboratory are useless or they can be dangerous.

The higher pupil-teacher ratio together with lack of adequate facilities for effective Chemistry teaching – learning process in most schools offering the subject means that the

teachers are overworked. Due to this, many teachers and headteachers are currently recognizing the attraction of mixed ability grouping in their secondary schools which has a negative implication especially for the progress of the very bright pupils, (Rao, 1975). The biggest difficulty to the Chemistry teacher is the provision for the most able Children. It is very easy to drift them along producing excellent work and results on the basic materials but not at the same time being fully extended considering the wide nature of the Chemistry knowledge area.

It is quite necessary to have well equipped Chemistry laboratories, i.e. with adequate facilities because Practicals in Chemistry involve either teacher demonstrations or class experiments where the pupils perform the experiments or class activities. Class experiments are better than other practicals because the pupils develop manipulative skills better, (Wachanga, 1991).

Apart from the laboratory equipment, finance also controls the availability of other relevant and appropriate Chemistry teaching and learning materials e.g. Chemistry textbooks, commercial models for teaching abstract concepts, worksheets which are necessary for individualizing learning activities of pupils due to the widespread introduction of mixed ability classes, and other business-sponsored chemistry educational audio-visual materials (aids) such as charts, (Archenhold et al, 1978).

Chemistry requires that pupils should be creative in expression in practicing their experimental skills for better understanding in some Chemistry concepts. However, lack of adequate Physical facilities is an obstacle to the creative expression required. In most schools there are large classes in small classrooms and laboratories resulting to less

emphasis on project and/or practical work hence pupils think of education generally as memorization of facts, (Hughes, 1965).

Availability of relevant and appropriate Chemistry teaching and learning resources to some great extent should always be determined by the Chemistry teacher. However, lack of empowerment of individual teachers can lead to inadequacy of such resources, (Clark, 1990). For instance, it is a well trained Chemistry teacher who can effectively determine the competence of a Chemistry laboratory technician/assistant by assessing his/her qualifications before being employed in a school given that all our institutions are formally free to determine the non-academic staff within approved estimates, (Silverman, 1988).

The rhetoric about the importance of science is not accompanied by funding. For example, rural schools do not have science laboratories and equipment partly because of their low economic standards. They cannot raise the necessary resources. For the same reason, rural communities experience difficulties starting and maintaining resource centres.

Over the years, educationists have lobbied for the introduction of calculators, arguing that they are common in the workplace and the informal sector. Calculators are also in use in tertiary institutions. "Research has shown that when calculators are used, students feel confident, and this helps reduce negative attitude," says a senior Mathematics lecturer and coordinator in the Mathematics Mentoring Group at the Jomo Kenyatta University of Agriculture and Technology (JKUAT). "It also allows teachers more time to spend on teaching concepts."

Many students in rural district schools come from poor families and they are often sent away for school fees. Some eventually drop out, leaving behind huge arrears. School fees payment is the least of the strong sides of the schools and they, therefore, are not able to have basic facilities like adequate classrooms, desks and laboratories for science subjects especially Chemistry.

The basis of the use of technology and industrialization is effective implementation of Mathematics and Science curricula at all levels of education. Unfortunately, school performance in the subjects has not been satisfactory. The major reasons cited for the low achievement include lack of equipment, inadequate textbooks and a shortage of teachers. However what is emerging is that even schools with adequate resources also register low grades in Mathematics and Sciences. As such, what the teacher does with the available equipment and materials is critical.

It is a common position that developing countries have problems with resources. This position however, should not be used as an excuse to relax on making chemistry a practical subject. Encouraging and guiding learners to develop skills for improvising resources such as making models can go a long way to improve conceptualization in chemistry.

Familiarity with the role of resources and in particular a chemistry laboratory is emphasized. A laboratory is a very important resource to a chemistry teacher. Other resources such as charts, models and mini –labs are emphasized options for a chemistry teacher to choose from. In this regard improvisation is encouraged as a way of enriching resources for teaching chemistry. (Twoli, 2006)

2.5 Teaching Methodology and Students' Performance in Chemistry

Teaching is a challenging and time – consuming activity. With this sort of awareness, it is therefore the duty of a chemistry teacher to give a wide range of options in strategies, methods, techniques e.t.c that will assist new teachers to select according to varying situations. Teachers are strongly encouraged to give learners an opportunity to participate in some of the activities related to practical and in a variety of special activities that challenge them to demonstrate their skills and knowledge. A school teaching laboratory would be very ideal for these sorts of activities.

The understanding of why we teach chemistry is likely to make a teacher focused in the activities and knowledge that follow this treatment. Methodology or pedagogy in general is key in instruction. Thus it is necessary to give a number of options in terms of methods for teaching chemistry and suggestion of possible situations that suit their uses. (Twoli, 2006).

Selection of a method of instruction is usually influenced by personal and environmental factors such as objectives of a particular lesson, group sizes, availability of resources, entering behaviour of learners, teacher preferences and dislikes among others. In most cases a teacher finds himself/herself using some teaching methods far more frequently than others or certain methods with particular subjects. For instance, he/she may use drama or rhymes in English subject but rarely in Social or Environmental studies. He/She may use drills in Mathematical subjects but never in the English subject. There may be some methods he/she never uses at all. (Quist, 2000).

Education experts always quote figures that show how best students and pupils learn science. 95% of deans of education and 93% of teachers say students learn best through experiments and discussions, especially where they are allowed to defend their conclusions. 78% of new teachers say they use inquiry-based science teaching often compared to 63% ten years ago. However, for many years, observations by experts who visit classrooms regularly and the continuing poor performance of elementary students in science put these figures to question and doubt.

There are many things that hinder the learning and teaching of science. Believe in the information particularly textbooks is entrenched. It is not unusual for teachers to tell pupils that something is right because a book says so. Whether a practical is done or not, lessons are often statements of facts or absolute truth from books not to be challenged.

Of course, a school laboratory rarely has the resources to challenge such laws and the learner has to believe and memorize. But physical conditions of some schools demotivate learning and inhibit the learning of science. They have dilapidated buildings and lack science equipment, laboratories and libraries.

Another new aspect that should be taken into consideration by science and mathematics teachers is the use of calculators to solve mathematical problems in their subjects. A senior Mathematics lecturer and coordinator in the Mathematics Mentoring Group at the Jomo Kenyatta University of Agriculture and Technology (JKUAT) said that calculators must be scientific, should not be programmable, and should not have an external communication system. And then the mathematics teacher should ensure that mathematics concepts are mastered, and that the same calculator models are used by all

students. Mathematics teachers should also liaise with those of other subjects that require calculators, such as Geography, Chemistry, Physics and Commerce.

Teachers should also ensure that students are aware of expected errors. They should show students how to interpret results, especially for very large and very small numbers.

There are two main approaches to the teaching of chemistry.

- a) **Learner-centred approach:** This is where the learner is actively involved in the learning process through the guidance of the teacher.
- b) **Teacher-centred approach:** This is where the teacher exposes learners to the knowledge with little learner participation.

Chemistry is a practical subject and should be taught by way of discovery through investigation. Learner centred approach is therefore most appropriate. However, learners require the teacher's guidance. An integration of the two approaches may be necessary in certain topics.

There are four methods which can be used in the teaching of chemistry:

- Class experiment
- Teacher demonstration
- Class discussion
- Projects

There is no best method of instruction. These methods overlap considerably to ensure that desirable outcomes are attained. It is unwise for the teacher to choose one method as the

best and adhere to it exclusively. A combination of these methods is sometimes necessary in achieving the stated objectives. (Ministry of Education, 2006).

It is worthy noting that project work should be emphasized in most cases because a project provides a unique chance to integrate into one piece of work a range of skills and knowledge gained from a variety of disciplines. (Brian, 1991)

It is important to note that teaching methodology has a role to play in determining students' performance in science subjects. For instance, in the 2005 KCSE examinations, little-known Ober Secondary School of Migori in Rachuonyo District in Nyanza Province led the pack in the district school category. It was 23rd nationally and third in the province behind national school Maseno and provincial school St. Joseph's Rapogi of Migori. Among the best performed subjects were chemistry which had a mean score of 11.07 or a mean grade of A- and Biology which had a mean score of 10.75 or a mean grade of A-.

The success in the sciences is amazing at a school which has no adequate laboratory equipment. The chairman of the Board of Governors, says the school seeks laboratory equipment, including used ones, from bigger schools. The institution lacks facilities but they do not wait until things get better. They do with what they have.

2.6 The Concepts From Chemistry Related Subjects Used in Some Chemistry Topics and Students' Performance in Chemistry

In addition to proficiency in chemical knowledge, a chemistry teacher should have basic knowledge in chemistry related fields. These include: mathematics, technology, philosophy, sociology and psychology. A chemistry teacher can no longer ignore even areas such as language, reading and writing skills, since these skills have been found to be important determinants to learning and understanding of any subject matter (Twoli, 2006)

There is a great necessity for secondary schools to reflect on integration of such sciences as Chemistry on physics, and on Biology. Exciting related topics and development in these subjects should be pointed out. For example, the secondary school can provide firm Principles of Chemistry with Physics, on a good Mathematical basis, (Jezowska, 1975).

The fact that any science like Chemistry at its best is quantitative means that really to understand science requires a good knowledge of Mathematics as one of its tools. It is an essential part of scientific training in Chemistry to insist on accuracy and this must by its very nature bring in Mathematics. The Chemistry teaching-learning process involves a lot of measuring of volumes, weights, lengths, drawing graphs etc. An important factor in the use of measuring instruments is their degree of accuracy.

The changes that are taking place in Chemistry courses throughout the world should not be measured only in terms of content, but also in terms of the teaching methods used. The

aim of teaching science (and mathematics) is to achieve 'process goals' as well as 'product goals'.

Traditional teaching laid emphasis on 'product goals' whilst, today the development of a person's ability to think critically (i.e process goals) is considered just as important if not more. This is reflected in the style and contents of today's examinations in chemistry. Questions are no longer based on re – call of factual information; candidates are required to show a depth of understanding not previously expected. Today's questions expect candidates to know the facts and then be able to use these facts to make certain judgements. (Sinclair, 1985).

One important reason for this change in emphasis is that countries are becoming increasingly more aware of their obligations towards students from whom 'O' level will mark the end of formal education. The role of the teachers must be to provide their students with a sufficiently wide base for them to have a balanced view of the world, so that on leaving school they can take rational decisions in any field of human endeavour. In the modern world of nuclear energy and micro – computers the study of chemistry provides students with thought patterns which are considered essential in acquiring such a balanced view.

"It should be part of the teaching of Mathematics to indicate what is meant by probable error and what is likely to amount in a particular case. In general, error of measurement arises from two weaknesses: the relative inaccuracy of the instrument, and the varying ability of the observer (Gordon, 1965).

While releasing the 2003 Kenya Certificate of Secondary Education (K.C.S.E.) examination results, the Minister for Education, expressed concern over the continuing poor performance in Mathematics and the Sciences. General performance in these subjects was still low, meaning the interventions in the past few years to raise the grades were not yet yielding fruits.

The worst performed subject was Mathematics with a mean score of 19.30 %. Other poorly done subjects were Chemistry (26.85%), and Physics (31.36%). Science and mathematics teachers are always on the firing line, as their subjects are deemed 'hard'. While everyone expects students to perform poorly in the subjects, science teachers are always being accused of contributing towards lowering the mean score. .

It has been noted that calculators make estimation and checking of answers much easier than mathematical tables. Calculators are also in use among students in Uganda and South Africa.

To improve students' performance in mathematics and related science subjects like chemistry which require a wide range of application of mathematical concepts, nurturing mathematics geniuses, the Japanese way is very crucial.

The Japanese are so innovative because according to a new school based in Nairobi, the secret lies in the abacus, an instrument that was used in 18th century Japan to teach mathematics, which, they say, has turned out to be useful in the modern-day world. "We are going back to past teaching methods in this era of digital computerization, because it has proved to be much easier and more efficient," says the Director of Abacus Kenya.

SEMAS, the acronym of Soroban (Japanese abacus) Education for Mental Arithmetic System is, apparently, widely used in Japan, India, Singapore, Taiwan, Thailand, Canada, United Kingdom, United States. The system is now in Kenya.

The instrument, abacus, is easily used to teach such areas of mathematics as addition, subtraction, multiplication, division, square roots and cube roots. "It is an excellent substitute for tedious memorization of tasks like multiplication tables, which are detestable, particularly to young children," the Director of Abacus Kenya observes.

The abacus is "a frame containing rods with small balls that slide along them. It is used as a tool or toy for counting." The school, Abacus Kenya, is named after the gadget. In the course of using the abacus, according to the director, the learner gets to a level where its processes are internalized. Thereafter, one is able to calculate without direct contact with the instrument. "Essentially, very high levels of concentration are developed and these skills are transferred to other disciplines," he says.

