INFLUENCE OF COMMUNITY INDIGENOUS KNOWLEDGE OF SCIENCE ON STUDENTS' PERFORMANCE IN CHEMISTRY IN SECONDARY SCHOOLS OF SAMBURU COUNTY, KENYA

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Egerton University

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DECLARATION AND RECOMMENDATION

DECLARATION

I declare that, this is my original work and has not been presented for any Degree or Diploma in this or any other university.

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RECOMMENDATION

This Thesis has been submitted for examination with our approval as University Supervisors.

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DEDICATION

This piece of work is dedicated with affection and love to my wife Margaret APoo Ekwam and my son Douglas Lomonyang Ekwam, daughters Ann Iruata Ekwam and Abigael Akiru Ekwam for their patience, understanding and support during the period of my study. And also to my parents Lomonyang Naluku and Mary Akiru Lomonyang for their moral support that encouraged me to undertake a great task as this, may the Almighty God bless them.

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ABSTRACT

African communities have a relatively rich body of indigenous knowledge and related technology. This is embodied in the continent's cultural and ecological Indigenous Knowledge Systems and has been used by the African people for thousands of years to solve their specific developmental and environmental problems. According to Kenya National Examinations Council report, Secondary School students' performance in Chemistry has been poor for many years. This has been attributed to many factors including Cultural knowledge systems. However, it is not quite clear how this has influenced students' performance in Chemistry. The current concern in Samburu county among parents and other stakeholders in education is that, students' performance in chemistry was more likely to be negatively affected. The purpose of this study was to assess the influence of Community Indigenous Knowledge of Science on Students' Performance in Chemistry in secondary schools of Samburu County. Cross-Sectional study design under the descriptive survey research was used. A stratified random sample of 9 secondary schools including both the public and private was drawn. From the target population of 752 form three students of Samburu County in the year 2013, stratified and simple random sampling was used to select a sample of 224 students. The instruments were validated and pilot tested before use. The reliability coefficient for Chemistry Performance Test (CPT), Students' Questionnaire (SQ) and Students' Interview Schedule (SIS) was 0.80, 0.68 and 0.72 respectively. The instruments were scored and data was analyzed using descriptive statistics where means, percentages and frequencies were used to analyze the data. Pearson's Correlation Coefficient was used to establish the relationships between the different variables in the study. All statistical test of significance were conducted at coefficient alpha (α) equal to 0.05 with the help of the computer program, statistical package for social sciences (SPSS). The results of the study showed that students' performance in chemistry was below average whereby boys' schools performed better than both the girls' and co-educational schools. There was no statistically significant relationship between Community Indigenous Knowledge and Students' Performance in Chemistry. Community Indigenous Knowledge of Chemistry and its application in treatment of diseases promote students' understanding of chemistry. The researcher recommended that the Ministry of Education should initiate in-service courses for science teachers to equip themselves with the skills of Community Indigenous Knowledge of Science to enhance their effectiveness in teaching of science subjects. The findings of this study are of great benefit to teachers, curriculum developers and policy makers in addressing the current poor performance of chemistry and realization of strategies for boosting performance of chemistry in secondary schools countrywide.

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LIST OF ABBREVIATIONS AND ACRONYMS

AIDs	Acquired Immuno Deficiency Syndrome.
CPT	Chemistry Performance Test.
CIDA	Canadian International Development Agency.
CIKWS	Conflict of Indigenous Knowledge on Western Science.
DoE	Department of Education.
FET	Further Education and Training.
GET	General Education and Training.
GIS	Geographical Information Systems.
HIV	Human Immuno Deficiency Virus.
IK	Indigenous Knowledge.
IKS	Indigenous Knowledge System.
INSET	In-service Education and Training.
IIRR	International Institute of Rural Reconstruction.
SIS	Students' Interview Schedule.
JICA	Japan International Co-operation Agency.
KCSE	Kenya Certificate of Secondary Education.
KNEC	Kenya National Examinations Council.
MoEST	Ministry of Education, Science and Technology.
NACOSTI	National Commission for Science, Technology and Innovation.
NCHE	National Commission on Higher Education.
NEPAD	New Partnership for Africa's Development.
NGOs	Non-Governmental Organizations.
RCKC	Role of Chemistry Knowledge in the Community.
SBFLPPA	Students' Background Factors Leading to Poor Performance in Academics.
SIS	Students' Interview Schedule.
SMASSE	Strengthening of Mathematics and Science in Secondary Education.
SQ	Students' Questionnaire.
STDs	Sexually Transmitted Diseases.
UNICEF	United Nations International Children's Fund.
TB	Tuberculosis.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Education is an integral part of life in any society. The social and cultural forces surrounding each individual thus form the basis of indigenous education. Hinzen (1988) observes that during the long ages of pre-history, human beings survived because they were capable of learning by example and experience to adapt their way of life to their environment throughout succeeding generations. Indigenous education in its various forms is intimately intertwined with social life. Sifuna (1990) emphasizes that what is taught in traditional societies was related to social context in which people lived as well as the demands of their particular environment. Thus, indigenous knowledge had a direct and symbiotic relationship with the environment (Castle, 1966 & Ocitti, 1973). Indigenous Knowledge also responded to social change and was an important catalyst of change. Indigenous knowledge was therefore associated with social development.

Indigenous knowledge takes many forms, depending on the particular historical and cultural background. According to Ishumi (1976), this education was influenced by the prevailing economic, social, religious and political systems. In short, this system of education sustains community development. In support of this, former President of Tanzania, Mwalimu Julius Nyerere, described indigenous education as an integral part of life (Hino, 1996).

Africa has a relatively rich body of indigenous knowledge and related technologies. This is embodied in the continent's cultural and ecological diversities and has been used by the African people for thousands of years to solve specific developmental problems (Ogunleye, 2009). Indigenous knowledge and technologies play major roles in biodiversity conservation, sustainable use and prospecting. In addition, their contributions to increasing food production, fighting HIV/AIDS and other diseases, and stemming environmental degradation are considerable (Hills, 1989). Despite their contributions, indigenous knowledge and technologies are not adequately promoted and protected in most African countries (Turnbull, 2000). Institutions to safeguard the rights of indigenous knowledge holders are weak in most countries. In addition, there are weak links between the formal institutions and the local communities that hold and use the knowledge. This has denied Africa the opportunity to better understand and use its indigenous knowledge

base hence having a wider gap between IK and Western Science (Hills, 1989 & Ogunleye, 2009).

African leaders have recognized and stressed the importance of protecting and promoting indigenous knowledge and technologies to solve specific problems and improve the continent's economies. NEPAD framework document are devoted to the protection and promotion of indigenous and related technological innovations (Turnbull, 2000). Paragraph 140 of NEPAD states:

> "Culture is an integral part of development efforts of the continent. Consequently, it is essential to protect and effectively utilize indigenous knowledge…and share this knowledge for the benefit of humankind…special attention (will be given to) the protection and nurturing of indigenous knowledge…inventions…and all other tradition- based innovations and creations" (Turnbull, 2000: Pp.210-387).

Indigenous knowledge has been used in treatment of various diseases using herbs for example the Chinese Wormwood (*Artemesia annua*) for treating malaria and Prunus Africana bark used for treating cancer (Turnbull, 2000).

Culture has received considerable attention in the global world with its varying definitions. The assumptions that culture is the primary determinant of academic achievement can be dangerous and counterproductive if misinterpreted (Hills, 1989 & Ogunleye, 2009). Culture depicts people's peculiar patterns of values, attitudes, knowledge, skills, behaviours, language and technology (Akinwale, 2004). It is the sum total of the learned behaviour of a group of people that are generally considered as their tradition and are transmitted from generation to generation and in various forms (Ogunleye, 2009). Cultural differences and characteristics manifest themselves in different domains and at different depth. Applying UNESCO's general definition, domains of culture include spiritual, material, intellectual and emotional features of society or group, in addition to its art and literature, lifestyles, way of living together, value system, traditions and beliefs (Akinwale, 2004).

Chemistry teaching can only be result-oriented when students are willing and the teachers are favourably disposed, seeing the appropriate methods and resources in teaching the students. With the current increase in scientific knowledge in the world all over, much demand is placed, and emphasis is laid on the teacher, the learner, the curriculum and the environment in the whole process of teaching and learning of science (Emovon, 1985).

Despite the importance of Chemistry to mankind and the varied efforts of researchers to improve on its teaching and learning, the achievement of students in the subject remains low in Nigeria and also in Kenyan secondary schools (Changeiywo, 2000). Among the factors that have been identified to lower the outcomes in chemistry are, poor methods of instruction (Osuafor, 1999), teacher's attitude (Aghadiuno, 1992), laboratory in-adequacy (Rajah, 1999 & Adeyegbe, 2005) and poor science background (Oshokoya, 1998 & Adesoji, 1999).

Positive perception of Science by students plays a major role in advancement of modern technology of any country in the world. America, Britain, Japan and China have excelled well in the field of Industrialization because of being well established with scientific skills (Aduda, 2003). Kenya envision being a middle income country by the year 2030, however looking at the performance of science subjects at Secondary education level, achievement of the vision may be in doubt because of the negative perception of Mathematics and sciences leading to lower performance by students at Kenya Certificate of Secondary education (SMASSE project, 1998). Many students in Kenya choose to drop science subjects when given a choice and even for those who take them, the performance is below average (Changeiywo, 2000). The poor performance is evident from results in Table 1, which compares the students' performance in Chemistry and other science subjects and the situation is similar to that one in Samburu County.

Table 1 Comparison of Students' Performance in KCSE Chemistry and other Science Subjects

Subject	2008		2009		2010		2011		Average
	Cand:	(%)	Cand:	(%)	Cand:	(%)	Cand:	(%)	
Biology	203,96	25.95	217,923	27.4	245,911	40.6	270,894	47.25	35.3
Physics	63,562	37.21	72,499	40.0	83,273	39.9	94,318	43.21	40.3
Chem	213,499	24.31	236,901	24.8	266,761	25.1	298,761	25.58	25.0

Source: Kenya National Examination Council report, 2012:Pp. 2-3

Table 1 Shows that the average mean scores in Biology and Physics lie between 35 - 40% while the average mean score in Chemistry was 24%. This difference in performance may be as a result of the negative influence of community indigenous knowledge of science

held by students towards science subjects. Improving the performance of science education is a great societal challenge in Kenya not only for industrialization of the country but also for producing scientifically empowered citizens with adequate scientific skills for handling science related challenges. This poor performance is the one that prompted the government of Kenya through the Ministry of Education Science and Technology (MOEST), with assistance of the Japan through Japan International Corporation Agency (JICA) to initiate a programme on the Strengthening of Mathematics and Science in Secondary Education (SMASSE) (Changeiywo, 2000). This programme has been implemented in Samburu County but students' performance in these subjects especially Chemistry among the Sciences continued being below 50% in spite of this intervention (KNEC report, 2012), as shown in table 2.

Table 2 Samburu County Students' Performance in 2010 to 2012 KCSE Examinations in Mathematics and Sciences

Subject	2010				2011				2012			
	No. Sat	Female Mean (%)	No. Sat	Male Mean (%)	No. Sat	Female Mean (%)	No. Sat	Male Mean (%)	No. Sat	Female Mean (%)	No. Sat	Male Mean (%)
Math	159	20.09	314	25.8	211	24.5	358	28.13	251	21.43	374	27.93
Biology	159	41.02	314	43.3	211	54.5	358	57.83	251	53.43	374	55.21
Physics	17	40.12	88	43.5	20	41.39	87	44.93	17	37.92	87	45.13
Chem	159	31.09	314	32.6	211	32.93	358	34.52	251	31.14	374	33.91

Source: Samburu County DEO's office, 2012: Pp. 4-5

In response to the challenges posed by the influence of indigenous knowledge of science on students' performance and low enrolment in science subjects, several studies have been carried out in Kenya to investigate the possible causes, (Mondoh, 1986 & Wachanga, 2002). Majority of the previous studies on science education were centered on the instructional methods used by teachers, however, Haimowitz (1989), noted that the causes of most failures in schools might not be due to insufficient or inadequate instructions but perhaps by active resistance of the learners. Also, the research findings from baseline studies by SMASSE project (1999), has shown that consistent failure in Mathematics and Sciences at KCSE and negative attitude by students towards Mathematics and Sciences continues to characterize the classroom. This trend is posing huge problems to parents, government, politicians and students in education sector.

This therefore suggests that favourable means of improving Science subjects' performance in secondary level Education should be developed if success is to be attained. To be able to do this, clear understanding of the influence of community indigenous knowledge of science on students' performance in Chemistry is essential. However, this is not clear among students in Samburu County. This study attempts to investigate on the influence of Community Indigenous Knowledge of Science on students' performance in chemistry in secondary schools of Samburu County.

1.2 Statement of the Problem

African communities have a relatively rich body of indigenous knowledge and related technology. This is embodied in the continent's cultural and ecological Indigenous Knowledge Systems and has been used by the African people for thousands of years to solve their specific developmental and environmental problems. According to Kenya National Examinations Council report, Secondary School students' performance in Chemistry has been poor for many years. This has been attributed to many factors including Cultural knowledge systems. However, it is not quite clear how this has influenced students' performance in Chemistry. The current concern in Samburu county among parents and other stakeholders in education is that, students' performance in chemistry was more likely to be negatively affected. This study therefore was conducted as an attempt to provide specific information on the influence of Community Indigenous Knowledge of Science on Students' Performance in Chemistry.

1.3 Purpose of the Study

The purpose of this study was to determine the influence of community indigenous knowledge of chemistry and its application in treatment of diseases on students' performance in chemistry in secondary schools of Samburu County. The study further sought to find out the relationship between community indigenous knowledge of students' beliefs in cultural interpretations of scientific phenomena and students' performance in Chemistry. The study also aimed at determining the relationship between attitude towards community indigenous knowledge of science and students' performance in chemistry. It was hoped that based on the findings from this study, measures would be taken to improve students' performance in chemistry.

1.4 Objectives of the Study

The study was guided by the following objectives:-

(i) To determine the influence of Community Indigenous Knowledge on Students' performance in Chemistry in secondary schools of Samburu County.

(ii) To find out the influence of Community Indigenous Knowledge of students' beliefs in cultural interpretations of scientific phenomena on students' performance in Chemistry.

(iii) To investigate the influence of Community Indigenous Knowledge of Chemistry on students' performance in Chemistry.

(iv) To find out the influence of Community Indigenous Knowledge application in treatment of diseases on students' performance in Chemistry.

(v) To determine the influence of attitude towards Community Indigenous Knowledge of Science on students' performance in Chemistry.

1.5 Research Questions

In order to achieve the objectives of the study, the study was guided by the following five research questions.

(i) What is the influence of Community Indigenous Knowledge on students' performance in Chemistry in secondary schools of Samburu County?

(ii) What is the influence of Community Indigenous Knowledge of students' beliefs in cultural interpretations of scientific phenomena on students' performance in Chemistry?

(iii) What is the influence of Community Indigenous Knowledge of Chemistry on students' performance in Chemistry?

(iv) What is the influence of Community Indigenous Knowledge application in treatment of diseases on students' performance in Chemistry?

(v) What is the influence of attitude towards Community Indigenous Knowledge of Science on students' performance in Chemistry?

1.6 Significance of the Study

The findings would be of use to the stakeholders namely, the policy makers, parents, students and employers in their endeavour to enhance the realization of students' performance in Chemistry. Likewise, the findings would be of great value to curriculum developers and curriculum implementers by providing basis for them to appreciate and strategize on ways of boosting performance of Chemistry in secondary schools Countrywide.

1.7 Scope of the Study

The study was conducted among form three (3) students in nine secondary schools in Samburu County of Kenya. It focused on the influence of community indigenous knowledge of science on student's performance in Chemistry. The study focused mainly on the following areas such as community indigenous knowledge, students' beliefs in cultural interpretations of scientific phenomena, community indigenous knowledge of Chemistry, indigenous knowledge application in treatment of diseases and attitude towards community indigenous knowledge of science on students' performance in chemistry. Both public and private secondary schools under the two main divisions that are Kirisia and Leroki were included in the study. The divisions had more secondary schools than other divisions in the County that was why the category of schools was chosen. The findings of this study would specifically be generalized to these divisions, however in other divisions in the County; it would be done with caution.

1.8 Limitations of the Study

The study was limited only to both public and private secondary schools of Kirisia and Leroki divisions of Samburu County. No wider generalization of the findings of this study could be done. The study focused only on influence of community indigenous knowledge of science on students' performance in chemistry but other educational inputs were not considered. Some respondents might have not exhaustively given the information sought, however including the open-ended questions in the interview schedules in order to capture as much information from the respondents as possible would have solved this shortcoming. Ideally the study should have covered all the factors on Community Indigenous Knowledge of Science which influence students' performance in Chemistry for the whole Secondary School cycle.

1.9 Assumptions of the Study

The study was carried out under the following assumptions:

a) That Students' possess the information sought in Science subjects especially Chemistry.
b) That the responses given by students were honest to permit their use in the data analysis.
c) Chemistry syllabus coverage in both public and private Secondary Schools in Samburu County was covered uniformly.

d) The Chemistry teachers in Samburu County secondary schools were committed and motivated in their work.

1.10 Definition of Terms

The following terms are defined below as they are used in this study.

Attitude: Means one's perception about something and in this study it refers to students' disposition or feelings towards community indigenous knowledge. In this study, attitude is a variable that was determined by the scores students obtain after responding to items that asked on their feelings about the influence of Community Indigenous knowledge on students' performance in Chemistry that they were exposed to.

Chemistry: The field of scientific study of the structure of substances, how they react when combined or in contact with one another and how they behave under different conditions. It also involves study of nature and properties of all forms of matter, substances which make up our environment and the various changes they undergo in different conditions when used.

Cohort: A group of people who share a common feature or aspect of behaviour. In this study, it was taken to mean all the secondary school KCSE pre-candidates (form three students, 2013).

Community: A group of people, living in a particular area with a common feeling of sharing things and belonging to a group in the place where one lives. In this study it refers to different ethnic communities living together in a given area or locality at a given time.

Concept of Chemistry: Means a mental plan or picture of the field of Science dealing with the study of matter and its properties. In this study it refers to an idea or principle held by people in connection to their understanding of nature, properties of all forms of matter and the various changes they undergo in different conditions. It also involves a clear understanding of different forms of matter and processes they undergo in different reactions.

Culture: Is the Customs, ideas and way of life of a group of people or a Country. In this study it refers to people's way of life , their behaviours, beliefs, values and symbols they accept generally without thinking about them and which are passed on by communication and imitation from one generation to the next. For example,

the Community Indigenous Knowledge of Science and its influence on Students' Performance in Sciences especially Chemistry affects their attitude towards Science.

Disease: Is an illness, especially one that one can catch from other people for example Malaria and Measles. In this study it refers to an illness affecting humans, animals or plants and often caused by infection. It also leads to unusual functioning of the body of an organism leading to less productivity in its working environment.

Indigenous Knowledge: Is the way in which residents of an area have come to understand themselves in relation to their environment and how they organize their understanding, information and skills of their cultural beliefs and history to enhance their lives. For example use of herbs to treat various Animal and Plant diseases by the community.

Influence: Is the power to change what some body believes or does. In this study it refers to a person or something that affects the way one behaves and thinks, especially by giving an example to follow. For example in this study, ''influence '' was taken to mean the effect(s) of indigenous knowledge on students' performance in chemistry.

Performance: Is an indicator of how well one does something. In this study it refers to a measure of the level of success or failure attained in doing specific tasks in a subject or an area of study after teaching/learning experience. In this study the measure was in form of scores attained by students in Kenya Certificate of Secondary Education and also the Chemistry Performance Test (CPT).

Phenomenon: Is a fact or an event that is very successful or impressive in nature or society and cannot be easily understood. In this study, it was taken to mean students' beliefs in cultural interpretations of scientific concepts in relation to their performance in chemistry.

Science: Means the study of Natural things for example Biology, Chemistry and Physics. In this study it is refers to the knowledge about the structure and behaviour of the natural and physical world based on facts that can be proved by use of

experiments. In this study, chemistry is a science subject whose knowledge, skills and facts could be acquired or proved by students through experiments.

Science Education: Refers to acquisition of desirable knowledge, skills and attitude in the study of Natural things. In this study it is taken to mean the process of training, teaching and learning in schools or colleges to acquire the knowledge, attitudes and develop skills which helps one to understand the structure and behaviour of the Natural and physical world based on facts that can be proved through use of experiments.

Student: A person who is studying at a school, college or university for example medical/science student, graduate/post graduate/research student or student teacher/nurse. In this study, ‘‘student’’ was taken to mean any person studying in a secondary school.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature related to the present study. It focuses on literature in developed countries, developing countries and finally Kenya. The chapter is subdivided in to seven sections as follows, influence of indigenous knowledge on Science learning, influence of community indigenous knowledge of Chemistry on student' performance in Chemistry, influence of indigenous knowledge application in treatment of diseases, influence of attitude towards Community indigenous knowledge on students' performance in Chemistry, Students' background factors leading to poor performance in academics, theoretical framework and finally the chapter concludes with a conceptual framework which was used to guide the study.

2.2 Influence of Indigenous Knowledge on Science Learning

Indigenous knowledge (IK) in broadly speaking terms is the knowledge used by local people to make a living in a particular environment (Warren, 1991). Terms used in the field of sustainable development to designate this concept include indigenous technical knowledge, traditional environmental, rural knowledge, local knowledge and farmer's or pastoralist's knowledge. Indigenous knowledge can be defined as "A body of knowledge built up by a group of people through generations of living in close contact with nature" (Johnson, 1992). Generally speaking, such knowledge evolves in the local environment, so that it is specifically adapted to the requirements of local people and conditions. It is also creative and experimental, constantly incorporating outside influences and inside innovations to meet new conditions. It is usually a mistake to think of indigenous knowledge as non-confirmative to contemporary issues in the Community (Thrupp, 1998).

There are two basic reasons why it is important for researchers to consider IK when carrying out research projects. First and foremost, incorporating IK into research projects can contribute to local empowerment and development, increasing self-sufficiency and strengthening self-determination (Thrupp, 1989). Utilizing IK in research projects and management plans gives it legitimacy and credibility in the eyes of both local people and outside scientists, increasing cultural pride and thus motivation to solve local problems with local ingenuity and resources (Emery, 1996). Local capacity-building is a crucial aspect of sustainable development, researchers and development specialists should design

approaches with support and strengthen appropriate indigenous knowledge and institutions.

Secondly, indigenous people can provide valuable input about the local environment and how to effectively manage its natural resources. Outside interest in indigenous knowledge systems has been fueled by the recent worldwide ecological crisis and the realization that its causes lie partly in the overexploitation of natural resources based on inappropriate attitudes and technologies. Researchers in Science, now recognize that indigenous people have managed the environments in which they have lived for generations, often without significantly damaging local ecologies (Emery, 1996). Many researchers in Science feel that indigenous knowledge can thus provide a powerful basis from which alternative ways of managing resources can be developed. Indigenous knowledge technologies and know-how have an advantage over introduced forms in that they rely on locally available skills and materials and are thus often more cost-effective than introducing exotic technologies from outside sources (IIRR, 1996a). As well, local people are familiar with them and so do not need any specialized training.

As with scientific knowledge, however, IK has its limitations, and these must be recognized. Indigenous knowledge (IK) is sometimes accepted uncritically because of naive notions that whatever indigenous people do is naturally in harmony with the environment. There is historical and contemporary evidence that indigenous people have also destroyed environment through activities such as over-grazing, over-hunting, or over-cultivation of the land. It is misleading to think of IK as always being ‘good,’ ‘right’ or ‘sustainable’ (IIRR, 1996a). For example in America, a critical assumption of indigenous knowledge approaches is that local people have a good understanding of the natural resources base because they have lived in the same, or similar environment for many generations, and have accumulated and passed on knowledge of the natural conditions, soils, vegetation, food and medicinal plants (Grenier, 1998).

However, under conditions where the local people are in fact recent migrants from a quite different ecological zone, they may not have much experience yet with their new environment. In these circumstances, some indigenous knowledge of the people may be helpful, or it may cause problems for example, use of agricultural practices adapted to other ecological zones. Therefore it is important, especially when dealing with recent

migrants, to evaluate the relevance of different kinds of indigenous knowledge to local conditions.

In developed countries, Indigenous knowledge can also be eroded by wider economic and social forces. Pressure on indigenous people to integrate with larger societies is often great, and as they become more integrated, the social structures which generate indigenous knowledge and practices can break down. The growth of national and international markets, the imposition of educational and religious systems and the impact of various development processes are leading more and more to the 'homogenization' of the world's cultures (Grenier, 1998). Consequently, indigenous beliefs, values, customs, know-how and practices may be altered and the resulting knowledge base being incomplete.

Sometimes IK that was once well-adapted and effective for securing a livelihood in a particular environment becomes inappropriate under conditions of environmental degradation (Emery, 1996). Although IK systems have a certain amount of flexibility in adapting to ecological change, when change is particularly rapid or drastic, the knowledge associated with them may be rendered unsuitable and possibly damaging in the altered conditions (Grenier, 1998). Finally, an often overlooked feature of IK which needs to be taken into account is that, like scientific knowledge, sometimes the knowledge which local people rely on is wrong or even harmful (Thrupp, 1989). In developing countries, practices based on for example, mistaken beliefs, faulty experimentations, or inaccurate information can be dangerous and may even be a barrier to improving the well-being of indigenous people. However, researchers need to be careful when making such judgments (Warren, 1991). From the foregoing, there is evidence which indicate that local people in developed countries had a good understanding of Indigenous Knowledge approaches and use in their lives. However, in the case of Kenya there is no specific information on how students' performance in chemistry is related to the mentioned Community Indigenous Knowledge of Science.