The teacher ought to be resourceful, innovative, and creative in order to make teaching effective. (Ministry Of Education, 2006)

2.7 Summary

The Kenya National Examination Council (KNEC) has a national responsibility for examinations and certification. Examinations are administered nationally and test a wide range of courses. However both primary and secondary education examinations do not give sufficient attention to formative monitoring. In practice, therefore, teachers tend to

ignore aspects that are not examined, even if they are emphasized in the curriculum, and are important for learners' holistic development.

CHAPTER THREE
RESEARCH METHODOLOGY

Currently there is no system for monitoring the learning achievements of various competencies at various levels of the education cycle. This means that data that could be generated from a national assessment system, and which could be used for improvement of educational quality is limited. Under the current system, the analysis which is conducted by the KNEC only provides information on the aggregate achievement of students in national examinations, performance of schools and districts, and judgement of the teaching and learning process. (Ministry of Education, 2006).

Factors such as time and other variables can limit a researcher's choices and designs.

The choice of research design, data collection methods, and sampling strategies depend not only on the purpose of the study and the research questions posed, but also on what is known about the context (based on thorough field working), and resource availability.

3.2 Research Design

In this study, survey design was used. It was the most appropriate because survey research deals with the frequency, distribution and interrelations of individual variables. It allows researcher the diverse aspects of a single case or to study multiple cases. The researcher receives number of answers to the same questions by different people. Such studies are concerned with gathering of facts and figures rather than the manipulation of variables.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Because research questions vary considerably, the designs constructed to answer them also vary considerably. The choice of a research design is based on a variety of reasons, some of which are functional and realistic. Although most researchers would be delighted to be able to always design research where threats to internal and external validity are eliminated, this is not always possible. Availability of resources, the nature of the research questions, and other variables can limit a researcher's choices and designs.

The selection of a research design, data collection methods, and sampling strategies depend not only on the purpose of the study and the research questions posed, but also on what seems to work best (based on thorough field testing), and resource availability.

3.2 Research Design

In this particular study, survey design was used. It was the most appropriate because survey research deals with the incidence, distribution and interrelations of educational variables. It does not emphasize the diverse aspects of a single case as in case studies, but rather, the frequency or number of answers to the same question by different people. Such studies are concerned with gathering of facts and figures rather than the manipulation of variables.

Comprehensive school surveys explore and evaluate many aspects of the school system, such as: conditions and maintenance of school buildings; administrative procedures and management styles; sourcing of funds and school financial expenditure patterns; quality of teaching staff in terms of qualifications and teaching strategies; learning objectives; curriculum issues; people's attitudes; students' performance and discipline.

Among scientific disciplines, education, anthropology, public health etc, make use of surveys to collect information relevant to interests and problems in their fields. Studies involving surveys account for a substantial proportion of the research done in the field of education. For example, Lazarsfield and Sieber did a content analysis of educational research appearing in 40 journals and found that about one third of them involved use of survey methods (Borg and Gall, 1989:416). A wide range of educational problems can be investigated in survey research. (Orodho, 2004).

3.3 Locale

The performance in chemistry by students in Nyamira District is generally poor as can be seen from the analyses of KCSE results in the previous recent nine years as much as it is not the poorest in Kenya. However, due to the large number of schools and students in the district, it was impractical to carry out the study of factors influencing this poor performance in all the schools considering the time and financial constraints. Therefore, only some public schools in Nyamaiya Division in the district were sampled for the study.

3.4 Target Population

In Nyamaiya Division in Nyamira District there is a total of fifteen schools. All these offer Chemistry from Form one to Form four. Fourteen out of these schools are public (government-sponsored) schools. The only private school in the division has been in existence for only six years.

Twelve out of the fourteen public schools are mixed Secondary schools. There is only one public boys secondary school which is a provincial school and only one public girls secondary school which is also a provincial school. The only private school is a mixed school.

In this study only secondary schools, their chemistry teachers and students were targeted although some other organizations such as SMASSE centres and their officials could yield useful information for this study.

Table 3.1: Showing Target Population

Type of School	Number of Schools
Public boys schools (Provincial)	1
Public girls schools (Provincial)	1
Public mixed schools (District)	12
Private mixed schools	1
Total	15

3.5 Sample Selection

In many education and social science studies, the sample should be selected in such a way that the researcher is assured that certain sub – groups in the population will be represented in the sample in proportion to their numbers in the population itself. Such sub – samples are usually referred to as stratified samples.

In stratified sampling, the population is first sub divided into two more mutually exclusive segments, called strata, based on one or a combination of variables. Simple random samples are then drawn from each stratum, and then these sub – samples are joined to form the complete stratified samples.

The schools in Nyamaiya Division in Nyamira District are widely dispersed and considering the financial and time constraints, only six public schools were selected to constitute the sample.

There was only one private school in the division and it had some features that did not correspond to key population differences. For instance, it was not funded by the government, it did not have teachers employed by the government, there was high turn over rates among students as they kept on migrating to public schools where they pay lower school fees thus student enrolment kept on fluctuating by a big margin from term to term and from one form to another. Furthermore, it had been in existence for a very short period of time, that is, about only six years while the public schools had been in existence for more than ten years. Therefore, the school could not be included in the sample since it could be misleading to use findings from the school to draw conclusions on the target population

The general strategy was to identify important sources of variation or criteria in the population and then to select a sample that reflected this variation, that is, whether the school was private or public and also the sex (gender), that is whether a school was a boys school, a girls school, or a mixed school.

One way of increasing precision other than selecting a large sample is to use stratified sampling rather than random sampling. Stratified random sampling provides greater efficiency (or precision) when the stratified variable is related to the dependent variable of interest. Such correlation means that a good deal of the population heterogeneity resides in differences between strata and each stratum tends to be relatively homogeneous. (Orodho, 2004)

Stratified sampling was used to select the public schools to be included in the sample. This is because the target population is not homogeneous. There were three strata in the study i.e. the public boys school, the public girls school and the public mixed schools.

Table 3.2: Showing Sampling Frame

Type of School	Number of Schools
Public boys schools (Provincial)	1
Public girls schools (Provincial)	1
Public mixed schools (District)	4
Total	6

From the stratum of twelve mixed schools, simple random sampling was used to select the four schools (one third of the mixed schools) to constitute the sample. Simple was random sampling was used in this case to give each of the mixed schools in the division

an equal and independent chance of being selected as a member of the sample. The lottery technique was used to select these schools, where twelve individuals were assigned names of the twelve schools. Each individual was assigned one name randomly so that no school was left out. Small pieces of paper of the same colour, texture and size were numbered one to twelve. Each paper bore one number so that no number between one and twelve was repeated. The pieces of paper were folded into same shape and size then placed in a container and mixed thoroughly. Each of the twelve individuals was then allowed to pick one piece of paper, one at a time. The schools that corresponded to the individuals who picked 1, 2, 3 and 4 constituted the sample.

In the allocation of the sample size among strata, the proportional allocation was used. In this format, each stratum contributed to the sample a number that was proportional to its size in the population. Thus, there were ten student respondents from the public boys school (one sixth of the student respondents in the study), ten students respondents from the public girls school (one sixth of the student respondents in the study), and forty students respondents from the public mixed schools (two thirds of the student respondents in the study).

To select the ten students in the boys school and ten students in the girls school, simple random sampling was used to give each of the form four students in the respective schools an equal and independent chance of being selected as a member of the sample. The lottery technique was utilized again. Similar pieces of paper whose total number corresponded to the number of students in a form class were used. Ten pieces of paper were written 'YES' and the rest 'NO'. They were then folded, put in a container and

mixed thoroughly and then each student allowed to pick one piece of paper, one at a time. The students who picked the papers written 'YES' constituted the sample.

In each of the four mixed schools constituting the sample, the form four students were first subdivided into two groups to take care of gender balance, that is, boys and girls. This is because in public mixed schools, it is a government policy that when admission of students is done, one stream of every form should have forty students whereby twenty should be boys and twenty should be girls. In case of the upper limit which is forty five students per stream, boys should be twenty three and girls should be twenty two or vice versa since the difference of one student is small and can be ignored.

From each of the two groups simple random sampling was used to select five boys and five girls to constitute the sample. In each of this cases the lottery technique is utilized whereby, similar pieces of paper whose total number corresponded to the number of students in each group were used. Five pieces of paper were written 'YES' and the rest 'NO'. They were then folded, put in a container and mixed thoroughly and then each student allowed to pick one piece of paper, one at a time. The students who picked the papers written 'YES' constituted the sample.

The teacher who was the head of chemistry in each of the six sampled schools was the respondent to the teachers' questionnaire. Thus in the study, one boys secondary school, one girls secondary school and four mixed secondary schools constituted the sample. From all these schools, a total of six Chemistry teachers and sixty Form Four students of which thirty were boys and thirty were girls constituted the sample of respondents to the teachers' and students' questionnaires respectively.

3.6 Data Collection Instruments

Two types of questionnaires were used; Chemistry Teachers' Questionnaires and Students' Questionnaires.

The chemistry teachers' questionnaires sought general information about:

- The academic and professional qualifications as well as the teaching experience of the chemistry teachers.
- The adequacy and use of chemistry teaching physical and human resources.
- The methods chemistry teachers use in teaching chemistry.
- The problems chemistry teachers are facing in their teaching of chemistry.
- The chemistry teachers' strategies aimed at improving the performance in chemistry by the students in their respective schools.

The students' questionnaires sought information about:

- (i) The availability and use of learning resources in chemistry.
- (ii) Their attitudes towards chemistry
- (iii) The problems they are facing in their learning in chemistry.
- (iv) Ways by which they think their performance in chemistry could be improved.

3.7 Validity and Reliability of Research Instruments.

Thirty students' questionnaires were printed in time. Three of the sampled schools were then visited by the researcher. The researcher introduced and explained the aims and significance of the study to the headteachers of each of the three sampled schools. They were requested to make the relevant teachers and students aware about the study, i.e., its objectives and significance.

Piloting of the questionnaires was then carried out on three of the six schools that were to constitute the sample. The schools for the piloting of the questionnaires included: the boys school, the girls school and one of the four mixed schools used in the study. The mixed school was selected by simple random sampling using the lottery technique.

To pilot the teachers' questionnaires, two chemistry teachers from each of the three schools was selected and ten students from each of the three schools was used to pilot the students' questionnaires i.e. in piloting the questionnaire, six teachers and thirty Form Four students. Ten student respondents from the boys school and another ten from the girls school were selected by simple random sampling using the lottery technique where small pieces of paper equal in number to the number of students in the Form Four classes in the pilot schools were used. Ten similar pieces were written 'YES' and the rest 'NO'. The papers were folded, mixed thoroughly and the students allowed to pick one piece of paper, one at a time. This was done to give each of the form four students in the respective schools an equal and independent chance of being selected as a member of the sample. Those who picked the pieces of paper written 'YES' were the respondents to the students' questionnaire.

In the mixed school constituting the sample for the pilot study, the form four students were first subdivided into two groups to take care of gender balance, that is, boys and girls. From each of the two groups simple random sampling was used to select five boys and five girls to constitute the sample. In each of this case the lottery technique was utilized whereby, similar pieces of paper whose total number corresponded to the number of students in each group were used. Five pieces of paper were written 'YES' and the rest 'NO'. They were then folded, put in a container and mixed thoroughly and then each

student allowed to pick one piece of paper, one at a time. The students who picked the papers written 'YES' constituted the sample.

The teachers' questionnaire and students' questionnaire were administered to six sampled chemistry teacher respondents and thirty student respondents respectively.

To assess the reliability of the research instruments the same students' questionnaire and teachers' questionnaire were administered to the same group of student respondents and teacher respondents respectively after two weeks.

The data to the piloted questionnaire items were analyzed and the items adjusted accordingly in cases where the piloting of the questionnaires revealed some deficiency such as insufficient space to write the responses, clustered questions, wrong phrasing of questions, unclear directions.

The spearman rank order correlation was used to compute the correlation coefficient in order to establish the extent to which the contents of the questionnaires were consistent in eliciting the same responses every time the instruments were administered to the same respondents.

The spearman's rank order coefficient formula used was:

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

Where Rho (r_s) = Spearman's coefficient of correlation

d_i = difference between ranks of pairs of two variables.

n = the number of pairs of observations.

During the first pilot studies the student & teacher respondents were ranked in order from the one who gave them most detailed information to the one who gave the least detailed information in the filled respective questionnaires.

After the second pilot study the responses in the questionnaires used in the first pilot study were compared with the corresponding responses in the filled questionnaires used in the second study using the students and teachers identification numbers on the filled questionnaires.

Table 3.3: Showing the Number of Responses That Were Different in the Two Pilot

Studies of the Students' Questionnaire.