2.2.1 Community Indigenous Knowledge Perspective on Science Learning

Castle (1966) concurs with Ocitti (1972) that the content of native education grew naturally out of the physical and social environment. He stresses that an individual's habitat was dominated by mountain, plain, river or tropical forest. Beside the acquisition of practical skills, an individual in traditional society was expected to achieve an awareness or understanding of his place in the society; his role in the same society; and

what the environment (both natural and human) offered for his personal and community utilization (Ocitti,1993).

Prominence given to indigenous knowledge in South Africa is evidence by a number of recently held conferences on the topic, the identification of Indigenous Knowledge System (IKS) as one of the research focus areas of the National Research Foundation, and so on. But what is meant by indigenous knowledge? For Semali and Kincheloe (1999) indigenous knowledge 'reflects the dynamic way in which the residents of an area have come to understand themselves in relation to their environment and how they organize that folk knowledge of flora and fauna, cultural beliefs, and history to enhance their lives'. According to Smith (1999) indigenous knowledge is a term that internationalizes the experiences, concerns and struggles of some of the world's colonized people. However, it is important to note that the indigenous project is not a unified one but rather subsumes nuances, contradictions and contestations. As Dei (2000) points out: Indigenous knowledge does not reside in 'pristine fashion' outside of the influences of other knowledge and do not exist on its own. He argues that bodies of knowledge continually influence each other demonstrating the dynamism of all knowledge systems. Rendering a false dichotomy or 'moral evaluation between good (Indigenous) and bad (conventional/western) knowledge' (Dei 2000) is therefore not useful.

However, Semali (1991) observed that people should nonetheless challenge imperial ideologies and colonial relations of production which continually characterize and shape academic practices. Furthermore, that the exclusion of Indigenous knowledge from the academy leaves unchallenged space for the (re)colonization of knowledge and cultures in local environments and contexts (Ocitti, 1972).

Kincheloe (1999) argued that if Indigenous Knowledge System is to hold any promise of contributing to Africa's transformation and reconstruction then education has a pivotal role to play. The transformational challenge for education is a dual one; education must transform for its own sake and is also crucial to the transformation of other spheres of social life (Pendlebury, 1998). The transformation challenge for education has implications for all dimensions of education but the main focus will be on curriculum and research. Ginsburg (1992) view 'curricula as the selection and organization of knowledge and research as the production of knowledge about reality'.

The curriculum challenge faced in South Africa is that, which topics and perspectives are included and excluded? This challenge confronts all levels of the education system. The challenge of including Indigenous Knowledge in school curricula has been taken up in both the Revised curriculum Statement for General Education and training (GET) and the National Curriculum Statement for Further Education and Training (FET); both documents mandate that elements of indigenous knowledge should be integrated into all learning area subjects (Department of Education, 2002 & 2003). The curriculum challenge is also pertinent to higher education but it is higher education's research role (in production of knowledge) that shall specifically be focused on. From the foregoing, there is evidence which indicate that inclusion of Indigenous Knowledge in school curricula is a great challenge not only to developing countries. This is because of the nature of Indigenous Knowledge which varies from region to region or community to community. It is also very difficult to identify the topics and perspectives to be included or excluded in the school curriculum.

2.2.2 Western Science Knowledge Perspective on Science Learning

In the middle to late 1990s there was much debate in South Africa about emerging new mode of knowledge production. Much of the debate is captured in a book edited by Kraak (2000a). Gibbons (1994) and Scott (1995) argue that there was a shift from disciplinary science (mode 1) to a new mode of knowledge production that is trans-disciplinary, trans-institutional and heterogeneous (mode 2). Protagonists of the mode 2 Thesis argue that this new mode of knowledge production is an outcome of two powerful social forces, namely, globalization and the democratization of access to higher education (Kraak, 2000b). Scott (1995) elaborates on the latter by pointing out that with the massification of higher education the number of graduates is employed elsewhere, in government laboratories, in industry, while others have established their own laboratories, think tanks and consultancies.

Higher education institutions are therefore no longer the only role players in knowledge production processes, and what is now emerging is in Gibbon's (2000) terms, ' a socially distributed knowledge system'. The future survival of higher education is therefore dependent on the performance of partnership research with government, industry, and so on. The mode 2 Thesis of Gibbon (1994) and Scott (1995) influenced post-apartheid South African higher education policy significantly, in particular the following policy texts: the

final report of the National Commission on Higher Education (NCHE), entitled a framework for transformation (South Africa NCHE, 1996).

The department of Education's Green paper on Higher Education Transformation (DoE 1996); the Education White paper *3:* A programme for the Transformation of Higher Education (DoE 1997); and the Higher Education Act of 1997. However, Jansen (2000) points out that even though South African Higher education policy documents bear the unmistakable fingerprints of Gibbons' and his colleagues accommodation in South African universities is uneven. For example, whilst Mode 2 knowledge forms thrive and is expanding at an institution such as the University of Pretoria there is a little evidence of its success in a historically disadvantaged university such as the University of Durban Westville. Kuhn (1970), concern about the debates that have transpired on new modes of knowledge production is that they have been framed largely in Western terms. The emerging socially distributed knowledge system that Scott (1995) refers to comprises knowledge produced by graduates with research skills that are located in institution outside the university. However, these graduates would have received their education and training within Western disciplines and exposed mainly to the influences of Western epistemologies.

The potential partnership research between academics situated inside and outside universities therefore remains underpinned by a Western science or scientific paradigm-mode of knowledge production has changed but not the ontological and epistemological frameworks underpinning the knowledge production processes. In his research, Odora (2002), explores possibilities (even though only conceptually) of an expanded notion of a socially distributed knowledge and indigenous Western researchers work in partnership with indigenous researchers. Bicultural research of this kind is, however, only possible in Western frameworks rather than competing perspectives. Specifically, he attempted to demonstrate two things in his research: how we might conceptually understand ways in which Western science(s) and indigenous knowledge(s) can work together; and to briefly explore how the term Indigenous knowledge can be invoked to engage Western science deconstructive, Science/knowledge as representation and performance.

Kuhn (1970) proposed that Western science and indigenous knowledge might be viewed either as disparate epistemologies or as contemporary frameworks depending on whether one views science/knowledge as representative or science/knowledge as performance. In

his seminal work the structure of scientific revolutions, Kuhn (1970) identifies two distinct notions of the term paradigm, namely, paradigm as disciplinary matrix and paradigm as exemplar. The former denotes the 'entire constellation of beliefs, values, and techniques, and so on shared by the members of a given community' (Gratton, 2003). The latter refers to some sort of element in that constellation, 'the concrete puzzle solutions which, employed as models or examples, can replace explicit rules as the basis for the solution of the remaining puzzles of normal science' (Kuhn, 1970).

Turnbull (2000) points out that Kuhn's (1970) first usage of the term paradigm (the main focus of his book) is something analogous to a global theory such as a Newtonian physics and is subject to revolutionary change. The second usage (exemplar) on the other hand is closer to the standard meaning of the term – 'a sample problem solution which can be extrapolated to other problems' (Turnbull, 2000), exemplars are based on agreements about which kinds of problems are sufficiently similar so that they can be treated in the same way. The implication of this is that disparate problems can be perceived as being similar and known techniques and solutions can be applied to it. Gratton (2003) notes that exemplars are the product of tacit knowledge that is learned by doing science rather than by acquiring rules for doing science.

The table 3 is illustrative of a representationalist perspective of knowledge where African Indigenous knowledge is viewed as distinctive of Western science. To borrow Kuhn's words, 'the entire constellation of beliefs, values, techniques, and so on' shared by members of traditional African and Western communities are perceived as distinctly different. Separating knowledge system/worldviews conceptually are useful in aiding us to think and learn (i.e. for heuristic purposes). However, there is a danger of our constructions/representations being perceived as mirroring reality to the extent that we try to make reality fit representations of it. For example, Gough (1998), remembered;

> 'That as a science student at the university when asked to sketch objects that were observed with the aid of a light microscope; often one (and so did other fellow students) turned to the textbook diagram of the object to measure the accuracy of the work' (Grough, 1998: Pp.120-315).

As a student of science, confidence was not in the work one had performed (what one drew from what had been observed) but in how accurately it resembled the representation(s) of the object(s) as it appeared in a textbook. School and university

students learned earlier on, science as representation to the neglect of science as performance. What students do not learn is the situated messiness of science and for that matter the situated messiness of all knowledge production processes. Furthermore, in representations of Western and African Indigenous knowledge, Western science often is portrayed as superior, universal, and as not having the 'cultural fingerprints' that appear to be much more conspicuous in other knowledge systems (Odora, 2002). Also, representations of Western science are used for declaring 'other' knowledge as non-science. A representationalist perspective on knowledge therefore produces an incommensurability perspective, that Western science and indigenous knowledge are incompatible or that Indigenous ways of knowing may be recognized as a particular way of understanding the world, but that it is not science. These varied ideas are well outlined as shown in Table 3 which provides a summary of some main differences between African and Western systems of Thought.

Table 3 Summary of African and Western Systems of Thought

Africa	Western
Anthropocentric,	Mechanistic,
Monistic – Metaphysical,	Seeks Empirical Laws and Principles,
Cosmology with Religion as an important focus,	Public property minus religion,
Orality dominates,	Documented,
Sage Practice,	Truth can be challenged,
Learning is communal.	Learning is an individual enterprise.

Source: Jegede, 1999: Pp.118 - 47

However, understanding knowledge production as performance enables seemingly disparate knowledge to work so as to produce new knowledge spaces, what Turnbull (1997) terms as 'third spaces' or 'interstitial spaces'. It is widely recognized by sociologist of scientific knowledge and philosophers of science that even though knowledge systems may differ in their epistemologies, methodologies, logistics and cognitive structures or in their socio-economic contexts, a characteristic that they all share is their localness (Latour, 1988). Moreover, knowledge is not simply local but located/situated, that is, it has place and creates space. When knowledge is produced it is assembled from heterogeneous components and given coherence through the deployment of social strategies and technical devices, as Star (1989) writes: As mentioned the common element of all knowledge

systems are their localness. However, their differences lie in the way they are assembled 'though social strategies and technical devices for establishing equivalences and connections between otherwise heterogeneous and incompatible components' (Turnbull, 2000) as (Star, 1989) write.

What makes a particular knowledge powerful is not its claim to rationality, objectivity or universality but rather its ability to other places and times (Latour, 1988). Western science is powerful in part because of its ability to deploy a variety of social strategies and technical devices for creating the equivalences and connections between heterogeneous and isolated knowledge. Of course, Western science's powerful position also has been abetted by the use of military power and imperialism. Creating equivalences and connections between heterogeneous and isolated knowledge is the result of what Turnbull (2000) refers to as 'social labour'. In other words knowledge is assembled through connections and negotiation and judgment that each of the participants in the knowledge production process contributes so as to create order and meaning.

Kraak (2000a) argues that when knowledge is assembled through connections and negotiating equivalences a social order trust and authority is simultaneously established resulting in a knowledge space. In demonstrating how knowledge space can be created from situatedness Scott (1995) uses a premodern example of how the Chartres cathedral were built without architects, plans structural mechanics or common measure. He writes: 'Chartres is motley, an ad hoc mess, and put together with talk, tradition and templates. Through the adoption of variety of such social strategies and technical devices, a knowledge space was created where the work of many men could be assembled' (Turnbull, 2000).

Furthermore, Turnbull (2000) also points out the difficulties of contemporary Western Science research in trying to produce a vaccine for malaria. He notes that despite the irredeemingly messy and local nature of malaria, western scientists are continually trying for monocultural, global solutions at the expense of local knowledge and local people. Moreover, all knowledge is located/situated – all knowledge is motley (messy situatedness). Knowledge is given coherence through the application of social strategies and technical devices (social labour). When connections are created and equivalences established between isolated and heterogeneous knowledge a social order of trust and authority is simultaneously created which results in a new knowledge space. But, how

does the mentioned link to the debate: western science versus Indigenous knowledge? Firstly, recognizing that all knowledge has localness in common decentres Western science and serves as basis for comparing different knowledge equitably. Secondly, because knowledge production in all cultures are assembled from situated messiness (heterogeneous and incompatible parts), an assemblage of heterogeneous components drawn from Western science and indigenous knowledge is possible and would result in the creation of new knowledge space (third space or interstitial space) (Turnbull, 1997).

Enabling western knowledge and indigenous knowledge to work together would depend on how the social order of trust is negotiated between western researchers and indigenous researchers. At least at a conceptual level, there is a basis for bicultural research in which connections and equivalences are created from seemingly disparate components of Western knowledge and Indigenous knowledge through processes of negotiation and judgment. But, such a conceptual understanding depends on viewing knowledge as performance and not as representation (Turnbull, 2000). From the foregoing, there is clear evidence that conceptual understanding between Western Science and Indigenous Knowledge systems depends on viewing knowledge as performance and not as representation. However, in the case of Kenya there is no specific information on how Western Science and Indigenous Knowledge is integrated or harmonized.