Student's Identification No.	No. of responses in the second pilot study that were different from those given in the first pilot study. (d_i)	d_i^2
1	2	4
2	4	16
3	2	4
4	3	9
5	2	4
6	1	1
7	3	9
8	2	4
9	3	9
10	4	16
11	1	1
12	3	9
13	3	9
14	1	1
15	4	16
16	2	4
17	1	1
18	3	9
19	2	4
20	4	16
21	4	16
22	3	9
23	4	16
24	1	1
25	2	4
26	3	9
27	3	9
28	2	4
29	2	4
30	4	16
		$\sum d_i^2 = 234$

$$\begin{aligned}
 r_s &= 1 - \frac{6\sum d_i^2}{n(n^2 - 1)} \\
 &= 1 - \frac{6 \times 234}{30(900 - 1)} \\
 &= 1 - \frac{1404}{26970} \\
 &= 1 - 0.052 \\
 &= 0.948
 \end{aligned}$$

The critical value of rho is 0.307 at $\alpha = 0.10$ and 0.363 at $\alpha = 0.05$ for a non-directional test when there are 30 subjects. The obtained value 0.948 is larger than the critical value, therefore there is a significant correlation between the results obtained with a repeated measure of the same concepts in the research instrument.

Table 3.4: Showing the Number of Responses That Were Different in the Two Pilot Studies of the Teachers' Questionnaire.

Teacher's Identification No.	No of responses in the second pilot study that were different from those given in the first pilot study. (d_i)	d_i^2
1	2	4
2	0	0
3	1	1
4	0	0
5	0	0
6	0	0
		$\sum d_i^2 = 5$

$$\begin{aligned}
 r_s &= 1 - \frac{6\sum d_i^2}{n(n^2 - 1)} \\
 &= 1 - \frac{6 \times 5}{6(36 - 1)} \\
 &= 1 - \frac{30}{210} \\
 &= 1 - 0.143 \\
 &= 0.857
 \end{aligned}$$

The critical value of rho is 0.829 at $\alpha = 0.10$ for a non-directional test when there are 6 subjects. The obtained value of 0.857 is larger than the critical value, therefore there is a significant correlation between the results obtained with a repeated measures of the same concepts in the research instrument.

Generally a correlation coefficient of about 0.75 is usually considered high enough to judge the reliability of a research instrument. (Orodho, 2004)

3.8 Data Collection Procedures

The questionnaires were printed in time. The sampled schools were then visited by the researcher. The researcher introduced and explained the aims and significance of the study to the headteachers of each of the six sampled schools. They were requested to make the relevant teachers and students aware about the study, i.e., its objectives and significance.

The researcher and the headteachers of the six schools that constituted the sample for the study agreed on the day to administer the questionnaires with the help of their respective

chemistry teachers. The data were then collected on the dates agreed upon (See Appendix III – Research Timetable). The researcher then took the responses from the sampled chemistry teachers and students for analysis of the responses from the instruments administered.

3.9 Methods of Data Analysis

In order to obtain a higher degree of accuracy in analysis of the data, all the responses from the participating teachers and students were considered. Since it was difficult to look at the masses of numbers and see any trend or make meaning in them, the data collected were summarized using simple descriptive statistics. This involved tabulating, graphing and describing data. Each statistic used in this descriptive statistics depended on the type of variables in the study and the level of measurement used. The mean and the mode were the main descriptive statistics used to indicate the average scores of the sample used in this study.

The data collected were organized using frequency distributions. This involved using tables showing the values that a variable could take on and the frequency with which each value occurred. In this study, univariate frequency distributions whereby one variable and each subject contributed one observation were used. This was necessary to change the raw data collected into some form that is consistent and understandable not only to the researcher, but also to anyone who might examine the collected data.

However, many people find it easier to interpret data presented in a graph rather than a table. This is because ordinary frequency distributions do not give a very clear picture of the real situation, but can be supplemented with graphical representation of the same

data. A graph enables the reader to see the trends of the distributions more easily than is possible by simply looking at the numbers in a frequency distribution table. Therefore graphs were an effective method of clarifying points.

In this particular study, pie – charts and bar graphs were used. For some cases pie – charts were used to communicate data in proportion of a circle dimension. For other cases bar graphs were preferred because it is usually preferred when data is discrete or categorical or when the scale is nominal or non – ordered. This is because the categories in a nominal scale do not imply any order except for identification purposes.

The Statistical Package for Social Sciences (SPSS) Computer Programme was used to analyse the data involving the simple descriptive statistics, that is, the frequencies, mode and the mean to indicate the average scores used in this study.

CHAPTER FOUR

RESEARCH FINDINGS, PRESENTATION AND DISCUSSIONS

4.1 Introduction

This study was meant to investigate the factors influencing the students' poor performance in Chemistry in Nyamaiya Division in Nyamira District. The researcher prepared sixty (60) copies of the students' questionnaire to be administered to sixty Form IV students. He also prepared six copies of the chemistry teachers' questionnaire for the six chemistry teachers in the six sampled schools. These instruments were administered for data collection by the researcher and the response level is summarized in table 4.1.

The data that were collected were analyzed using quantitative techniques. Calculations of proportions in form of percentages from the contents of the questionnaires were done after organizing the data using frequency distributions. The results from the sample were also graphically presented and explained to necessitate generalizations to be made on the target population.

This chapter presents the results of the study according to its objectives. The study set out to:

- i. Find out the students' attitude towards chemistry subject.
- ii. Establish the chemistry teachers' qualifications
- iii. Analyze the availability and use of chemistry teaching and learning resources
- iv. Identify the teaching methods used in chemistry

- v. To determine the effect of concepts from chemistry related subjects used in some chemistry topics on students' performance in chemistry

4.2 Demographic Data on Population

On administering the instruments, the 60 students who constituted the sample in this study filled the students' questionnaire, and were collected by the researcher for analysis. The researcher sampled six chemistry teachers. In schools with more than one chemistry teacher, the subject head was the respondent because in most cases a subject head in any school is usually one who been in the teaching profession for the longest period of time and has a wide range of experience in the subject as compared to those who taught the subject for a shorter period. Thus from each of the six sampled schools, one teacher filled in the teacher's questionnaire and returned them to the researcher for analysis. The total number of respondents were 66 (100%) of the sampled respondents.

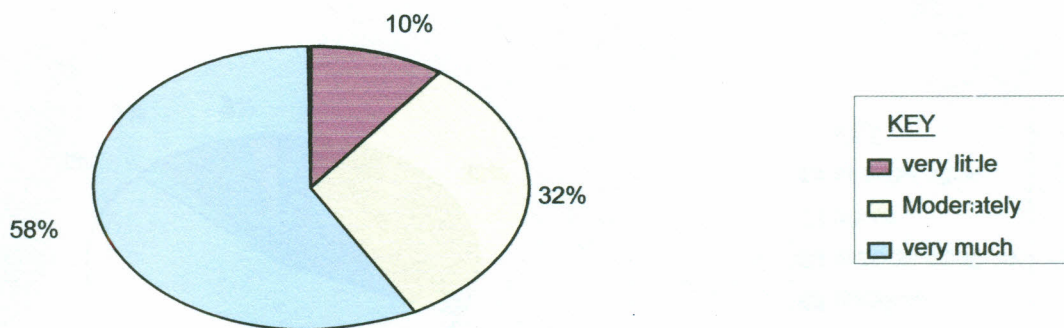
Table 4.1: Showing Percentages of Respondents

	SAMPLED	RESPONDED	PERCENTAGE (%)
STUDENTS	60	60	100
TEACHERS	6	6	100
TOTAL	66	66	100

4.3 Students' Attitude Towards Chemistry and Their Performance

Of the student respondents, 35 (58%) of them liked chemistry very much indicating that over half of the student respondents had a positive attitude towards the subject. It is only 6 (10%) who had little liking of chemistry whereas the rest, that is 19 (32%) had moderate liking of the subject as shown in Figure 4.1.

Figure 4.1: Pie – Chart Showing Students Rating for Chemistry Liking

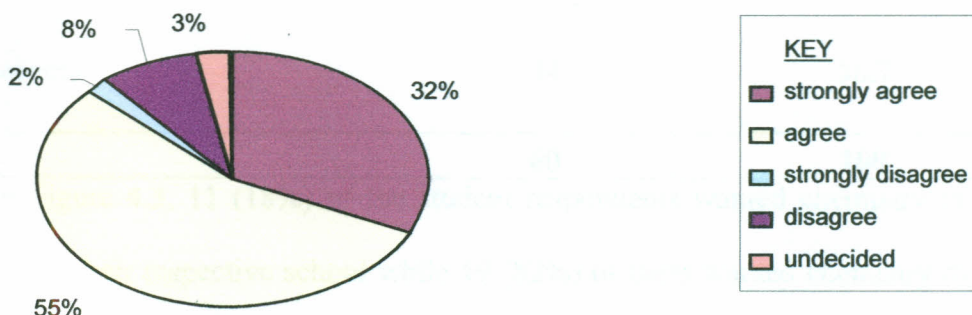


Given that only very few students had little liking for chemistry, it is an indication that the majority of the students, that is, 54 (90%) had a positive attitude towards the subject.

When the question of whether chemistry was easier than other subjects was posed, 19 (32%) of the 60 students strongly agreed that chemistry was easier with 33 (55%) agreeing making a total of 52 (87%) of the students. It is only 1 (2%) who strongly disagreed with 5 (8%) disagreeing and 2 (3%) were undecided. This is an indication that students like the subject.

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Figure 4.2: Pie – Chart Showing Students’ Views on Whether Chemistry is Easier Than Other Subjects



Since the majority of the students were of the opinion that chemistry was easier than other subjects, then it implies that they had an interest in studying the chemistry subject even though their performance in examinations in the subject was poor.

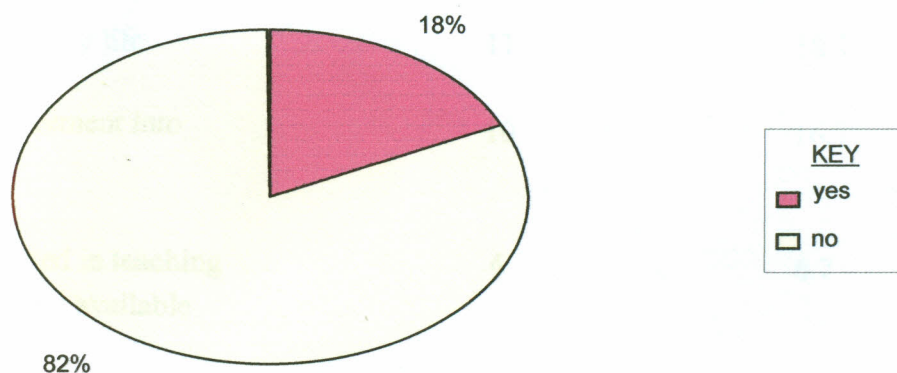
As shown in Table 4.2, 26 (43.3%) of the students were influenced by the way chemistry was taught whereas 34 (56.7%) of them were influenced by the chemistry content. The percentage of students influenced by the chemistry subject content being almost equal to that of the students who like chemistry very much as shown in figure 4.1, is a confirmation of the liking of the subject by the students. This is because the chemistry subject content taught in the various schools is the same whereas the way it is taught varies with individual teachers.

Table 4.2: Showing What Influences Students' Attitude Towards Chemistry

What influences students' attitude towards chemistry	Number of student respondents (frequency)	Percentage (%)
The way chemistry is taught	26	43.3
Chemistry content	34	56.7
Total	60	100

As shown in Figure 4.3, 11 (18%) of the student respondents wanted chemistry to be made optional in their respective school while 49 (82%) of them wanted chemistry to be made compulsory. Considering that the student respondents have a positive attitude and like the content of the subject, it indicates that many will want it made compulsory.

Figure 4.3: Pie – Chart Showing Students' Rating on Whether Chemistry Subject Should Be Optional in Schools



According to the current secondary school curriculum, among the three sciences (Chemistry, Biology and Physics), a student has the option of selecting any two of them. However, students opt to take chemistry as one of them and make a choice between biology and physics. This is a clear indication that they have great interest in the chemistry subject.

In Table 4.3, the student respondents gave various reasons why chemistry should be compulsory in their schools. 21 (35.0%) of the respondents considered the subject easy, 12 (20.0%) said that it was related to other subjects, 11 (18.3%) said that chemistry was applicable in daily life. 10 (16.7%) considered chemistry as an entry subject into certain careers, 4 (6.7%) said that materials needed in teaching chemistry were readily available with 2 (3.3%) saying that chemistry was interesting hence the need to make it compulsory.

Table 4.3: Showing Reasons Why Chemistry Should be Compulsory in Respective Schools as an Indicator of Students' Attitude Towards Chemistry Subject.

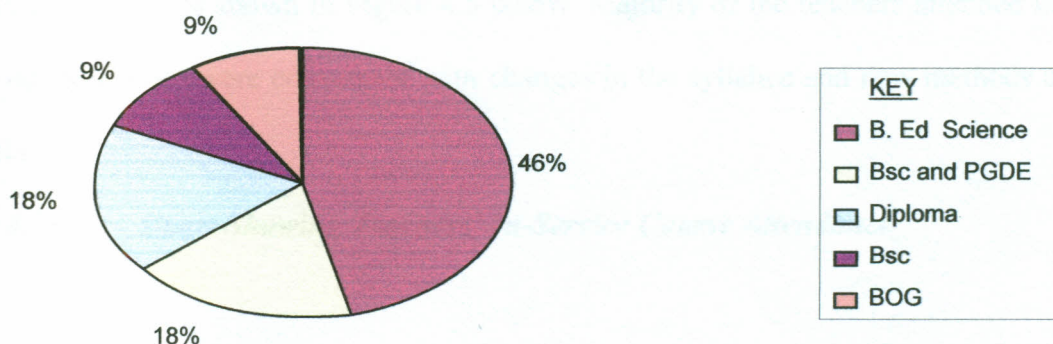
Reasons why Chemistry should be compulsory in respective schools	Frequency	Percentage (%)
The subject is easy	21	35.0
It is related to other subjects	12	20.0
It is applicable in daily life	11	18.3
It is an entry requirement into certain careers	10	16.7
The materials needed in teaching chemistry are readily available	4	6.7
Chemistry is interesting	2	3.3
Total	60	100

4.4 Chemistry Teacher Qualifications and Students' Performance in Chemistry.

The six schools under study had a total of eleven chemistry teachers. One school had two chemistry teachers, two schools had three chemistry teachers each and three schools had

one teacher each. Of these teachers 5 (46%) had a Bachelor of Education in Science, 2 (18%) had Bachelor of Science with a Post Graduate Diploma in Education, another 2 (18%) had Diploma in Education with 1 (9%) having Bachelor of Science General and another 1 (9%) was a Board of Governors employee as illustrated in Figure 4.4 below. This indicates that with 10 (91%) of the teachers having at least a Diploma, the schools were well staffed with chemistry teachers. It was only one school that had an untrained employee employed by the school's Board of Governors. A quality/trained chemistry teacher contributes positively to effective chemistry teaching-learning process by easily overcoming the major problems of any science teacher, (Richard, 1975).

Figure 4.4: Pie – Chart Showing Academic and Professional Qualifications of Chemistry Teachers



4.4.1 Teaching Experience of Chemistry Teacher Respondents

4 (66.66%) of the teacher respondents had a teaching experience of between five and ten years. 1 (16.67%) of the teacher respondents had a teaching experience of more than ten years and only 1 (16.67%) had a teaching experience of less than five years. Thus 5 (83.33%) of the teacher respondents had a teaching experience of between five and ten

years as illustrated in Table 4.4. This shows that the teachers were well experienced in teaching chemistry.

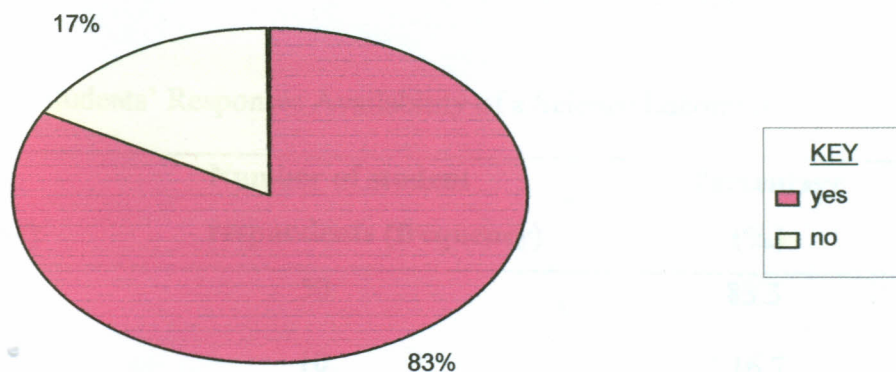
Table 4.4: Showing Teaching Experiences of Chemistry Teachers

Teaching experience	Number of teacher respondents (frequency)	Percentage (%)
More than ten years	1	16.67
Between five years and ten years	4	66.66
Below five years	1	16.67
Total	6	100

4.4.2 Attending In-Service Courses

Of the teacher respondents, 5 (83%) of them had attended in-service courses with only 1 (17%) not attending as shown in Figure 4.5 below. Majority of the teachers attended in-service courses hence were conversant with changes in the syllabus and new methods of instruction.

Figure 4.5: Pie – Chart Showing Teachers’ In-Service Course Attendance



A chemistry teacher has an important role to play not only in relation to the teaching profession but also to his own professional growth. Pre – service training is just the beginning of a long route of personal and professional development. Chemistry teachers need to be alert to new knowledge, innovations, and remain continuing learners by participating in in – service courses and seminars. Such growth will not only give a teacher just the knowledge and skills to cope with change but also the motivation in the job.

4.5 Availability of Chemistry Teaching and Learning Resources and Students' Performance in Chemistry

4.5.1 Availability of Science Laboratories

50 (83.3%) of the student respondents said that their schools had a laboratory with 10 (16.7%) saying they had none as illustrated below in Table 4.5. This shows that only one school did not have a laboratory. This is confirmed by teacher respondents whereby 50 (83.3%) of them said they have a laboratory in their school and only 1 (16.7%) said there is no laboratory in his school. This further proves the reliability of the study because the students and the teachers agree on the availability of a laboratory in their respective schools.

Table 4.5: Showing Students' Responses Availability of a Science Laboratory

Availability of a science laboratory	Number of student respondents (frequency)	Percentage (%)
Available	50	83.3
Not available	10	16.7
Total	60	100

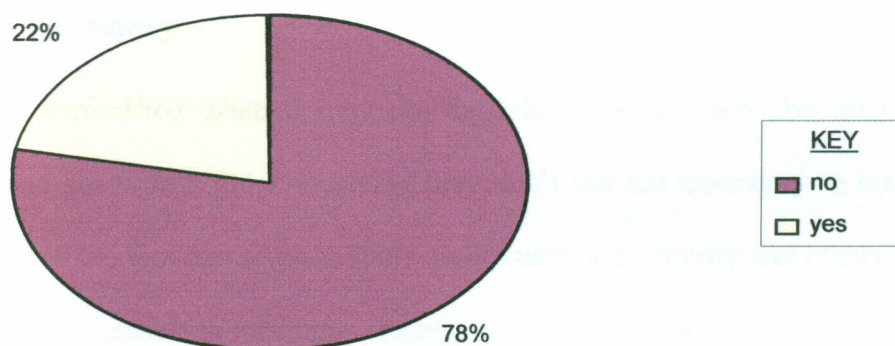
Table 4.6: Showing Teachers' Responses Availability of a Science Laboratory

Availability of a science laboratory	Number of teacher respondents (frequency)	Percentage (%)
Available	5	83.3
Not available	1	16.7
Total	6	100

4.5.2 Availability of Chemistry only Laboratory

Of the sixty student respondents, 47 (78%) said they did not have a laboratory for chemistry only with only 13 (22%) of them saying they had a laboratory for chemistry only. This indicates that most of the schools have not invested in subject laboratories which will make it easier for chemistry teachers to teach the subject with relative ease.

Figure 4.6: Pie – Chart Showing Availability of a Laboratory for Chemistry only

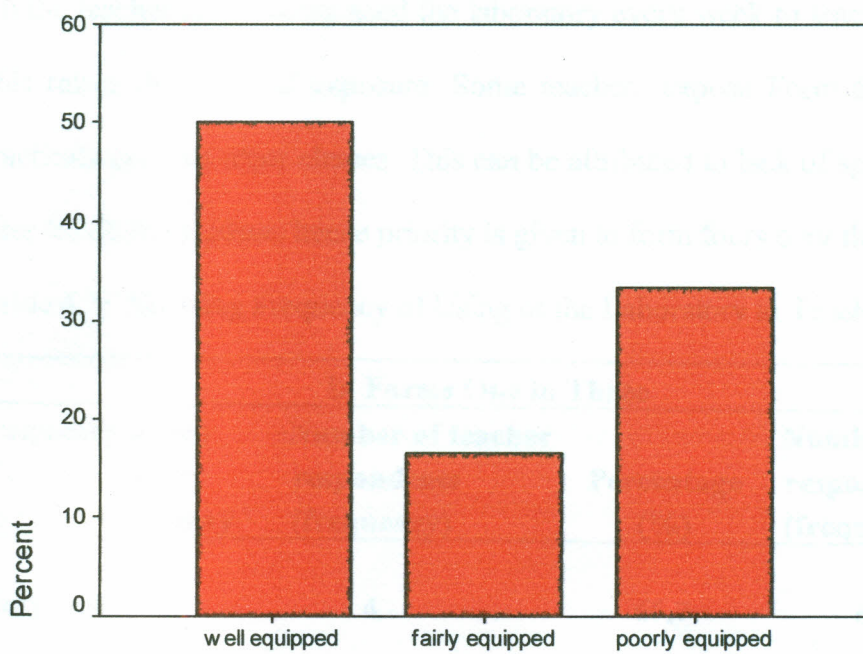


4.5.3 Equipping of the Laboratory

This question was posed to teachers only and 3 (50.0%) of them said their laboratories were well equipped, 1 (16.7%) of them said their laboratories were fairly equipped and 2 (33.3%) of them said their laboratories were poorly equipped. This poses the first

challenge to good performance in chemistry. With half of the laboratories fairly to poorly equipped then it becomes difficult for the teachers to teach practicals effectively.

Figure 4.7: Bar Graph Showing Equipping of the Laboratory



4.5.4 Use of the Laboratory

When the teachers were asked whether they use the laboratory to teach chemistry, 4 (66.7%) of them said yes with 2 (33.3%) saying they don't use the laboratory to teach. This is probably due to the fact that some schools do not have a laboratory and others are poorly equipped to be useful in teaching. Laboratories are important to carry out experiments because Class experiments are better than other practicals because the pupils develop manipulative skills better, (Wachanga, 1991).

4.5.5 Frequency of Using the Laboratory

4 (66.7%) of the teacher respondents used the laboratory every week to teach forms one, two and three while 2 (33.3%) used the laboratory once every two weeks as illustrated in

Table 4.6. This indicates that due to poor equipping of laboratories the teacher used the laboratory once every two weeks which will seriously affect chemistry performance as the students are not well exposed to practicals

All the teacher respondents used the laboratory every week to teach Form four students. This raises the issue of exposure. Some teachers expose Form four students to more practicals than the other classes. This can be attributed to lack of space and equipment to cater for all the students hence priority is given to form fours over the other classes.

Table 4.7: Showing Frequency of Using of the Laboratory to Teach Chemistry

Frequency of use of the laboratory To teach chemistry	In Forms One to Three		In Form Four	
	Number of teacher respondents (frequency)	Percentage (%)	Number of teacher respondents (frequency)	Percentage (%)
Every week	4	66.7	6	100
Once every two weeks	2	33.3	0	0
Total	6	100	6	100

4.5.6 Laboratory Space

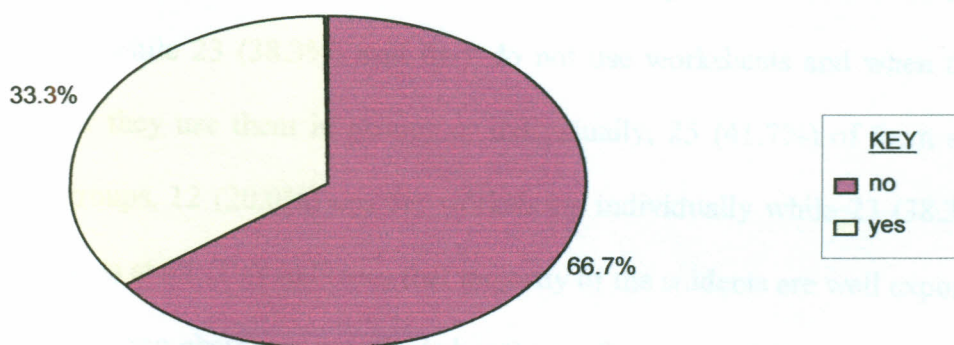
When the teacher respondents were asked whether the laboratory space was enough for their students, 4 (66.7%) of them said no while 2 (33.3%) said yes. This justifies the frequency of use of the laboratory as Form four students are given priority over the other classes due to limited space. Some of the schools, that is 2 (33.3%) of the six schools to which the teacher respondents belong did not have enough space in the laboratories to cater for all the students. This situation makes the teachers to stagger laboratory use and sometimes classes end up using the laboratory once every two weeks.

All the teacher respondents, that is the 6 (100%) of them agreed that their students did practicals in groups of more than three students per group. This confirms that the laboratory space is limited and the space available can be utilized by students to do practicals in groups of more than three students per group as the only solution.

4.5.7 Laboratory Technicians

4 (66.7%) of the schools to which the teacher respondents belong did not have a laboratory technician while 2 (33.3%) of the schools had a laboratory technician according to the teacher respondents. This is probably another impediment to better student performance because teachers are left with heavy workload of teaching and preparing practicals. This compromises quality and effectiveness of the teacher.

Figure 4.8: Pie – Chart Showing Availability of a Laboratory Technician



A lab – technician or assistant is a very useful person in a laboratory. In most developing countries like Kenya, only a few well – established schools enjoy the services of a trained lab – technician. There are few trained lab – technicians and these few prefer to join more established institutions and companies that offer better terms of service. This leaves schools with little option but to hire someone on local terms to assist in keeping the

laboratory tidy (washing and sweeping) with very little technical responsibility as he/she has had practically no training in laboratory management. Without the strong backing by a qualified technician, a chemistry teacher is bound to work under immense pressure, and this will no doubt affect overall performance.