2.2.3 Conflict between Indigenous Knowledge and Western Scientific Knowledge on Students' Performance in Chemistry

Africa's development is dependent on the use of both Western Science and Indigenous Knowledge. Africa has to use the good of Western Science and also recognize its negative side that has destroyed natural environments and denigrated the cultures of African people. Invoking the term Indigenous Knowledge can engage Western Science deconstructive so as to overcome the binary opposition between Western science and Indigenous Knowledge. Gratton (2003) argues that the future of African Indigenous Knowledge lies in the recognition that the post-colonial present is hybridized and that a transcendental synthesis (of traditional and western) is unworkable.

However, the hybridized post-colonial presence does not mean the conservation of two competing identities but rather invokes "the important ways in which post-constructionalists use the language of the dominant structure in order to re-organize it from within" (Gratton, 2003). As Bhabha (1985) writes:

> "A contingent borderline experience opens up in-between colonizer and colonized. This space of cultural and interpretive in decidability produced in the "present" of the colonial moment. The margin of hybridity, where cultural differences "contingently" and conflictually touch resists the binary opposition of racial and cultural groups" (Gratton, 2003: Pp.418 – 612).

Recognizing the deconstructive force of African indigenous knowledge negates higher education knowledge production processes from being 'reduced to that which is at worst is an historical (universalist) or relativist (local) enterprise' (Gratton, 2003). Bhabha (1985) argues that by working on the margins of the dominant colonial and metaphysical discourses, African indigenous knowledge is able to render their (western science) blind sports and fissures in order to displace them. Africa indigenous knowledge is an expression of the African lived experience but when it is invoked the consequence also is the deconstruction of (western) science. As Gratton (2003) writes: "African [indigenous knowledge]" is a performative signifier that by its very name brings together and calls into question an endless number of oppositions: past/future, universalist/perticularist, African thought/philosophy. The performative side of knowledge production should be emphasized in African higher education institutions as it enables the working together of disparate knowledge, making authentic bicultural research possible and creating new knowledge spaces.

As Africans, one can draw inspiration from examples elsewhere, where new knowledge spaces have been created. For example, in Australia aborigines in Australia's northern territory have for many years through their own performative modes mapped their country by identifying every tree and every significant feature of their territory. Today some aborigines are doing the same using the satellites, remote sensing and Geographical Information Systems (GIS). By representing their local knowledge on digitals map they are able to make their ways of knowing visible in Western terms – 'a new knowledge space which will have transformative effects for all Australians' (Turnbull, 1997). In South Africa, San (Bushmen) trackers are being equipped with digital devices to record animals' sightings, a local example of traditional African ways of knowing, working together with sophisticated western technologies and in so doing creating new knowledge space (Gibbon's, 2000). Partnership (bicultural) research of this kind (between university academics and indigenous communities) would represent an expanded notion of Gibbon's (2000) 'socially distributed knowledge system.' For this reason, addressing the issue of

conflict between Indigenous Knowledge and Western Scientific Knowledge on students' performance in chemistry is of high priority for the Government. This is because of the persistent poor performance of students' in chemistry at KCSE examinations.

2.2.4 Integration of Indigenous Knowledge and Practices in Education Curriculum

The erosion of African indigenous knowledge base is largely associated with the absence of mechanisms to ensure that the knowledge and related practices are passed on from generation to generation. Often old generations are dying without endowing new ones with the wealth of information and skills on the use and management of African ecological and agricultural systems. This threatens the future and cultural wellbeing of African communities. Star (1999), proposed a project that aims at promoting education on African indigenous knowledge systems in schools and institutions of higher learning. It would facilitate the integration of indigenous knowledge issues into curriculum and related teaching methodology for better teaching and learning processes aimed at achieving high academic standards in learning institutions globally. From the foregoing, there is clear evidence that African Indigenous Knowledge lack mechanisms for it and related practices to be passed on from one generation to another generation. This leads to old generations dying without endowing new ones with the desired information and skills. However, in the case of Kenya there is no specific information on how Indigenous Knowledge is integrated in to the secondary school curriculum.

2.3 Influence of Community Indigenous Knowledge of Chemistry on Students' Performance in Chemistry

Indigenous education refers to the inclusion of indigenous knowledge, models, methods and content within formal and non-formal educational systems. Often in a post-colonial context, the growing recognition and use of indigenous education methods can be a response to the erosion and loss of indigenous knowledge and language through the processes of colonialism (Aikman, 2003). Furthermore, it can enable indigenous communities to 'reclaim and revalue their languages and cultures, and in so doing, improve the educational success of indigenous students.'

Increasingly, there has been a global shift toward recognizing models of education (methods and content) as a viable alternative within the scope of many different education systems. The inclusion of indigenous models of education has come to represent a significant factor contributing to the success of those members of indigenous communities

who choose to access these systems, both as students/learners and as teachers/instructors (Aikman, 2003). As an educational method, the inclusion of indigenous ways of knowing, learning, instructing, teaching and training has been viewed by many critical and scholars as important for ensuring that students and teachers (whether indigenous or non-indigenous) are able to benefit from education in a culturally sensitive manner that draws upon, utilizes, promotes and enhances awareness of indigenous traditions (Merriam, 2007). For indigenous students or learners, and teachers or instructors, the inclusion of these methods often enhances educational effectiveness, success and learning outcomes by providing education that adheres to their own inherent perspectives, experiences and worldwide views. For non-indigenous students and teachers, education using such methods often has the effect of raising awareness of the individual traditions and collective experience of surrounding indigenous communities and people, thereby promoting greater respect for and appreciation of the cultural realities of these communities and people.

In terms of educational context, the inclusion of traditions, perspectives, world views and conceptions within curricula, instructional materials textbooks and course books have largely the same effects as the inclusion of indigenous methods in education. Indigenous students and teachers benefit from enhanced academic effectiveness, success and learning outcomes, while non-indigenous students/learners and teachers often have greater awareness, respect and appreciate for indigenous communities and people in consequence of the context that is shared during the course of educational pursuits (Malatest, 2002).

Indigenous cultures usually live in a particular bioregion for many generations and have learned how to live there sustainably. This quality often puts truly indigenous cultures in a position in modern times to be aware of and knowledge about the interrelationships, needs, benefits and dangers of their bioregion. This is not true of indigenous people who have been displaced (Hall, 2000).

A prime example of how indigenous methods and content can be used to promote the above outcomes is demonstrated within higher education in Canada. Due to certain jurisdictions, focus on enhancing academic success for Aboriginal learners and promoting the values of multiculturalism in society, the inclusion of indigenous methods and content in education is often seen as an important obligation and duty of both government and educational authorities (Aikman, 2003).

Many scholars in the field of education assert that indigenous education and knowledge has a "transformative power, which can be applied in the fostering of empowerment and justice," for indigenous communities (Semali, 1999). The shift to recognizing indigenous models of education as legitimate forms is therefore important in the ongoing effort for indigenous rights, on a global scale. Many students in Kenya choose to drop science subjects when given a chance and even for those who take them, the performance is below average (Changeiywo, 2000 & Aduda, 2003). This is as a result of negative attitude towards sciences. For this reason, addressing the issue of the influence of community Indigenous Knowledge of Chemistry on students' performance in chemistry is of high priority to all stakeholders in education. This is due to the poor performance of students in chemistry at KCSE examinations and low enrolment in science subjects.

2.3.1 Influence of Culture on Science Learning

Cultural influences on science education boils down to how local community thinks about science and what they believe that are different from modern scientific thinking (Ogunleye, 2009). The Ibo of Nigeria, Maasai and the Samburu of Kenya are still very much engrossed with superstitious beliefs. For instance, someone with medical ailments (such as heart attack or cancer) instead of seeking appropriate medical attention from the hospital would prefer to seek supernatural help from 'traditional healers' or 'unfaithful pastors' who tell them that their problems are caused by their enemies or next door neighbours (Hills, 1989). To receive curative measures, they would be asked to bring white clothes, goats or pigeons to appease the oracles. There are scientific explanations for every ailment which has nothing to do with superstition (Hills, 1989). Again, a member of the Ibo community had blamed his step - mother for contributing to the swollen of his leg, just to claim their late father's assets. He was persuaded to visit a hospital and his leg was diagnosed to be diabetes. Ignorance and superstition have dominated the thinking and behaviour of some Nigerians, Kenyans among other African states and these do not guarantee scientific growth (Ogunleye, 2009).

Conservative religious members of Jehovah Witness denomination do not believe in blood transfusion. They always quote biblical injunction in Lev.17:11-12, stating that,

> 'The soul of the flesh is in the blood…and members should not accept blood transfusion by any means' (Ogunleye, 2009: Pp. 216 - 400).

Medically, blood transfusion has saved lives of people suffering from shock, hemorrhage, or blood disease (Akinwale, 2004). Blood transfusion is employed in cases of surgery,

trauma, gastrointestinal bleeding, and in child births that involves loss of blood. Members of this denomination prefer death rather than receive blood which they believe as cannibalism and unholy act before God. This religious belief does not contribute to scientific growth (Akinwale, 2004). According to Qur'an, 5:32, it states that,

> 'because of that we ordained for the children of Israel that if any one killed a person not in relation of murder, or (and) to spread mischief in the land, it would be as if one has killed all Mankind and if anyone saved a life, through services or material assistance even by donation of any part of his/her body including blood transfusion or organs transplant, it would be as if one saved the life of all mankind (Muhammed, 2008: Pp. 600 - 718)'.

In south-east and south-west parts of Nigeria and other parts of Africa including Kenya, people believe that earthquake is a punishment from gods and sacrifices need to be made to appease the ancestors. But science sees earthquake as an aspect of volcanic eruption. If such a person with such beliefs becomes the Minister of Science and Technology (this is possible in developing countries), one would not be able to make any contributions to scientific advancement due to personal ignorance. Socrates and Plato have suggested that if cultural beliefs are identified, individuals would be knowledgeable to ignore irrational thoughts that instill fears in to the minds of science students (Ogunleye, 2009). From the foregoing, there is clear evidence that developed and developing countries are faced with the problem of cultural beliefs that are not identified. This is because it instills fear in to the minds of students, hence affecting negatively their performance in chemistry.

2.4 Influence of Indigenous Knowledge Application in Treatment of Diseases on Students' Performance in Chemistry

Horn (2005) asks the important question of what kind of knowledge Traditional healers have and how it differs from the knowledge taught and researched in western universities. This question has a determining influence on the way indigenous African knowledge is perceived in the western countries, and also on how western knowledge is used in Africa. Thus it is important to understand how indigenous African people relate to a globalized economy. Africans cannot avoid becoming part of what the West has achieved in the world, without forgetting that they too, have something to offer from their cultures and knowledge. One needs to arrive at a new integration of IK and that of the rest of the world.

Scientists in South Africa and other countries in Africa are testing many different plants that seem to have potential for healing illnesses like Malaria, TB and diabetes (Akinwale, 2004). Others are being considered for use as immune modulators for liver transplant patterns (Horn, 2005). *Sutherlandia frutescence* is commonly known as the cancer bush. According to a traditional healer, Credo Mutwa, the cancer bush radiates energy and well-being, cleans blood and tonic combats. The symptoms of flu can be used to combat cancer and STDs.

Researchers have realized that this indigenous shrub common in South Africa has potent medical qualities that were known in early times by the Khoi, San and Zulu healers. Early people have observed that people suffering from cancer responded well to extracts made from this plant (Ogunleye, 2009). This has made them hypothesize that *sutherlandia frutescence* may assist cancer patients, since there are active ingredients in this plant that assist the immune system to fight disease. Recent (Western) research has shown that the shrubs contains an amino acid that fights depression, pinitol (which helps patients to gain weight), and canavanine (which is successful in treating retroviruses). It is used to treat AIDS patients today. Although it does not cure AIDS but it definitely helps people with AIDS to live for a longer period of time. This is an interesting example of how modern science is giving status to the work of traditional healers (Bowie, 2005).

A researcher at the University of Pretoria, Tshikalange (2006), studied the success rate of traditional healers in treating sexually transmitted diseases (STDs). His finding showed that traditional healers are indeed very successful in treating patients with STDs. He has done a chemical analysis of some of the plants used by traditional healers, and identified anti-microbial agents in most of this plants (Tshikalange, 2006). Many traditional medicinal practitioners are people without education, who have rather received knowledge of medicinal plants and their effects on the human body from their forbearers (Helwig, 2010). They have a deep and personal involvement in the healing process and protect the therapeutic knowledge by keeping it a secret.

In a manner similar to orthodox medicinal practice, the practitioners of traditional medicine specialize in particular areas of their profession. Some, such as the Inyangas of Swaziland, Maasai/Samburu of Kenya are experts in verbalism, whilst others, such as the South Africa Sangomas, are experts in spiritual healing as diviners, and others specialize in a combination of both forms of practice (Mokaila, 2001). There are also traditional

bonesetters and birth attendants. Herbalists are becoming more and more popular in Africa with an emerging herb trading market in Durban that is said to attract between 700,000 and 900,000 traders per year from South Africa, Zimbabwe and Mozambique. Smaller trade markets exist in virtually every community (Helwig, 2010). Their knowledge of herbs has been invaluable in African communities and they were the only ones who could gather them in most societies. Healers commonly ‘‘describe and explain illness in terms of social interaction and act on the belief that religion permeates every aspect of human existence.’’

Although Western medicine is successful in developed countries, it does not have the same positive impact in many of the developing African countries. Though Western practices can make an impact in health care practices in certain areas such as in the spread of various diseases, it cannot integrate wholly into the culture and society. This makes the Traditional African practitioners a vital part of their health care system (Helwig, 2010). There are many reasons why the public health services do not work in Africa. Hospitals and medicinal facilities are difficult for many Africans to get to. With vast areas of land and poor roads and transportation systems, many native Africans have to travel immense distances on foot to reach help. Once they arrive, they are often required to wait in line up to 8 hours, especially in urban areas, as the lack of clinics and resources cause over – crowding. Patients are often not told the cause of their illness or much information about it all, so they have no way to prevent or prepare for it. The technology used is usually of poor quality, which affects the quality of treatment. From the foregoing, there is evidence that modern medicine is giving status to the work of traditional healers. This leads to more integration of Indigenous Knowledge of medicine to modern scientific practices. However, in the case of Kenya there is no information on how Indigenous Knowledge in treatment of diseases is integrated in to modern medicine and also to secondary school curriculum.

2.5 Influence of Attitude towards Community Indigenous Knowledge on Students' Performance in Chemistry

The enviable position which science education system of most countries of the world, including developed and other developing countries in Africa is perhaps justifiable. The reason is that science can exert a dominant, if not decisive influence on the life of individual as well as on the developmental effort of a nation (Emovon, 1985). The universal recognition of the above submission is responsible for the prime position that has

been accorded to science and in particular, chemistry worldwide. Within the context of science education, chemistry has been identified as a very important school subject and its importance in scientific, technological and development of any nation has been widely reported. It is as a result of the recognition given to chemistry in the development of the individual and the nation that is why is made a core-subject among the natural sciences and other science-related courses in the American education system. Its inclusion as a core subject in science in the secondary school calls for the need to teach it effectively. This is because effective science teaching can lead to the attainment of scientific and technological greatness (Adeyegbe, 1985).

Chemistry teaching can only be result-oriented when students are willing and teachers are favourably disposed, using the appropriate methods and resources in teaching the students. With the current increase in scientific knowledge in the world all over, much demand is placed, and emphasis is laid on the teacher, the learner, the curriculum and the environment in the whole process of teaching and learning of science (Okegbile, 1996). Despite the importance of chemistry to mankind and the efforts of researchers to improve on its teaching and learning, the achievement of students in the subject remains low in developing countries. Among the factors that have been identified affecting negatively the outcomes in chemistry are, poor methods of instruction (Adeyegbe, 2005) and poor Science background (Oshokoya, 1998 & Adesoji, 1999).

Papanastasiou (2001) reported that those who have positive attitude towards science tend to perform well in the subject. The affective behaviours on the classroom and strongly related to achievement, and science attitudes are learned (George & Kaplan, 1998) the teachers play a significant role during the learning process and they can directly or indirectly influence the student's attitude toward science which in consequence can influence students' performance. Teachers are, invariably, role models whose behaviours are easily mimicked by students. What teachers like and dislike, appreciate and how they feel about their learning or studies could have a significant effect on their students (Bajah, 1999). By extension, how teachers teach, how they behave and how they interact with students can be more paramount than what they teach (Adesoji, 1999).

Students' attitude towards the learning of chemistry is a factor that has long attracted attention of researchers. Ojo (1989) and Adesokan (2002) asserted that inspite of realization of the recognition given to chemistry among the science subjects, it is evident

that students still show negative attitude towards the subject, thereby leading to poor performance and low enrolment. In response to the challenges posed by the influence of community indigenous knowledge of science on students' performance in chemistry and low enrolment in science subjects, several studies have been carried out in Kenya to investigate the possible causes (Eshiwani, 1974, Kyalo, 1984, Mondoh, 1986 & Wachanga, 2002). Majority of the previous studies centered on the instructional methods used by the teachers, however, Haimowitz (1989), noted that the causes of most failures in schools might not be due to insufficient or inadequate instructions but perhaps by negative attitude of the learners towards science subjects. For this reason, addressing the issue of the influence of attitude towards community Indigenous Knowledge on students' performance in chemistry is of high priority to the Government of developed countries. However, in the case of Kenya there is no specific information on how influence of attitude towards community Indigenous Knowledge on students' performance in chemistry is addressed.

2.6 Students' Background Factors Leading to Poor Performance in Chemistry

Students' background is a broad concept which comprises of very many factors and varies from community to community. This is for example perception towards education varies depending on the community. Poverty lowers the parent's ability to pay fees and purchase learning materials for their children. Cultural factors are also another community based factor which condemns women to be married off at an early tender age before completing their education. These factors contribute to poor performance in chemistry and also leading to school dropout particularly at secondary school level (Oxfam UK, 1999). Danesy (2004) however mentioned that the innovative environment do stimulate head start learning and mental perception. Not only that, it has also been proved that students that come from stimulative environment, with laboratory equipment or those that are taught with rich instructional aids, pictures and allowed to demonstrate using their functional peripherals nerves like eyes, hands and sense of taste perform better than those trained under theoretical and canopy of abstraction.

Thus, teaching and learning should be done under organized, planned and good environment with learning instruction aids to stimulate students' sense of conception, perception and concentration to facilitate systematic understanding and acquisition of knowledge in Chemistry. In total, a combination of a healthy family background in good environment plus the child being educated in a conducive environment will prompt

academic performance (Wachanga, 2002). From the foregoing, there is clear evidence that students' background factors leading to poor performance in chemistry varies from region to region and also from community to community. However, in the case of Kenya there is no adequate information on how students' performance in chemistry is related to the mentioned background factors.

2.7 Theoretical Framework

In an attempt to understand the influence of community indigenous knowledge of science on students' performance in Chemistry, two theories were applied. These are General systems theory and Cultural ecology theory. This research therefore was informed by interplay of these two theories. The theoretical formulations associated with Buckley's (1967) general systems theory was useful in studying the Samburu's indigenous knowledge. General systems theory was interested in the varied relationships of the many aspects of the social world and thus operates against piecemeal analysis of the social systems. The argument of the general systems theory was that the intricate relationship of the parts cannot be treated apart from that context of the whole. In fact, general systems theorists reflect the idea that society or other large-scale components of the society should be treated as unified social facts. The focus was on relationships or processes at various levels within the social system.

Buckley (1967) describes social systems as generally consisting of complex elements or components directly or indirectly related in a casual network. In his view, Ritzer (1992) acknowledges that each component was related to at least some others in a minor or less stable way within any particular period of time. An analysis of the Samburu superstructure shows that the society's institutions were seen in totality. Therefore, an understanding of the Samburu life in general was related to how they interact with nature.

General systems theory owes its development to Buckley's (1967) formulation of society in equilibrium. He views the societal organism as possessing a self–regulating mechanism whose goal was the maintenance of equilibrium. The Samburu had maintained equilibrium with regard to utilization of indigenous knowledge for sustainable development. He stresses *interalia*, that general systems theory emphasizes self-regulation, structural integration, adaptation and pattern- maintenance. Whether there was a tendency toward self-maintenance or self-regulation of the society, the fundamental assumption of the general system theory were an underlying order, pattern, regularity and stabilization of a

social system in a continual change. These issues form the fundamental focus in this research as they relate to influence of indigenous knowledge on students' performance in chemistry.

In occurrence with Buckley (1967) and Giddens (1987) laid the foundation of general system theory in sociology with his formulation of the concept of society as a system in equilibrium. In such a system, change in some parts affects other parts as well as the whole. According to him, the set of forces which maintain social equilibrium involves three types of factors: first, the extra –human environment or physical condition, such as climate, soil and vegetation. Secondly, the external conditions such as a given society's previous state and contact with other cultures and finally the inner elements of the system such as interests, knowledge, values, ideologies and sentiments.

Giddens (1987) argues that if the social system was subjected to pressures from external forces, inner forces will then push toward the restoration of the equilibrium, hence restoring society to its normal state. He emphasized that there were mechanisms in society such as cultural organization that deal with the problem of social disruption. Perhaps the most important approach to general systems theory was inherently integrative (Buckley, 1967). In Buckley's view of this theory, he saw it as involving the integration of large-scale objective structures, Symbol systems, action and interactions well as consciousness and self-awareness. The subject of investigation in this research suggests that an integrative approach strategy thus provide a relevant means for examining the gender relations and apprenticeship schemes as they relate to the human and natural environment.

This theory views the social world in dynamic terms, with an overriding concern for ''socio-cultural emergence and dynamics'' in general. This particular approach was useful and relevant in informing this study on the various transformations that the Samburu underwent during colonialism and after. The Samburu intricate social institution as well as their political and economic structures as seen from this theory provides an understanding of the socio-ecological organization of their indigenous knowledge. As the community gradually underwent economic diversification, which had closer relations to the adaptation and management of indigenous knowledge (Buckley, 1967).

To supplement the general systems theory in explaining issues touching mainly on the period under colonial domination and postcolonial periods, cultural ecology theory was employed. Cultural ecology theory, according to Turnbull (1963), Hammond (1964) and

Kottak (2002), was based on the growing awareness that research on many cultural facts and processes remains incomplete if the interplay with the natural environment was neglected. Thus, cultural ecology was used in this study to show how the Samburu, had over time been able to sustainably utilize environmental resources at their disposal.

Cultural ecology as a theoretical approach sees cultural patterns as adaptive responses to the basic problems of survival and reproduction. Customs and the way of life that would be maladaptive in another. Contemporary cultural ecology grew out of the theories of white (1959) and Steward (1972) and had some links with evolutionary theory according to Nanda (1980). Theoreticians of this school observe that all other aspects of culture are secondary to the material base. In explaining this theory cultural ecologists identified cultures primarily as systems that evolved as adaptive responses to specific natural environments.

This theoretical approach was relevant in informing the study on how beliefs and rituals may function as part of a group's cultural adaptation to its environment. Avoiding the inherent weaknesses of this theory, the interpretation of data findings take into cognizance the holistic concept approach that emphasized that such factors as demography, settlement patterns, kinship structures, land tenure, land use and other key cultural features must not be considered separately from their interrelationships to one another and to that of the environment. The combination of the above two theoretical approaches thus provided the guidelines on how Indigenous Knowledge had influenced students' performance in chemistry in secondary schools of Samburu County, Kenya.

2.8 Conceptual Framework

The conceptual framework used in this study was based on the general systems theory presented by Buckley (1967) and cultural ecology theory by Nanda (1980) mentioned in section 2.7. To successfully adapt Buckley's and Nanda's General system theory and cultural ecology theory respectively, the conceptual model representation illustrated in figure 1, was used to guide the study.