Laboratory assistants should understand the lab – management, the experiments and be familiar with the equipment and procedures if they are to help the teacher and students well enough. While we expect qualified lab – assistants to work independently most of the time, chemistry teachers are advised to guide and instruct where useful. For example, teachers should write worksheets, give requirements for practicals, order for chemicals and apparatus etc.

4.5.8 Use of Worksheets in Chemistry Practical

Of the sixty student respondents, 37 (61.7%) of them said they use worksheets in their chemistry practicals while 23 (38.3%) said they do not use worksheets and when they were asked whether they use them in groups or individually, 25 (41.7%) of them said they use them in groups, 12 (20.0%) use the worksheets individually while 23 (38.3%) did not use worksheets at all. This indicates that majority of the students are well exposed to the procedures of doing chemistry practicals but the performance of those who do not use worksheets to carry out practicals is compromised. Due to space limitations the students were doing practicals in groups hence they used worksheets in groups too. This does not expose the students to individual challenges hence limits students ability to do practicals. The teachers cannot help in case of individual weaknesses.

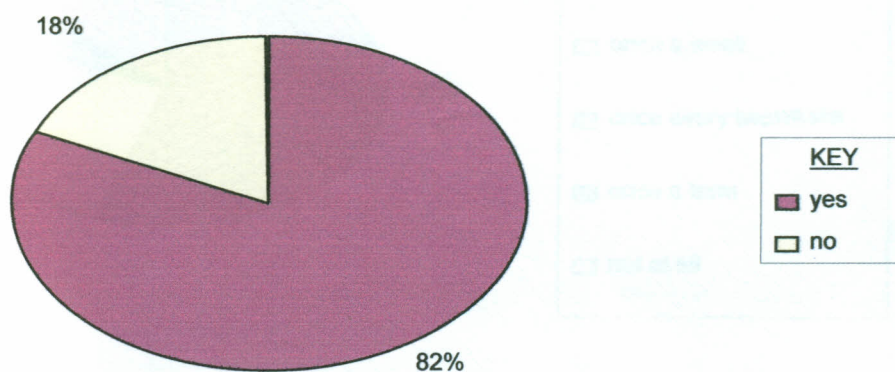
Table 4.8: Showing Use of Worksheets in Chemistry Practicals

Use of worksheets in schools	Frequency	Percentage (%)
Students who use worksheets in groups	25	41.7
Students who use worksheets individually	12	20.0
Students who do not use worksheets at all	23	38.3
Total	60	100

4.5.9 Availability of a Library

49 (82%) of the sixty student respondents said they had a library while 11 (18%) did not have a library. When the same question was posed to the six teacher respondents, 5 (82%) of them said they had a library while 1 (18%) said they did not have a library.

Figure 4.9: Pie – Chart Showing Availability of a Library

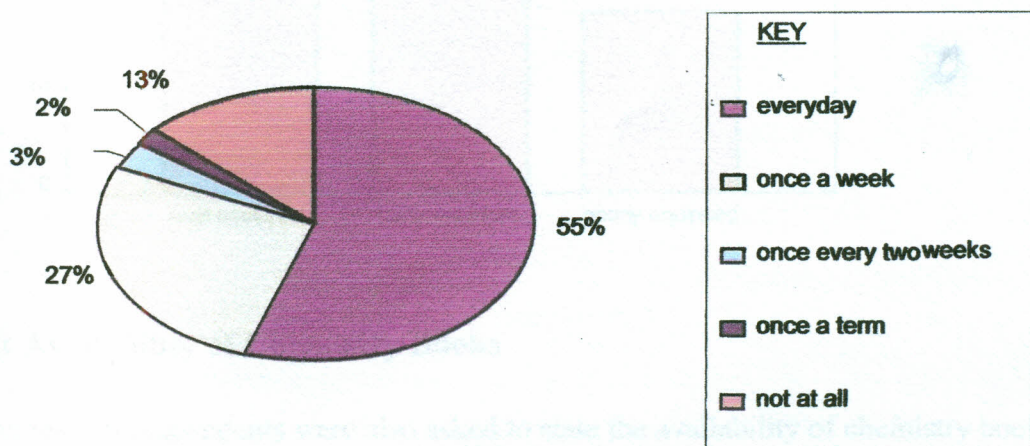


A library being an important resource in chemistry, this means that majority of the students had possible access to chemistry materials for reference and study. The secondary school chemistry syllabus being very wide students need to do some intensive reading on their own since the chemistry teachers can only afford to give students basic concepts and guidelines on what to learn.

4.5.10 Borrowing of Chemistry Books

When the student respondents were asked how often they borrowed chemistry books, 33 (55.0%) of them said they were allowed to borrow books everyday, 16 (27%) of them said once a week, 2 (3%) of the respondents said once every two weeks, 1 (2%) of them said once a term and 8 (13%) were not allowed to borrow books at all. Despite the presence of a library, nearly half of the students did not have access to the books on a daily basis with nearly a quarter having no access to the chemistry books at all. This negatively affected their performance.

Figure 4.10: Pie – Chart Showing Borrowing of Chemistry Books.

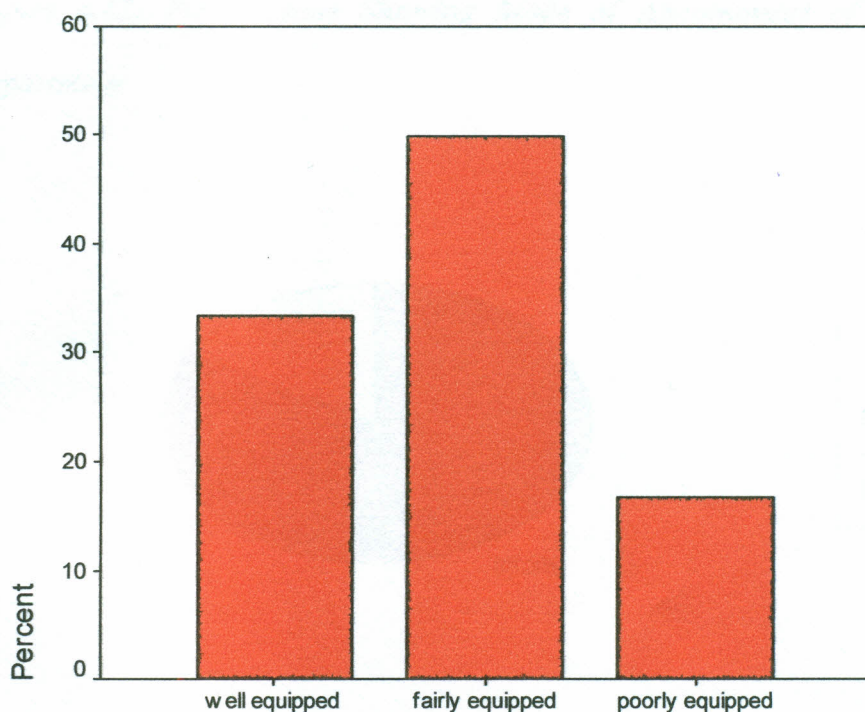


4.5.11 Equipping of Library With Chemistry Materials

When the teacher respondents were asked to gauge the level of equipping the library with chemistry materials, 33.3% of the teacher respondents said it was well equipped. 50.0% said it was fairly equipped while 16.7% said it was poorly equipped. This indicated that the libraries were not sufficiently equipped to satisfy the chemistry requirements. With

majority of the students having limited access to the library, it was considered a major contributor to the poor performance in chemistry.

Figure 4.11: Bar Graph Showing Level of Equipping Library With Chemistry Materials.



4.5.12 Availability of Chemistry Books

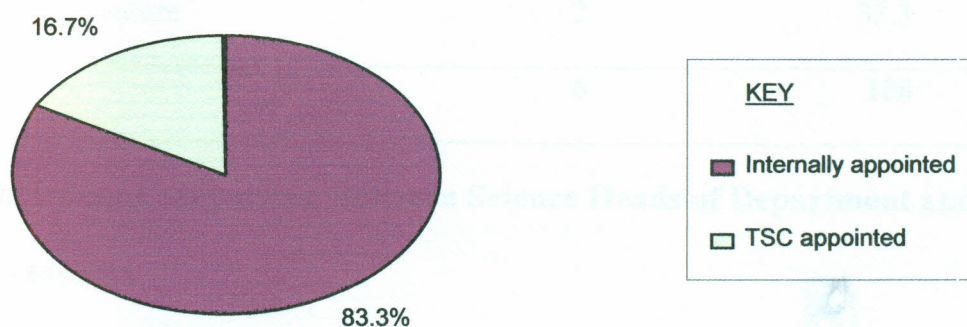
The six teacher respondents were also asked to state the availability of chemistry books in their schools. 3 (50.0%) of them said they were available and adequate while the other 3 (50.0%) said they were available but inadequate.

4.5.13 Head of Science Department

When the teacher respondents were asked whether they had a Head of Science Department in their respective schools, all of them said they have one. When they were asked whether the HOD was internally appointed or Teachers Service Commission appointed, 5 (83.3%) of them said they were internally appointed and 1 (16.7%) was TSC

appointed. This was a big disparity in terms of those Heads of Department recognized and remunerated appropriately because they will be motivated. Internally appointed Heads of Department lack the necessary motivation to effectively supervise the teachers under them. This impedes proper and effective teaching of chemistry.

Figure 4.12: Pie – Chart Showing Mode of Appointment of Heads of Science Department



4.5.14 Subjects Taught by Heads of Department

The six chemistry teacher respondents gave the following combinations as the subjects that were taught by the Heads of Department in their respective schools; 2 (33.3%) of them taught Mathematics and Physics, 2 (33.3%) taught Biology and Agriculture, 1 (16.7%) taught Chemistry and Biology, and 1 (16.7%) taught Mathematics and Chemistry. This indicates that the chemistry teachers had a second subject to teach and examine apart from chemistry. There is also an indication that the number of heads of department with chemistry as one of their teaching subjects is small hence relatively poor coordination in the chemistry subject area in the science department. This contributes to

poor performance because the teachers have a heavy workload which makes effective teaching difficult.

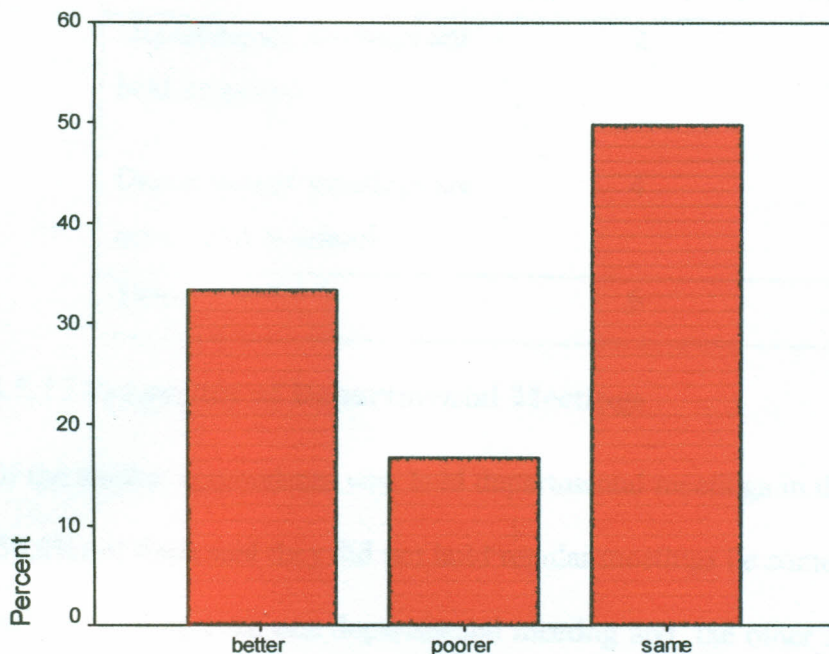
Table 4.9: Showing Science Heads of Department's Teaching Subjects

Science heads of department's teaching subjects	Number of teacher respondents (frequency)	Percentage (%)
Chemistry and Mathematics	1	16.7
Chemistry and Biology	1	16.7
Mathematics and Physics	2	33.3
Biology and Agriculture	2	33.3
Total	6	100

4.5.15 Performance Comparison Between Science Heads of Department and Chemistry Teachers

Teacher respondents were asked to compare their performance with that of their respective Heads of Science Department and the responses were as follows; 2 (33.3%) of them said their performance was better, 3 (50.0%) said that their performance was the same, and 1 (16.7%) had a poor performance when compared with the science HOD's performance. This indicated that there was no much difference between the delivery of the respective Head of Science Department and the teachers as half of the teachers had the same performance as the HODs and more than a quarter had performance that was better than that of Head of Department.

Figure 4.13: Bar Graph Showing Chemistry Teacher Performance as Compared to Science Heads of Department.



4.5.16 Staff Departmental Meetings

When the teacher respondents were asked whether they hold departmental meetings, their responses were as follows; 4 (66.7%) of the respondents said they do not hold departmental meetings at all and 2 (33.3%) said they hold departmental meetings. This indicated that departments were dormant and ineffective. Departmental staff meetings are meant to plan for every school term, share lessons, share teaching experiences and tackle emerging problems. If they are not held, then teaching will be uncoordinated and disorganized and that is likely to affect performance negatively.

Table 4.10: Showing Science Departmental Staff Meetings

Departmental staff meetings	Number of teacher respondents (frequency)	Percentage (%)
Departmental meetings are held in school	2	33.3
Departmental meetings are never held in school	4	66.7
Total	6	100

4.5.17 Frequency of Departmental Meetings

Of the teacher respondents who held departmental meetings in their respective schools, 3 (50.0%) of them said they did not hold regular meetings i.e some school terms could pass without holding even one departmental meeting and, the other 3 (50.0%) said they held departmental meetings at least once in a term. This confirmed the apathy in the science departments in the respective schools of the teacher respondents to hold meetings because half of them do not hold meetings regularly and the other half hold meetings only once in a term reflecting the lack of seriousness.

4.5.18 Involvement in Making Chemistry Requisitions

When the teacher respondents were asked about making of requisitions for the chemistry subject, 5 (83.3%) of them said they were involved and 1 (16.7%) said he was not involved. Those directly involved felt part of the system and identified themselves with the process and this helped in the instruction process. For those not involved, they complained of wrong requisitions which affected their delivery of the instructional process.

Table 4.11: Showing Making of Chemistry Requisitions

Making of chemistry requisitions	Number of teacher respondents (frequency)	Percentage (%)
Chemistry teachers are involved	5	83.3
Chemistry teachers are not involved	1	16.7
Total	6	100

When the chemistry teachers involved in making chemistry requisitions were asked whether they were directly involved or through their Heads of Department, 3 (60.0%) said they were directly involved and 2 (40.0%) said requisitions were made through the HODs.

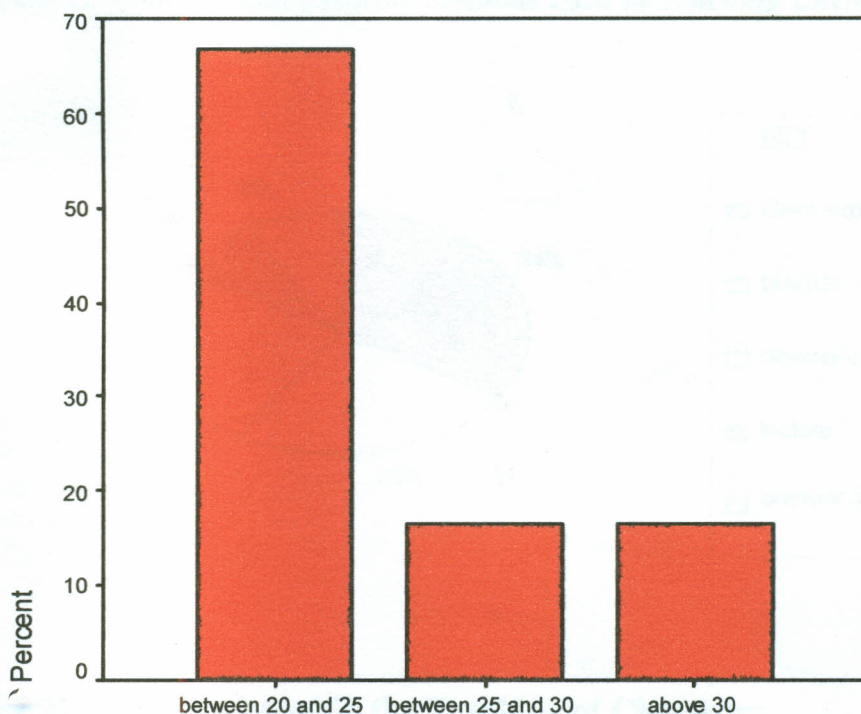
A realistic view of self is another pre – requisite for success. All teachers bring some strengths and weaknesses to the teaching situations. A useful consideration is to learn how to capitalize on their strengths and be determined to shed off their weaknesses as rapidly and conveniently as possible. This means that they must not only learn to be receptive to constructive criticism offered by supervisors, co – operating teachers, head of department and inspectors but they must also develop the skills of self criticism. This touches one of the goals of teacher education: ‘to help novices progress to a point where they can succeed in the classroom and continue learning about instruction on their own throughout their teaching career’.

4.5.19 Number of Lessons Taught by Chemistry Teacher Per Week

The teacher respondents were asked to state the number of lessons each taught per week. 4 (66.7%) of them taught between twenty and twenty five lessons per week, 1 (16.7%) taught between twenty five and thirty lessons per week and 1 (16.7%) taught over thirty

lessons per week. This indicated that all the teachers were overworked considering that they were also acting as laboratory technicians because majority of the schools did not have the technicians. Teaching science requires more input than other subjects because the teacher has to prepare for practical work and to care for equipment and the laboratory, yet they have the same number of periods and classes as teachers of other subjects.

Figure 4.14: Bar Graph Showing Number of Lessons Taught by the Chemistry Teacher Per Week



4.6 Teaching Methodology and Students' Performance in Chemistry

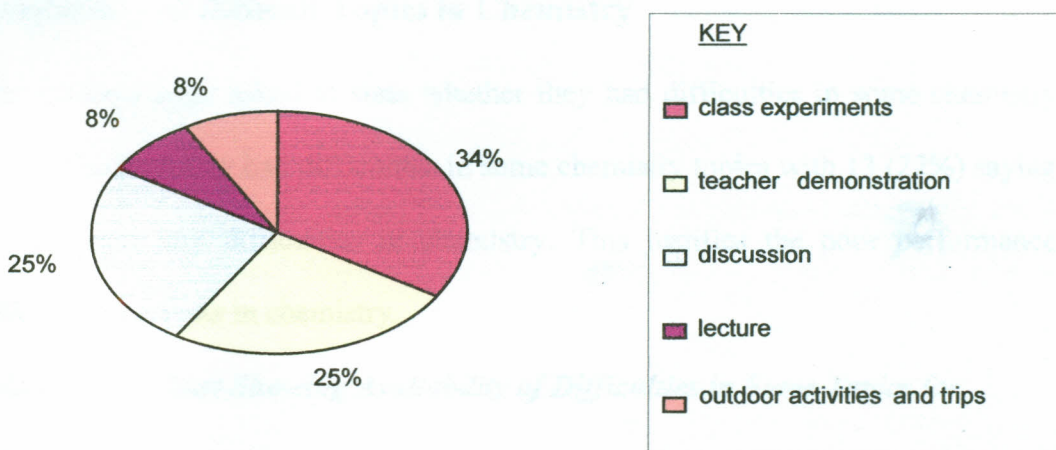
4.6.1 Methods Used in Teaching Chemistry

The teacher respondents used the following methods of teaching; 2 (34%) used class experiments, 1 (25%) used teacher demonstration, 1 (25%) used discussion, 1 (8%) used lecture method and 1 (8%) used outdoor activities and trips. 3 (50%) of the six respondents combined three teaching methods namely class experiments, discussion and

teacher demonstration. Half of the teachers employed a variety of teaching methods which ensured that the concentration span of the students is maintained and the teacher is not considered boring. These methods overlap considerably to ensure that desirable outcomes are attained. It is unwise for the teacher to choose one method as the best and adhere to it exclusively.

A combination of these methods is sometimes necessary in achieving the stated objectives. (Ministry of Education, 2006)

Figure 4.15: Pie – Chart Showing Methods Used in Teaching Chemistry



4.6.2 Methods Preferred in the Teaching of Chemistry

6 (100%) of the teacher respondents listed lecture method as the least used in their instruction process while discussion, teacher demonstration, class experiments were the most preferred and used methods of instruction.

4.7 The Concepts From Chemistry Related Subjects Used in Some Chemistry Topics and Students' Performance in Chemistry

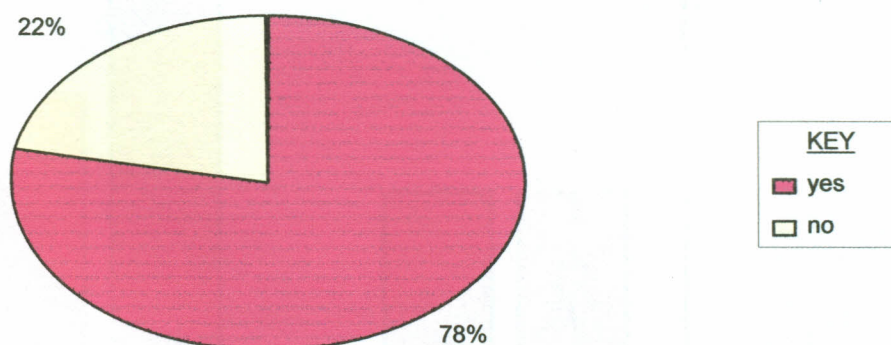
4.7.1 Teachers' Views on Whether Students Had Difficulties in the Chemistry Subject

When teacher respondents were asked whether their students have difficulties in chemistry, 6 (100%) of them said that their students had difficulties in chemistry. This indicated that students generally had difficulties in the subject.

4.7.2 Availability of Difficult Topics in Chemistry

When the students were asked to state whether they had difficulties in some chemistry topics, 47 (78%) said they had difficulties in some chemistry topics with 13 (22%) saying they did not have any difficulties in chemistry. This justifies the poor performance registered by the students in chemistry.

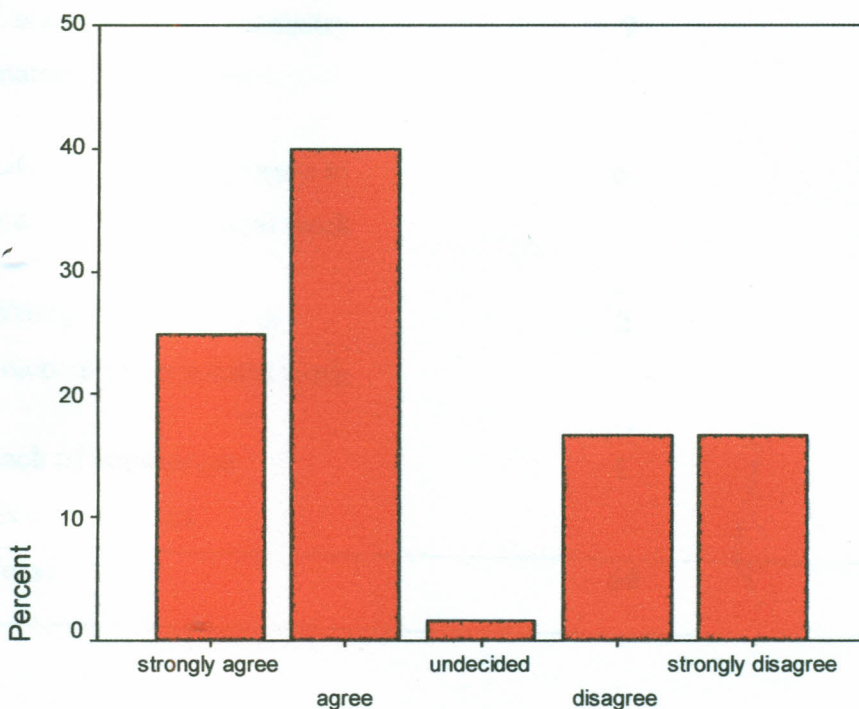
Figure 4.16: Pie – Chart Showing Availability of Difficulties in Some Topics for Students in Chemistry



Topics 4.7.3 Students' Views on Whether Concepts From Chemistry Related Subjects Used in Some Chemistry Topics Make Them Fail in Chemistry

When the question of whether concepts from chemistry related subjects such as mathematics used in some chemistry topics make students fail was posed to the student respondents, 15 (25.0%) of the students strongly agreed, 24 (40.0%) students agreed, 10 (16.7%) of the student respondents disagreed and 10 (16.7%) strongly disagreed while 1 (1.7%) was undecided. With 39 (65.0%) of the students agreeing that some concepts from chemistry related subjects make them fail then it can be concluded that poor performance in such subjects as mathematics will have negative effects on performance in chemistry. That meant that if the students found the chemistry related subjects such as mathematics difficult, then chemistry will be equally difficult.

Figure 4.17: Bar Graph Showing Students' Views on Whether Concepts From Chemistry Related Subjects Used in Some Chemistry Topics Make Them Fail in Chemistry.



4.7.4 Problems Encountered in the Learning of Chemistry Subject

When the student respondents were asked what problems they encounter when learning chemistry, 42 (70.0%) of the respondents cited difficult topics, 9 (15.0%) said lack of adequate chemistry materials was the main problem, 6 (10.0%) of the student respondents cited little or lack of exposure to practical/experimental work, 2 (3.3%) said wrong observations in practical/experimental work was the main problem while 1 (1.7%) of the student respondents cited lack of enough appropriate books as the main problem. This meant that even with laboratory equipments and materials/equipment, topics that were difficult were the main hindrance to good performance in chemistry.