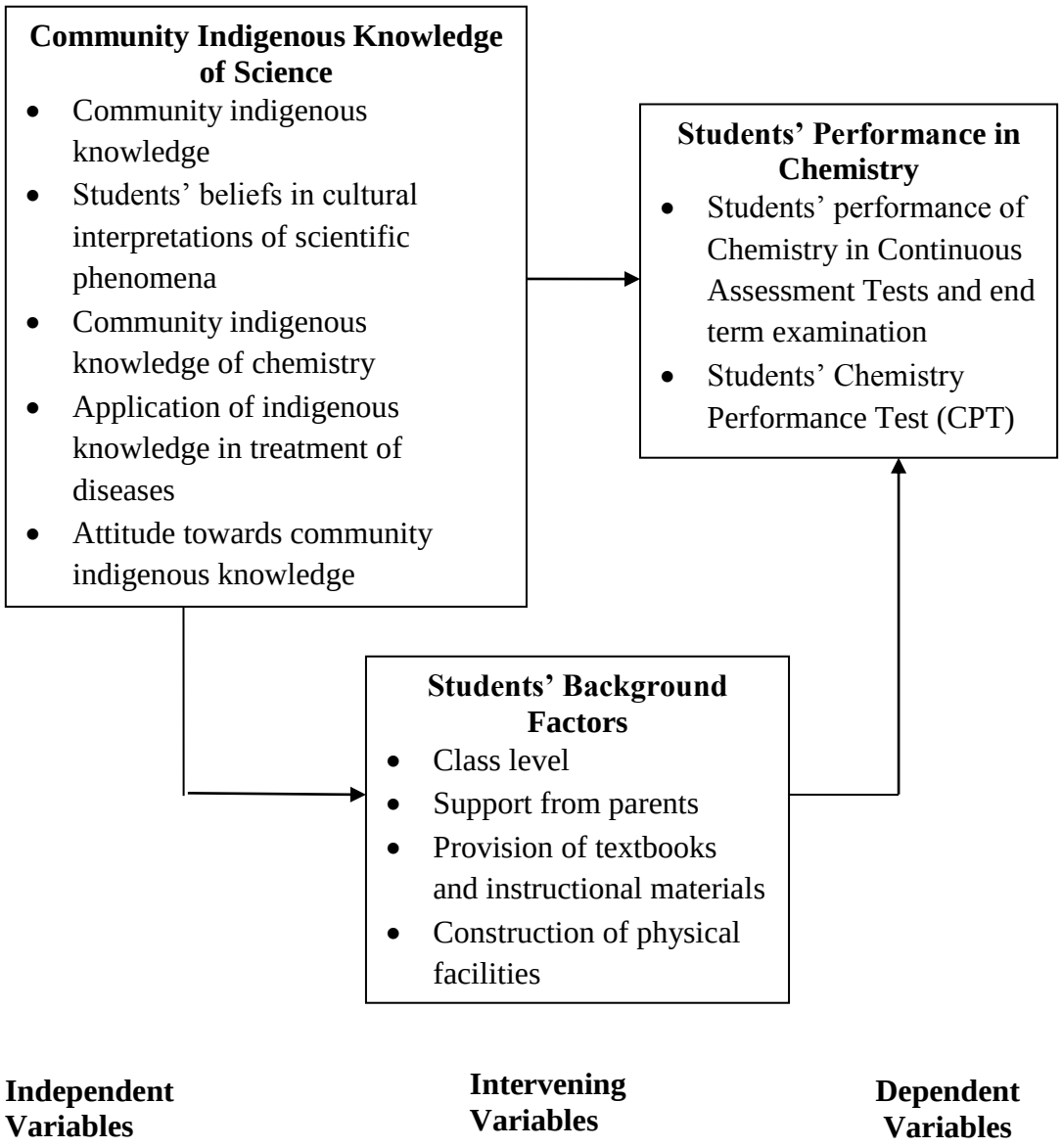


Figure 1: Conceptual framework for determining the influence of Community Indigenous Knowledge of Science on Students' Performance in Chemistry.

Figure 1 illustrates the conceptual framework that relates the various factors considered to have an influence on students' performance in chemistry. The extraneous or intervening variables in this study were class level of students, support from parents, provision of text books/teaching aids and construction of physical facilities. These were controlled as follows: Students' class level was controlled by involving form three students who had comparable language in understanding of chemistry concepts. Support from parents was controlled by involving students who did not miss classes because of indiscipline cases or

being out of school because of lacking school fees or even text books for use in school. The schools with adequate physical facilities including equipped libraries and laboratories were used. In this study, community indigenous knowledge was the independent variables and the students' performance in chemistry was the dependent variables. Students' background factors in this study were the extraneous or intervening variables.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the research approaches that were adopted in this study. It was divided into the following sub-sections: research design, study location, study population, sampling procedures and sample size, instrumentation, data collection and data analysis procedures.

3.2 Research Design

The study was a Descriptive Survey research, where Cross-Sectional study design was used. Moser and Kalton, (1993) stated that the value of surveys has been established beyond all questions and in widely different fields. The design was relevant in this study for it would provide a way of obtaining facts and about opinions of individuals who would avail representative information about a larger population. In this way Cross-Sectional studies provide a 'snapshot' of the outcome and the characteristics associated with it, at a specific point in time (Kasomo, 2007). In the present study, the researcher proposes to determine the Influence of Community Indigenous Knowledge of Science on Students' Performance in Chemistry. The study therefore would give an analysis of the existing state of events, hence a Cross-Sectional Study Design being chosen because of the nature of the subject of inquiry in this study.

3.3 Location of the Study

The study was carried out in Samburu County which is one of the counties of Rift valley Province. It shared common borders with Turkana to the Northwest and Baringo County to the Southwest. To the Northeast is Marsabit County and to the East and South are Isiolo and Laikipia counties respectively. The county lies between latitudes 0° 40′ S and 2° 31′ N, North of the Equator and Longitudes 36° 20′ W and 38° 10′ East of the Prime Meridian (Republic of Kenya, 1997). It covers an area of 20,800 square kilometers. The county has 6 administrative divisions namely: - Leroki, Kirisia, Baragoi, Nyiro, Wamba and Waso. There were 11 public and 4 private Secondary schools in the county. The county was chosen because, the extent to which the influence of community indigenous knowledge of science on students' performance in chemistry in the county was not known.

3.4 Study Population

The target population was all high school students in form three in Samburu County with a population of 302 girls, 450 boys and a total of 752. These students were in 4 private and 11 public schools giving a total of 15 high schools, 2 of them being National, 4 extra-County and 9 County schools as under the Ministry of Education classification.

3.5 Sampling Procedures and Sample Size

There were 752, form three students, 2013 in Samburu County. There were 302 girls and 450 boys who translate to 40 (%) percent and 60 (%) percent respectively of the total 2013 pre-candidates population in the County (DEO Report, 2013). Simple random sampling was used in selecting boys and girls in single sex schools because it gives each unit in the population an equal opportunity to be included in the sample (Kathuri & Pals, 1993). Nkapa (1997) argues that, there is no first hand rule for obtaining sample size. However, in this study the expression, $n = \frac{Z^2PqN}{(N-1)\,e^2 + z^2Pq}$ was used in determining the sample size (n) as with Kothari (2003) method of sample size determination from a finite population as shown in appendix IV. Where:-

n = Required Sample Size,

Z = Value of Standard Variate = 1.96 @ 95% Cl,

N = The given Population Size,

e = Acceptable error and Degree of Accuracy,

P = Proportionate Target Population with the Particular Characteristics (P = 0.141),

q = 1 – P.

Using this expression, a sample size of 224 was arrived at taking proportionate sample means that, 90 girls and 134 boys were selected for this study from a total sample of nine secondary schools. Therefore the minimum number of girls that were selected per school was 15, while on other hand the minimum number of boys was 22. The total sample size was selected as shown in Table 4, for equal distribution of responses among the respondents.

Table 4 Selection of the Sample Size per School Type

School type	Total No. of schools	Total No. of Girls	Total No. of Boys	Total
Girls' Schools	3	72	-	72
Boys' Schools	3	-	91	91
Co-educational	3	18	43	61
Total	**9**	**90**	**134**	**224**

Source: Samburu County D.E. Office, 2013: Pp, 9-12

From the total sample of 224 in Table 4, 50 students were proportionately sampled from the sample for the interview schedules. Taking a proportionate sample means that, 30 boys and 20 girls would be selected from the sample schools. A minimum number of girls that was selected per school were 3 and 5 for boys.

Stratified and simple random sampling was used to ensure that each category of Schools was equitably selected for the study. Using stratified sampling technique each of the six divisions of the County was grouped in to strata, such that schools in every division form a separate stratum. Because of the homogeneity of the schools across divisions, smaller size divisions with one or two schools were merged with large divisions with many schools falling on the same side of the County, hence having two major divisions that are Kirisia and Leroki. For the purpose of sampling, the distribution of schools in each of the two major divisions was based on the type of school category as shown in table 5.

Table 5 Selection of School Categories for Sample Size

School Type	Division		Total
	Leroki	Kirisia	
Boys	1	2	3
Girls	2	1	3
Co-Educational	1	2	3
Total	**4**	**5**	**9**

Source: Field Data, 2013

The advantage of stratified sampling is that, it ensures the inclusion into the sample, sub-groups which otherwise would be omitted entirely by other sampling methods because of their small number in population (Gall, 1989; Mugenda & Mugenda, 1999). In this case, stratified sampling would ensure that all the schools from the six divisions were given a chance to be included in the sample. To ensure that all parts of the County were represented, equal number of schools from each school type was selected randomly from each of the two divisions since most of the schools in Samburu County had one stream.

3.6 Instrumentation

The fieldwork research involved a survey of the expected participants. The instruments were aimed at collecting information on the influence of Community Indigenous Knowledge of Science on Students' Performance in Chemistry in line with the research questions and objectives of the study. In order to obtain the data, three instruments were used and these include; Chemistry Performance Test (CPT), Students' Questionnaire (SQ) and Interview schedules. The interview survey was an important aspect of this study since it aimed at enabling those who were being studied to speak for themselves (Sherman & Webb, 1988). According to Gall et al (1996) questionnaires are cost and time effective, however, cannot probe in to respondents opinions, feelings and some items may be unclear to respondents hence there was need for interview schedules to take care of the above shortcomings. The following was a brief description of the aspects of the Chemistry Performance Test, Questionnaires and the Interview Schedules.

3.6.1 Chemistry Performance Test (CPT)

The CPT was adapted from (Wambugu, 2010) and modified to suit the study (Appendix1). The test consisted of 6 structured short answer questions on form three Chemistry topics; Gas Laws, Mole Concept, Organic Chemistry (1), Nitrogen and its Compounds, Sulphur and its Compounds and lastly Chlorine and its Compounds. One question was set from each topic ranging from Gas laws up to Chlorine and its compounds a total of 30 marks. The items tested on knowledge, comprehension and application of learnt material. The questions were scored dichotomously, where a score of one was given to the correct answer and Zero to the wrong answer. The questions were used to obtain students' performance in Chemistry and this was used in calculation of Pearson's correlation coefficient (r) together with opinion scores obtained from students' questionnaire and interview schedule. The Chemistry Performance Test (CPT) was self-administered.

3.6.2 Students' Questionnaire (SQ)

The SQ was adapted from (Kiboss, 1997) and modified to suit the study (Appendix 11). It consisted of eighteen close-ended questions developed in order to collect the relevant information in line with the research questions and objectives of the study. It was used to collect information on community indigenous knowledge, students' beliefs in cultural interpretations of scientific phenomena and lastly attitude towards community indigenous knowledge. SQ contained 18, Five point Likert-type items on favourable and unfavourable statements of students' attitude towards Community Indigenous Knowledge and beliefs in Cultural interpretations of Scientific Phenomena. The scoring of SQ was based on assigning weights from 1 to 5 for each position on the scale. Favourable statements were weighted 5, 4, 3, 2, 1 going from strongly agree (SA) to strongly disagree (SD). Unfavourable statements had their weights reversed. Thus they were weighted 1, 2, 3, 4, and 5 going from SA to SD. These aspects of chemistry have been found to bear positive relationships to achievement as well as students' performance in sciences and mathematics (Wasanga, 1997). The questionnaire was self-administered.

3.6.3 Students' Interview Schedule (SIS)

The interview schedule was structured and consisting of twelve open-ended questions developed in order to collect the relevant information in line with the research questions (3 & 4) and objectives of the study respectively. The open-ended questions were used so as to allow the interviewees respond to the probing questions to elicit the answers in depth. It was used to collect information on community Indigenous Knowledge of Chemistry and application of Indigenous Knowledge in treatment of diseases. From the total sample of 224, 50 students were proportionately sampled for the interview schedules. The interview schedule for students' was also self-administered.

3.6.4 Validity of the Instruments

Three experts from the Faculty of Education and Community Studies, Egerton University validated the instruments. They checked on face, construct and content validity to ascertain whether the instruments would accurately represent the variables under study in line with the purpose and objectives of the study. After several reviews, the final instruments then were developed in the light of their comments. Also the content validity of the questions was reviewed by two trained and experienced secondary school Chemistry teachers who were Chemistry examiners with KNEC. The Chemistry Performance Test, Questionnaire and the Interview schedule were pilot-tested on

independent form three students who would not take part in the study to avoid contamination of the research results.

3.6.5 Reliability of the Instruments

The instruments were pilot- tested in four schools in Wamba Division of Samburu County so as to avoid contamination of results. This was an immediate neighbouring division whose schools had similar characteristics to the actual sample schools. After piloting, the internal consistence procedure was used to determine the reliability of the instruments. This was determined from the scores obtained from a single test administered to a sample of subjects. The score obtained in one item was correlated with scores obtained from other items in the instrument. Finally, Cronbach Alpha Reliability Coefficient value was computed to determine how items correlated among themselves. Cronbach Alpha is used in calculating the reliability of instruments with items that are not scored dichotomously thus more than one response is possible. This is the case with the instruments the researcher used in this study. The values obtained were 0.80, 0.68 and 0.72 for Chemistry Performance Test (CPT), Students' Questionnaires and Students' Interview Schedules respectively. According to Fraenkel and Wallen (2000) and Mugenda and Mugenda (1999), an instrument with a value of 0.7 and above is considered suitable to make inferences that are accurate enough, thus all the instruments were considered reliable. The use of this technique was preferred because, it reduced the time required to administer the instruments to a sample of subjects. It also assesses multiple response items compared to the other methods (Kathuri & Pals, 1993).

3.7 Data Collection Procedure

Before proceeding to conduct the study, the researcher obtained an introductory letter from Egerton University board of postgraduate studies. This would facilitate the issuance of a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) authorizing the researcher to carry out the research in public and private secondary schools in Samburu County. The County Director of Education and the head teachers of the sample schools in the Samburu County were informed of the purpose, scope and time frame of the study. The chemistry performance test, questionnaires and interview schedule were self- administered where students were asked to complete the same and also attend to the interview schedule. For accuracy and consistence of information, students were given thirty minutes to answer the questions in test items, fill in the questionnaires and later on attend to interview schedule. Students were assured of

confidentiality by the researcher who would then collect the chemistry performance test items and questionnaires from students the same day after they had been filled.

3.8 Pilot Survey

Rossi (1983) suggests that 20 to 50 cases examined before the main study is usually sufficient to discover flaws in research instruments so as to facilitate in refinement. The researcher examined 40 cases randomly during piloting. The participants were drawn from four schools in Wamba division of Samburu County. This was deliberately instituted to get diversed views from all the three categories of interviewees suggested in the research proposal, namely the girls, boys and coeducational schools. The purpose was to collect data to be used to improve and also to provide direction on how the data would be analyzed.

The results of the pilot survey assisted in the refinement of the Chemistry Performance Test (CPT), Questionnaires and Interview Schedules used in the main research. In view of the pilot results, it was evident that Indigenous Knowledge had a negative influence on students' performance in chemistry. The pilot result also provided that Community Indigenous Knowledge of Chemistry promoted students' understanding of chemistry and that have been adapted in chapter four for further consideration in the final results.

The three categories of the respondents (Girl's, Boy's and Coeducational schools) provided different results on Chemistry Performance Test, Students' Questionnaires and Interview schedules. However, they appeared to agree that Indigenous Knowledge promoted understanding of chemistry. There was a consensus by the respondents that Indigenous Knowledge of Science was very instrumental in learning of chemistry in secondary schools.

The findings also indicated that there were other factors apart from Community Indigenous Knowledge of Science that influence students' performance in chemistry and include factors such as socio-economic problems, some cultural practices, poor learning environment, inadequate facilities and lack of resources among others. Remedies were proposed and they included provision of adequate facilities, resources and bursaries / loans, academic advising among others.

The findings of the pilot survey appeared to be of great value to all the stakeholders in the field of education, namely; policy-makers, students, parents, employers, school

administrators and chemistry teachers when it comes to interpretation and implementation of Community Indigenous Knowledge of Science on students' performance in chemistry.

3.9 Data Analysis

The researcher scored the Chemistry Performance Test, Students' Questionnaire and the Interview Schedule so as to generate both the quantitative and qualitative data respectively. Data was analyzed using the computer program, Statistical Package for Social Sciences (SPSS) version 17.0 for windows. Descriptive Statistics was used where means, percentages and frequencies were determined. Pearson's Correlation Coefficient (r) was used to establish relationships between the Independent and Dependent variables in the study. Pearson's correlation coefficient is used where both data is in interval scale (Black, 2002). The cause and effect relationship between factors affecting the values in question would not be assumed. Consequently, the correlation coefficient was used to indicate the strength and direction of the relationship between scores of variables. To make reliable inferences from the data, the correlation was subjected to tests of significance at alpha ($\propto$) equal to 0.05. The research questions, independent variables, dependent variables and methods used to analyze each research question are indicated in Table 6.

Table 6 Variables and Methods of Data Analysis

Research Questions	Variables		Method of Data Analysis
	Independent	**Dependent**	
1. What is the influence of community indigenous knowledge on students' performance in chemistry in secondary schools of Samburu County?	Community indigenous knowledge.	Students' Performance in chemistry.	Pearson's Correlation Coefficient (r).
2. What is the influence of community indigenous knowledge of students' beliefs in cultural interpretations of scientific phenomena on students' performance in chemistry?	Community indigenous knowledge of students' beliefs in cultural interpretations of scientific phenomena.	Students' performance in chemistry.	Pearson's Correlation Coefficient (r).
3. What is the influence of community indigenous knowledge of chemistry on students' performance in chemistry?	Community indigenous knowledge of chemistry.	Students' performance in chemistry.	Means, Percentages and Frequencies.
4. What is the influence of community indigenous knowledge application in treatment of diseases on students' performance in chemistry?	Indigenous knowledge application in treatment of diseases.	Students' performance in chemistry.	Means, Percentages and Frequencies.
5. What is the influence of attitude towards community indigenous knowledge of science on students' performance in chemistry?	Attitude towards community indigenous knowledge of science.	Students' performance in chemistry.	Pearson's Correlation Coefficient (r).

Significance level tested at coefficient alpha (α) = 0.05

CHAPTER FOUR

RESULTS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This Chapter presents results obtained using descriptive statistics. The findings are presented in the form of graphs, tables and their implications discussed. Pearson's correlation coefficient was used to test the research questions on influence of Community Indigenous knowledge, community Indigenous knowledge of students' beliefs in Cultural interpretations of scientific phenomena and attitude towards community Indigenous Knowledge of science. Descriptive statistics were used to present information on the research questions; Community Indigenous Knowledge of Chemistry and Indigenous knowledge application in treatment of diseases. Chemistry Performance Test (CPT) was used to collect data on students' performance in Chemistry while students' questionnaire was used to collect data on Community Indigenous Knowledge, Students' beliefs in cultural interpretations of scientific phenomena and Students' attitude towards Community Indigenous Knowledge of science. Students' interview schedule was used to collect data on Community Indigenous Knowledge of chemistry and application of Indigenous Knowledge in treatment of diseases.

The sections that follow in this chapter contain information on the following areas:

a) Results on students' Chemistry Performance Test (CPT).
b) Influence of Community Indigenous Knowledge on Students' Performance in Chemistry.
c) Influence of Community Indigenous Knowledge on Students' beliefs in Cultural Interpretations of Scientific Phenomena on Students' Performance in Chemistry.
d) Influence of Community Indigenous Knowledge of Chemistry on Students' Performance in Chemistry.
e) Influence of Indigenous Knowledge Application in Treatment of diseases on Students' Performance in Chemistry.
f) Influence of Attitude towards Community Indigenous Knowledge of Science on Students' Performance in Chemistry.

4.2 Results on Students' Chemistry Performance Test (CPT)

Chemistry Performance Test (CPT) items were used to collect data on students' performance in chemistry. A total of 224 students sat for the Test items. Data was collected, analyzed and presented in tabula form using figures. Chemistry Performance Test (CPT) was administered to the sample schools in both Kirisia and Leroki divisions of Samburu County and results are summarized in Table 7.

Table 7 Students' Performance in Chemistry per Division (N = 224)

Division	Number of Respondents (N)	Mean
Kirisia	153	34.992
Leroki	71	34.377
Total	**224**	**34.795**

Source: Field Data, 2013

Results of Table 7; shows that Kirisia division was on the lead with a mean of 34.992 while Leroki becoming second with a mean of 34.377 and this could be attributed to having adequate teaching/learning resources in Kirisia division than in Leroki. In sample schools, both boys and girls were involved in the study. The results for Chemistry Performance Test (CPT) administered and scores scored by the different gender of students are presented in Table 8.

Table 8 Chemistry Performance Test Scores Scored by the different Gender of Students (N = 224)

Division	Number of Respondents (N)	Mean
Female	90	30.985
Male	134	36.902
Total	**224**	**34.548**

Source: Field Data, 2013

Results in Table 8 indicate that male students performed better than the female students as indicated by the means in the table above. This could be attributed to the general notion that sciences are for males and not for females (see appendix 1). Results of different school categories on students' performance in chemistry administered are presented in a bar graph shown in figure 2.

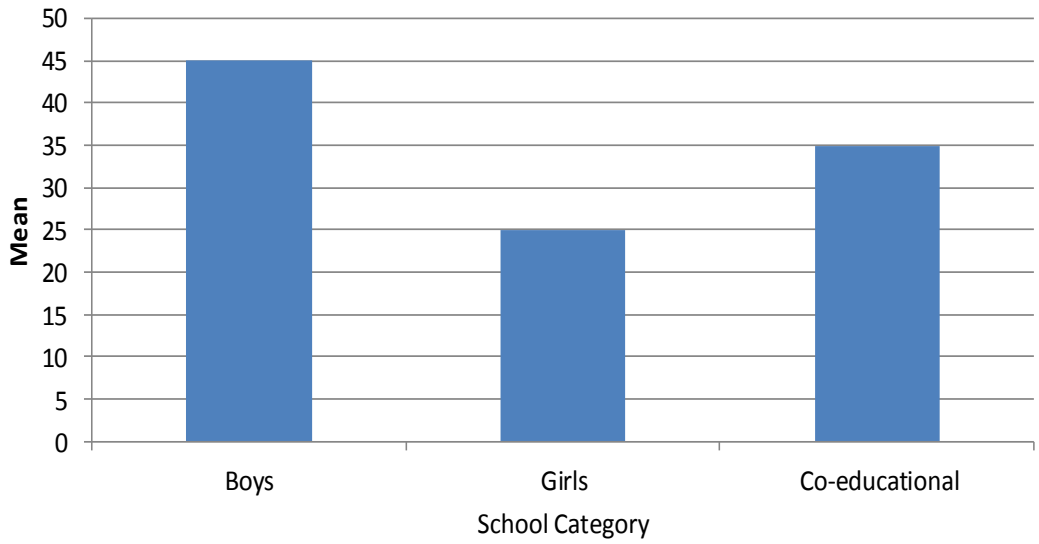


Figure 2 : Bar graph of the different school categories on students' performance in Chemistry Performance Test (CPT).

4.3 Influence of Community Indigenous Knowledge on Students' Performance in Chemistry

Chemistry Performance Test (CPT) scores of students and total attitude scores obtained using Students' Questionnaires were used in computing the correlation between Community Indigenous Knowledge and Students' Performance in Chemistry. Table 9 presents this information.

Table 9 Correlation between Community Indigenous Knowledge and Students' Performance in Chemistry (N = 174)

CPT Marks	Total Attitude Score	Pearson's correlation co-efficient (r)	P value (Sig. 2-tailed)
6.5	608	0.283	0.587
20.5	311		
34.5	685		
48.5	617		
62.5	653		
76.5	559		

The correlation is not significant at 0.05 level (2-tailed).

r- Critical = 0.811, $p > 0.05$.

Source: Field Data, 2013

Table 9 shows the correlation results between Community Indigenous Knowledge and Students' performance in Chemistry of question one of the study. Question one of the study sought to find out whether the Community Indigenous Knowledge has influence on students' performance in Chemistry. Results in Table 9 revealed a negative correlation between Community Indigenous Knowledge and Students' performance in Chemistry, at alpha (α) equal to 0.05 ($r = 0.283$, $N = 174$, $P > 0.05$). This means that Community Indigenous Knowledge has a negative influence on students' performance in science subjects especially in Chemistry. This was attributed to Community Indigenous Knowledge and practices having less practical skills required in learning of sciences and hence not forming the basic foundation in understanding of scientific concepts. Although r-calculated was less than r-critical (r- calc. < r- crit.), there was no direct significant correlation between the variables (See appendix I and II).

4.4 Influence of Community Indigenous Knowledge of Students beliefs in Cultural Interpretations of Scientific Phenomena on Students' Performance in Chemistry

Chemistry Performance Test (CPT) scores of students and total attitude scores obtained from Students' Questionnaires were used in computing the correlation between Community Indigenous Knowledge of Students' beliefs in Cultural interpretations of Scientific Phenomena and Students' Performance in Chemistry. Table 10 presents a summary of this information.

Table 10 Correlation between Community Indigenous Knowledge of Students' beliefs in Cultural Interpretations of Scientific Phenomena and Students' Performance in Chemistry (N = 174)

CPT Marks	Total Attitude Score	Pearson's correlation co-efficient (r)	P value (Sig. 2-tailed)
6.5	603	- 0.366	0.476
20.5	614		
34.5	398		
48.5	417		
62.5	457		
76.5	562		

The correlation is not Significant at 0.05 level (2-tailed)
r- Critical = 0.811, p > 0.05

Source: Field Data, 2013

Table 10 shows the correlation results between Community Indigenous Knowledge of Students' beliefs in Cultural Interpretations of Scientific phenomena and Students' performance in Chemistry. Question two of the study sought to find out whether Community Indigenous Knowledge of students' beliefs in Cultural Interpretations of scientific phenomena has influence on students' performance in Chemistry. Result reveals that there was no significant correlation between the variables at alpha (α) equal to 0.05 ($r = -0.366$, $N = 174$, $p > 0.05$). The correlation revealed that, students' beliefs in Cultural interpretations of scientific phenomena had a negative influence on their performance in Chemistry. This was attributed to students' not being able to interpret their beliefs in Cultural interpretations of scientific phenomena to modern science especially Chemistry. Since r-calculated was less than r-critical (r- calc. < r- crit.), there was inverse correlation in cultural beliefs with students' performance in chemistry (See appendix I and II).