Table 4.12: Showing Problems Encountered in Learning Chemistry

Problems encountered in learning chemistry	Number of teacher respondents (frequency)	Percentage (%)
Difficult topics in chemistry	42	70
Lack of adequate chemistry materials/equipment	9	15
Little or lack of exposure to practical/experimental work	6	10
Wrong observations in practical/experimental work	2	3.3
Lack of appropriate chemistry books	1	1.7
Total	60	100

4.8 Emerging Issues on Problems Encountered in Teaching Chemistry

Subject and Views on Possible Ways of Improving Students' Performance.

4.8.1 Problems Teachers Encounter in the Teaching of Chemistry

3 (50%) of the teacher respondents cited negative attitude and lack of laboratory materials as the problems they encounter when teaching chemistry. 2 (33%) identified heavy workload, weak students and lack of laboratory technician as the problems they encounter when teaching. 1 (17%) cited difficult topics and lack of laboratory as the main problems they encountered when teaching chemistry.

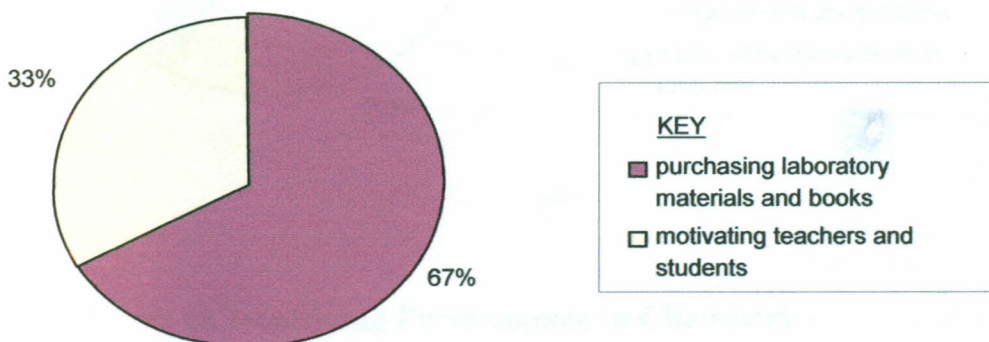
Table 4.13: Showing Problems Teachers Encounter in the Teaching of Chemistry

Problems teachers encounter in teaching chemistry	Number of Teacher Respondents (frequency)	Percentage (%)
Negative attitude and lack of adequate laboratory materials	3	50
Heavy workload, admission of weak students and lack of laboratory technicians	2	33
Difficult topics and lack of adequate laboratories	1	17
Total	6	100

4.8.2 Steps Taken by Head teachers to Improve Students' Performance in Chemistry

4 (67%) of the teacher respondents said that the school head teacher purchases laboratory materials and chemistry books in a bid to improve performance in the subject. 2 (33%) said the head teachers were motivating teachers and students in a bid to improve performance of chemistry.

Figure 4.18: Pie – Chart Showing Headteachers' Steps to Improve Students' Performance in Chemistry

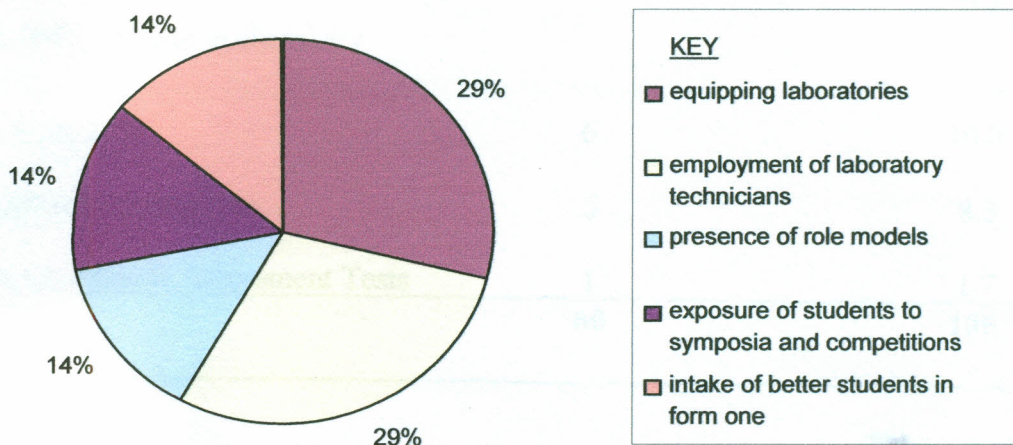


4.8.3 Teachers' Views on Improving Students' Performance in Chemistry

2 (29%) of teacher respondents said that equipping laboratories with materials and apparatus for effective teaching will improve student performance in chemistry, 2 (29%) said presence of laboratory technicians or assistants who help set up practicals will improve performance of chemistry. 1 (14%) of the teacher respondents considered presence of role models in chemistry as a necessary step in improving chemistry and another 1 (14%) said exposure of students to symposia and competition will improve

performance in chemistry. 1 (14%) of the teacher respondents said that intake of better students at form one will help in improving performance of chemistry.

Figure 4.19: Pie – Chart Showing Teachers’ Views on Improving Students’ Performance in Chemistry



4.8.4 Students’ Views on Improving Performance in Chemistry

When the student respondents were asked to identify ways of improving chemistry, 23 (38.3%) wanted more practicals done, 14 (23.3%) wanted more chemistry revision materials, 11 (18.3%) wanted more consultations with teachers on difficult areas, 6 (10.0%) identified group work as a way they can improve chemistry performance, 5 (8.3%) wanted laboratory facilities improved while 1 (1.7%) wanted more Continuous Assessment Tests(CATs) done.

Table 4.14: Showing Students' Views on Improving Performance in Chemistry

Students' views on improving their performance in chemistry	Number of student respondents (frequency)	Percentage (%)
Doing more chemistry practicals/experiments	23	38.4
Availing more chemistry revision materials	14	23.3
Enhancing more consultations with chemistry teachers on difficult areas in chemistry	11	18.3
Enhancing groupwork	6	10.0
Improving laboratory facilities	5	8.3
Doing more Continuous Assessment Tests	1	1.7
Total	60	100

4.9 Discussion of Findings

From the objectives and findings of this study, a number of conclusions, which have been discussed in the order of statements of objectives, can be made. This study found out that the students' attitude towards chemistry was positive but other limitations made them perform poorly in the subject. These limitations included lack of chemistry materials both in the library and the laboratory, overworked teachers and lackluster response from the administrators.

This study found out that a teacher's qualifications was not the issue in the poor performance of the students in chemistry in Nyamaiya Division in Nyamira District. Most of the schools had qualified teachers who were committed to teaching the subject. Their performance was hindered by factors beyond their control including too many

lessons per week, lack of laboratory technicians to assist in setting up practicals hence the teachers doubles up as a laboratory technician.

The study also revealed that majority of the teachers had been exposed to in-service training the major one being SMASSE although it had been observed that the SMASSE programme had not resulted in improved performance. The study also established that the teachers had the necessary experience because all the teachers had a teaching experience of more than five years.

The research established a positive relationship between availability and use of Chemistry resources and students' performance in Chemistry. Generally, there was a comparatively better performance in Chemistry in better equipped schools (in terms of existing well-stocked library and teaching/learning resources) than in schools lacking these resources. Therefore, according to this study, availability and use of teaching/learning resources is critical if performance in Chemistry is to be improved in secondary schools.

The study also revealed that availability of enough teachers is fundamental to influencing performance in Chemistry. In those schools where there were enough and qualified teaching personnel, performance in the subject was found to be high. It is therefore critical that Chemistry be taught by professionals who understand the subject requirements well. When a school has enough professional teachers, everyone will have a manageable number of lessons and therefore have more time with the students. In so doing, more students will be attracted to the subject as the teachers will be available to assist them through difficult or challenging areas in the subject.

The study also identified the problems that make students perform poorly in chemistry in the division and these included: lack of chemistry books and revision materials, for instance, there was no school having a dictionary of chemistry. Such an authoritative, comprehensive and up to date dictionary represents a ready made source book of worldwide value. The terms and definitions in it are frequently presented in brief or functional phrases, thus avoiding the more comprehensive type or treatment appropriate to larger reference works. This dictionary would be of immense value to students of chemistry, biochemistry, medical, engineering and other studies in the related fields. (Arora, 2007)

The study also revealed that there was inadequate exposure to practicals due to poorly equipped laboratories or lack of laboratories, difficulties in deducing observations from practicals. There were difficulties in some chemistry which require the use of concepts and skills from other chemistry related subjects such as mathematics. This is due to the fact that chemistry requires a wide range of application of mathematical concepts such as drawing and interpreting graphs as well as the use of mathematical tables and calculators in some topics such as gas laws, the mole, energy changes, radioactivity, thermochemistry, reaction rates among others.

The study also established the fact that concepts from chemistry related subjects such as mathematics are widely used in some selected topics in chemistry subject making students fail. The poor performance exhibited in chemistry is also reflected in such subjects as illustrated in Table 1.1. Thus, poor performance in chemistry can be attributed to a poor foundation in chemistry related subjects. The secondary school can provide firm Principles of Chemistry with Physics, on a good Mathematical basis, (Jezowska, 1975).

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In the preceding chapter the researcher has tried to establish the students' attitude towards chemistry, the qualifications of chemistry teachers and gauge availability and use of chemistry teaching and learning resources. The researcher has also tried to identify teaching methods used in chemistry, establish the effect of concepts from chemistry related subjects used in some chemistry topics on students' performance and establish ways of improving chemistry performance.

A number of issues affecting performance in chemistry in public secondary schools have been investigated and the findings discussed in this study. Most of the issues were raised by the objectives and research questions, while others emerged in the course of the study. This chapter summarizes the study and answers the research questions. It goes on to make recommendations on issues pertaining to performance in chemistry. In addition, it recommends on areas that should be considered for further research.

5.2 Summary

This study was necessitated by complaints from various education stakeholders at different levels regarding a notable decline in performance in Chemistry in secondary schools. Statistics available at education offices in the district reveal that performance in the subject is decreasing at an alarming rate and there was urgency that reasons be sought to explain this phenomenon that is causing discontent.

This study set out to establish the effect of such factors as teachers characteristics, availability of teaching/learning resources, availability of teaching personnel and the students' attitude towards chemistry on performance in the subject.

It was carried out in Nyamaiya Division in Nyamira District and targeted form IV students and Chemistry teachers in the fourteen public secondary schools in the division. The researcher sampled out six public secondary by stratified random sampling from the two zones of the division. Those who responded to this study were sixty (60) Form IV students and six (6) chemistry teachers.

The researcher used questionnaires to get information from the Chemistry teachers and students. The questionnaires were pre-tested for reliability. The study revealed that indeed students' performance in Chemistry was low in the division. Although the students considered chemistry a difficult subject, they generally had a positive attitude towards the subject after enumerating its importance. The teachers who responded in the questionnaire were qualified except in one school where there was no chemistry teacher. This indicated that the problem of staffing in the division in the subject was being addressed by concerned parties. But that is as far as subject staffing goes because when it comes to the teachers' workload, the issue of staffing comes up again. The understaffing was found to overload the few available teachers and this effect impacted negatively on performance in Chemistry due to the high enrolment in the subject in the schools in the division.

Majority of the teacher respondents had enough experience in the subject as most of them had taught for more than five years. Since the introduction of SMASSE to improve

performance in sciences and mathematics, majority of the teachers had attended the in-service training on the subject and this helped them to update on the current trends of curriculum implementation and evaluation. This programme though had not resulted in improved performance in the subject as well as other chemistry related subjects such as mathematics. The Heads Association in the District noted that the teachers had gone through the four cycles of the programme, however the results in the subjects had not changed for the better, (Ministry of Education, 2007)

The recent mushrooming of schools in Nyamira district leaves a lot to be desired. The schools vary in age, historical background and experience and/or legacies. School compounds vary lamentably with some schools no having play grounds at all. Basic facilities like classrooms, laboratories, libraries and dormitories not adequately available. (Ministry of Education, 2005)

Most schools were found to lack libraries with the necessary teaching/learning resources for the subject. Where they were available most students did not have adequate access to the reading or reference materials. This was the same for laboratory requirements whereby most of the schools lacked fully equipped laboratories considering that chemistry is a practical subject which requires frequent exposure of the students to practicals.

In two schools there was no laboratory at all and this complicated things for the two teachers in carrying out practicals and improving performance of the subject. To make matters worse majority of the schools did not have laboratory technicians which complicated matters for the already overworked teachers. Laboratory technicians make it

easy by setting up practicals for the teachers to use during the practical lessons. When they are absent, it means the teacher has to suspend some work to arrange for and set up practicals and finally administer it. This not only over-stretches the teacher but denies the teacher time to attend to students effectively.

The country needs to establish an effective National Assessment System that can monitor learner competencies at various levels. This will entail expanding the existing scope of the KNEC programme, which mainly focuses on summative testing. An integral strategy will also be to strengthen school – based testing. As required by the Sessional Paper No. 1 of 2005, KNEC must establish the necessary framework and therefore the objective of the MOE Strategic Plan for this area is to facilitate this process.

5.3 Conclusions

From the analysis and interpretation of the study findings, very important issues which have key implications to chemistry education have come up. The key issues which apply to all schools in the country are as follows:

- i) It is urgent that the stakeholders concerned take advantage of the positive attitude of the students towards chemistry as a subject and build on it to improve its performance. Concerted effort needs to be made in areas identified as contributing to poor performance such as improvement in staffing, equipping laboratories and libraries.
- ii) For sustainable and continued improvement of performance in Chemistry, new teachers should be inducted and oriented into the profession by experienced teachers. Equally, head teachers and education officers should ensure that this is done by organizing regular seminars, workshops and other such in-service

courses for all Chemistry teachers so as to keep them updated on the current trends in the teaching of Chemistry as a subject.

- iii) Since all teachers cannot be examiners at the same time, KNEC should liaise with the ministry of education and other statutory bodies to organize such workshops and seminars that it considers appropriate regularly for all teachers, so that everybody has the necessary skills and competencies required in preparing and presenting candidates for the national examinations.
- iv) Availability and use of teaching/learning resources in schools is a necessary pre-requisite to quality teaching and learning. Head teachers should ensure that such resources are available by putting in place efficient procurement systems. They should also strive to provide good working conditions and conduct regular teacher appraisal for the purpose of positively motivating teachers to work harder.
- v) Where schools are adequately staffed, most subjects are taken care of and teachers work like a team/family hence results are very good. Increased teacher recruitment, deployment and supply are crucial to quality teaching and consequently improvement in performance in various subjects.

5.4 Recommendations

Departments of science and mathematics should liaise and find a way in which they can collaborate in improving the performance of the subjects in these departments as poor performance in one subject leads to poor performance the other. Students and teachers should identify areas that are related and troubleshoot and brainstorm to identify appropriate approaches in tackling those areas.

Schools should be treated on their own merit and the poorly established schools should be encouraged to learn from the performing schools and aim higher. At the same time, QAS inspection should be enhanced in poorly established non-performing schools

Chemistry teachers should take into consideration the following when determining the approach and method to be used in chemistry teaching and learning process for high achievement to be realized:

- **The learner:** level of maturity, attitude, ability and capability.
- **Facilities and resources:** availability of a laboratory, library, text books, chemicals, equipment and apparatus.
- **Size of class:** If the apparatus are not enough for individual experiments for each learner, it is advisable to either use group experiments, class demonstration can be carried out depending on the adequacy of apparatus and materials.

There is need for further research to be done in order to strengthen the findings of this study. Therefore the following areas are recommended for further research:

- This study was carried out in Nyamaiya Division of Nyamira District. For better and more realistic generalization with a higher degree of accuracy, this study should be carried out in the entire District and the country in general.
- There is need to carry out a research to find out the specific areas in the Chemistry syllabus which are difficult or challenging (or both) to students and teachers.
- The unique relationship between other science subjects as well as mathematics and chemistry need to be investigated and determine why most students perform poorly in these subjects.

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Appendix I

Teachers' Questionnaire

Teacher's Identification No.:

A survey is being carried out to establish the factors influencing the students' performance in KCSE Chemistry examinations in Nyamaiya Division in Nyamira District. Your honest responses to each of the following questions are essential to this survey.

I hereby assure that your responses will be treated as being strictly confidential and will be used only for the purpose of the study. Please, write your responses in the spaces provided.

1) Name of school

.....
.....

2) Do you like teaching Chemistry? (Tick (✓) appropriately).

Yes [] No []

3) a) Of the three sciences; Chemistry, Biology and Physics, would you like Chemistry to be made optional in your school?

Yes [] No []

b) Give reasons for your response in a) above

.....
.....
.....
.....

4) What is the performance of Chemistry by students in your school as compared to that of other subjects in K.C.S.E.? (Tick (✓) appropriately).

Poor []

Good []

Better []

Same as others []

5) i) Fill the table below with regard to the academic and professional qualifications of the Chemistry teachers in your school.

TEACHER QUALIFICATION	NUMBER OF CHEMISTRY TEACHERS IN YOUR SCHOOL
B.ED	
B.SC	
B.SC and PGDE	
DIPLOMA	
S1	
ANY OTHER (SPECIFY)	

ii) What is your teaching experience (in years or months)?

.....

iii) Do you attend in-service courses/seminars on Chemistry education

regularly? (Tick (✓) appropriately).

Yes []

No []

6) a) i) Are there laboratories in your school? (Tick (✓) appropriately).

Yes []

No []

If Yes, how many laboratories are there?

ii) How equipped is/are your laboratory/laboratories with Chemistry facilities, i.e., apparatus and chemicals? (Tick appropriately).

Well equipped []

Fairly equipped []

Poorly equipped []

iii) Do you use the laboratory/laboratories in teaching Chemistry? (Tick (✓) appropriately).

Yes []

No []

If Yes, at what frequency does each class have its Chemistry practical lessons there?

Fill in the table below by ticking (✓) appropriately

FREQUENCY	FORM 1	FORM 2	FORM 3	FORM 4
Every week				
Once every two weeks				
Once a month				
Once a term				
Not at all				

iv) Is the space in the laboratory where you carry out Chemistry practical lessons enough in relation to the number of students in your Chemistry classes? (Tick (✓) appropriately).

Yes []

No []

v) Do Chemistry students do Practicals in groups or individually?

.....

If in groups, are the groups constituted by more than three students per group? (Tick (✓) appropriately).

Yes []

No []

vi) Is there a Chemistry laboratory technician/assistant in your school? (Tick (✓) appropriately).

Yes []

No []

b) i) Is there a library in your school? (Tick (✓) appropriately).

Yes []

No []

If yes, how equipped is it with relevant and appropriate Chemistry teaching and learning materials? (Tick (✓) appropriately).

Well equipped []

Fairly equipped []

Poorly equipped []

ii) In the table below, indicate the Chemistry textbooks available in your school library for most classes and their adequacy in relation to the number of students taking Chemistry, by ticking appropriately against the books you indicate

BOOKS	AVAILABLE AND ADEQUATE	AVAILABLE BUT INADEQUATE	NOT AVAILABLE
KIE, Secondary Chemistry Pupils' books			
Patel, Secondary Chemistry books			
Others (Specify)			

7) i) Is there a head of science department in your school?

Yes [] No []

ii) If Yes, is he/she internally appointed or appointed by the Teachers Service Commission (TSC)?

.....

iii) If you have a head of Science department, what subject does he/she teach in the science department?

.....

iv) If he/she teaches a different subject other than Chemistry in the department, how do you compare the performance of his/her subject with the performance in Chemistry? (Tick (✓) appropriately)

Better [] Poorer []

8) i) Do you ever hold science departmental meetings? (Tick (✓) appropriately)

Yes [] No []

ii) If Yes, how often? (Tick (✓) appropriately)

Once in a term []

Twice in a term []

Three times in a term []

More than three times in a term []

9) i) Does your headteacher/principal involve you in making requisitions for Chemistry textbooks and laboratory equipment and Chemicals? (Tick (✓) appropriately)

Yes []

No []

ii) If Yes, does he involve you personally or through the head of department?

.....

10) How many lessons do you teach per week? (Tick (✓) appropriately).

Below 15 []

Between 15 to 20 []

Between 20 to 25 []

Between 25 to 30 []

Above 30 []

11) a) Which of the following methods do you commonly use to teach Chemistry? (Tick (✓) appropriately).

Lecture []

Class experiments []

Discussion []

Teacher demonstration []

Outdoor activities and trips []

Others (Please Specify) []

i)

ii)

iii)

b) List the methods you prefer using in teaching Chemistry in order from the one that you use most to the one that you use least.

.....
.....
.....

12) Do your students have difficulties in some of the chemistry topics that require the use of concepts and skills from chemistry related subjects such as mathematics?

(Tick (\checkmark) appropriately).

Yes []

No []

13) What problems do you generally encounter in your teaching of Chemistry?

.....
.....
.....
.....

14) What steps is your headteacher/principal taking to improve the performance in Chemistry in your school?

.....
.....
.....
.....

15) Suggest ways by which your students' performance in Chemistry could be improved.

.....
.....
.....
.....
.....

Appendix II

Students' Questionnaire

Student's Identification No. :.....

A survey is being carried out to establish the factors influencing the students' performance in KCSE Chemistry examinations in Nyamaiya Division in Nyamira District. Your honest responses to each of the following questions are essential to this survey.

I hereby assure that your responses will be treated as being strictly confidential and will be used only for the purpose of the study. Please, write your responses in the spaces provided.

1. Name of your school

.....
.....

2. i) How much do you like Chemistry as a subject? (Tick (\checkmark) appropriately)

a) Very much []

b) Moderately []

c) Very little []

d) Not at all []

ii) What influences your feelings in 2 (i) above? (Tick (\checkmark) appropriately)

a) The way it is taught []

b) The Chemistry content []

c) Any other reason. Specify []

.....
.....

3. Chemistry is easier than other subjects. (Tick (✓) appropriately)

a) Strongly agree []

b) Agree []

c) Undecided []

d) Disagree []

e) Strongly disagree []

4. a) Of the three sciences; Chemistry, Biology and Physics, would you like Chemistry to be made optional in your school? (Tick (✓) appropriately)

Yes [] No []

b) Give reasons for your answer in a) above.

.....
.....
.....
.....

5. Since you joined the school, is there any time when you did not have a Chemistry teacher? (Tick (✓) appropriately)

Yes [] No []

6. i) Is there a library in your school? (Tick (✓) appropriately)

Yes [] No []

If Yes, which of the following textbooks are available? (Tick (✓) appropriately)

KLB, Secondary Chemistry []

Patel, Secondary Chemistry []

Others (specify)

.....
.....
.....

- ii) How often are students allowed to borrow text-books from the library? Tick (✓) appropriately
- Every day
- Once every week
- Once every two weeks
- Once a term
- Not at all

7. i) Are there laboratories in your school? (Tick (✓) appropriately)

Yes No

If Yes, how many laboratories are there in your school?

.....

ii) Is there a laboratory specifically for Chemistry only? (Tick (✓) appropriately)

Yes No

iii) Do you use worksheets (manuals describing experimental procedures) in your Chemistry practical lessons? (Tick (✓) appropriately)

Yes No

If yes do you use them individually or in groups?

.....

8. Do you have difficulties in some chemistry topics that require an extensive use of concepts and skills from other chemistry related subjects such as mathematics?

(Tick (✓) appropriately)

Yes No

9. An extensive use of concepts and skills from other chemistry related subjects such as mathematics make students to fail. (Tick (✓) appropriately)

a) Strongly agree

b) Agree

c) Undecided

d) Disagree

e) Strongly disagree

10. What problems do you encounter in your learning in Chemistry

.....

.....

.....

.....

.....

11. Suggest ways by which your performance in Chemistry could be improved.

.....

.....

.....

.....

.....

Appendix III

Research Timetable

<u>EVENT</u>	<u>DATE</u>
Problem selection	July 2006
Writing and typing of research Proposal	August 2006
Handing in of research proposal	April 2007
Pilot study and adjustment of data collection instruments	June 2007
Collection of data	July 2007
Analysis of data	August 2007 to August 2008
Writing of final report	September 2008 to October 2008
Typing of final report	November 2008
Submission of report to the supervisors	December 2008
Submission of report after first set of corrections	August 2009
Submission of report after second set of corrections	September 2009
Submission of report after third set of corrections	December 2009
Submission of final report to the School of Education	December 2009
Submission of final report to the School of Education after corrections	April 2010

Appendix IV

Research Budget

Item description	Amount (Kshs)
Proposal preparation	
Stationery	
Foolscaps: 2 reams @300	600
Assorted pens and pencils	700
Five spring files	200
Flash disk	1,500
Photocopying services	
Literature preparation	3,000
Proposal drafts	1,000
Final proposal : 2 copies @1000	2,000
Printing	
Proposal drafts: 2 copies @2000	4,000
Final proposal	4,000
Binding	1,000
Piloting	
Printing questionnaires: 11 pages @30	330
Photocopying questionnaires: 11 pages 35 copies @2	770
Subsistence during pilot 3 days @ 500	1,500
Traveling expenses 3 days	2,500
Report writing	2,500
Data collection	
Printing questionnaire: 11 pages @ 30 shillings	330
Photocopying questionnaires: 11 pages, 70 copies @ 2/=	1,540
Subsistence and accommodation 6 days @ 500	3,000
Traveling expenses 6 days @ 1000	6,000

Project preparation

Stationery 3 reams of paper @400	1,600
Final project draft: 2 copies @1,500	3,000
Final project report: 9 copies @1,500	13,500

Other expenses

Transport	24,000
Accommodation for 15 days @ 500	21,500
Computer services	10,500

Sub total **109,570**

Contingencies 10% 10,957

Grand total **120,527**

Appendix V

Map of Nyamira District



Source: Nyamira District Survey Office