4.5 Influence of Community Indigenous Knowledge of Chemistry on Students' Performance in Chemistry

Does Indigenous Knowledge of Chemistry help you in understanding of Chemistry concepts? Students' interview schedule was used to collect data on the influence of Community Indigenous Knowledge of Chemistry on students' performance in Chemistry. A total of 50 students were interviewed. Data was collected, analyzed and presented in tabular form using figures. The results for the students' interview schedule on the influence of Community Indigenous Knowledge of Chemistry on Students' Performance in Chemistry are summarized in Table 11.

Table 11 Influence of Community Indigenous Knowledge of Chemistry on Students' Performance in Chemistry (N = 50)

Response	Frequency (f)	Number of Respondents (N)	percentage (%)
Yes	50	50	100
No	00	00	00
Total	**50**	**50**	**100**

Source: Field Data, 2013

Table 11 implies that all the respondents interviewed agreed that Indigenous Knowledge promotes understanding of Chemistry Concepts. This was clearly indicated by their positive responses on this area (see appendix III). The findings of this study also concurs

with the research findings of Emery (1996) that, utilizing indigenous knowledge in research projects and management plans gives it legitimacy and credibility in the eyes of both local people and outside scientists, increasing cultural pride and thus motivation to solve local problems with local ingenuity and resources. The results for reasons to why Community Indigenous Knowledge promotes understanding of chemistry are summarized in Table 12.

Table 12 Reasons why Indigenous Knowledge Promotes Understanding of Chemistry (N = 50)

Reasons	Frequency (f)	Percentage (%)
i) Helps in understanding different states of matter and their chemical components	12	24
ii) Develop critical thinking for learning science	13	26
iii) Understanding of plants and their chemical components	13	26
iv) Help develop scientific skills needed in understanding nature	13	26
Total	**50**	**100**

Source: Field Data, 2013

Table 12 shows that critical thinking for learning science, understanding plants and their chemical components and development of scientific skills needed in understanding nature are the major reasons as to why indigenous knowledge promotes understanding of Chemistry (see appendix III). The results for reasons why Indigenous Knowledge promotes the understanding of Chemistry are presented in a line graph shown in figure 3.

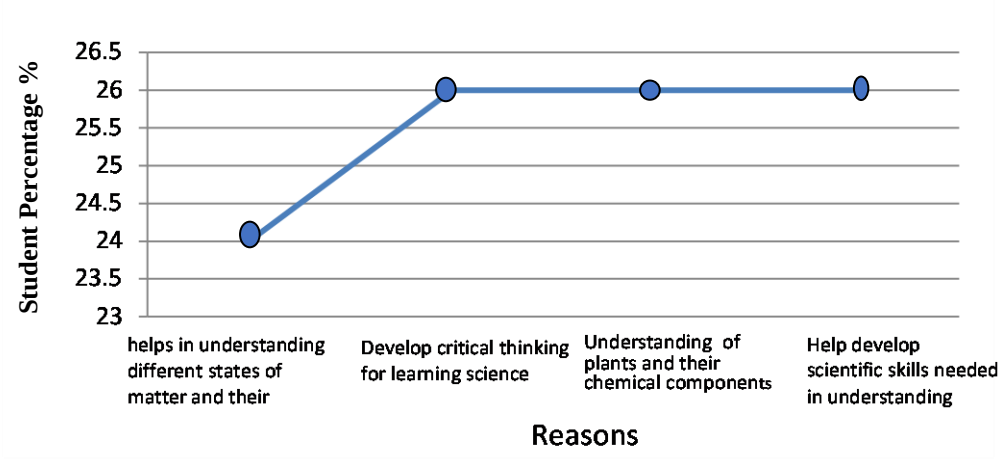


Figure 3: Reasons why Indigenous Knowledge promotes understanding of Chemistry.

Table 13 gives the summary on the importance of Community Indigenous Knowledge of Chemistry in herbal medicine.

Table 13 Importance of Indigenous Knowledge of Chemistry in Herbal Medicine (N = 50)

Importance	Frequency (f)	percentage (%)
i. Understanding various parts of plants and their Medicinal values.	35	70
ii. Classification of plants according to their Medicinal uses in treatment of Animal and plants Diseases.	15	30
Total	**50**	**100**

Source: Field Data, 2013

Results in Table 13 shows that, 70% of the respondents interviewed agreed that the importance of Indigenous Knowledge was to understand the various parts of plants and their Medicinal values while 30% accepted that Indigenous Knowledge was important in classification of plants according to their Medicinal values in the treatment of animal and plant diseases (see appendix III). Is there any Indigenous Knowledge of Chemistry in Witchcraft? The results for the presence of Indigenous Knowledge of Chemistry in witchcraft as revealed by the students' interview schedule are summarized in Table 14.

Table 14 Presence of Indigenous Knowledge of Chemistry in Witchcraft (N = 50)

Response	Frequency (f)	percentage (%)
Yes	31	62
No	19	38
Total	**50**	**100**

Source: Field Data, 2013

Most of the respondents in Table 14 agreed that Indigenous Knowledge of Chemistry was also applied to Witchcraft while a few denied that Witchcraft was not associated with Indigenous Knowledge of Chemistry (see appendix III). The results for reasons of having Indigenous Knowledge of Chemistry in witchcraft as revealed by the Students' Interview Schedule are presented in Table 15.

Table 15 Reasons for Indigenous Knowledge of Chemistry in Witchcraft (N = 50)

Reasons	Frequency (f)	percentage (%)
i. Animal parts mixed with charms to harm	13	26
ii. Plants parts and extracts used for harming other people	17	34
iii. It does not stimulate critical thinking needed in science	16	32
iv. Charms used to create wealth	04	08
Total	**50**	**100**

Source: Field Data, 2013

Results in Table 15 indicate that 34% of the respondents interviewed agreed that the use of plants extracts and parts was actually the chemistry that was applied to witchcraft in harming other people. While 32% disagreed arguing that it does not promote critical thinking needed in science (see appendix III). Recent (Western) research has shown that the shrubs contains an amino acid that fights depression, pinitol (which helps patients to gain weight), and canavanine (which is successful in treating retroviruses). It is used to treat AIDS patients today. Although it does not cure AIDS but it definitely helps people with AIDS to live for a longer period of time. This is an interesting example of how modern science is giving status to the work of traditional healers (Bowie, 2005). The results of the percentage and frequency of the reasons for indigenous knowledge of chemistry in witchcraft are presented in a line graph shown in figure 4.

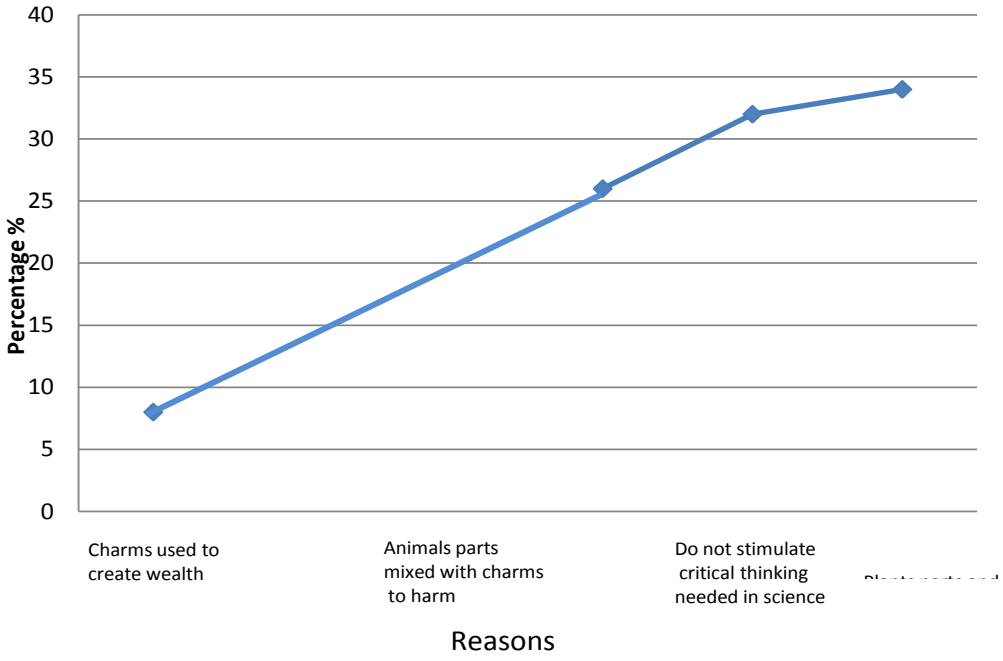


Figure 4: Line graph of the reasons for Indigenous Knowledge of Chemistry in Witchcraft.

Table 16a gives the summary of the challenges encountered by students in understanding Chemistry concepts as revealed by the Students' Interview Schedule.

Table 16a Challenges encountered by Students in Understanding Chemistry (N = 50)

Reasons	Frequency (f)	Percentage(%)
i) Chemistry language used by teachers and books Authors being difficult for learners to understand.	15	30
ii) Poor peer Influence towards Chemistry.	06	12
iii) Inadequate Chemistry practical skills.	11	22
iv) Difficulties in understanding chemistry calculations.	13	26
v) Inadequate teaching and learning materials.	05	10
Total	**50**	**100**

Source: Field Data, 2013

Results in table 16a; shows that the greatest challenge as per the percentages was chemistry language used by teachers and book authors being difficult for learners to understand with 30%, it was also noted that chemistry calculations with 26% posed a great challenge to understanding of chemistry. Inadequate chemistry practical skills to students 22% were also another main reason (see appendix III). The result of the percentages and

frequencies for the challenges encountered by students in understanding of chemistry are presented in a line graph shown in figure 5.

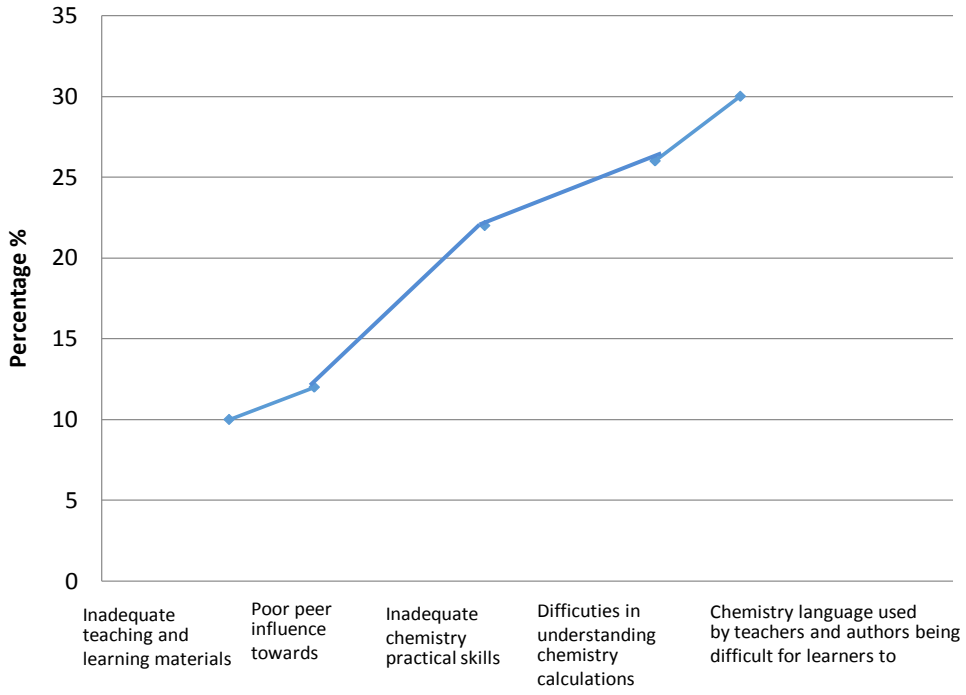


Figure 5: Line graph for the Challenges encountered by Students in understanding Chemistry.

The results for the remedies to the challenges encountered by students in understanding Chemistry concepts are presented in Table 16b.

Table 16b Remedies to the Challenges encountered by Students in Understanding Chemistry (N = 50)

Remedies	Frequency (f)	percentage (%)
i) Simple language to be used by teachers and Authors of Chemistry textbooks.	12	24
ii) Symposiums and discussions to be Introduced in learning chemistry.	09	18
iii) More practicals to be done in all Sciences especially Chemistry.	22	44
iv) Peer counseling and remedial teaching to be done in Chemistry subject.	07	14
Total	**50**	**100**

Source: Field Data, 2013

Results in Table 16b; shows that 44% of students interviewed agreed that the solution to the challenges faced by students in learning of chemistry was to encourage more practicals to be done in chemistry subject for better understanding. This could also enable the learners to get used to the calculations and language used in teaching and learning of chemistry. Students develop more practical skills and critical thinking needed in understanding of chemistry (see appendix III). The results of the percentages and frequencies for the remedies to challenges faced by students in learning of chemistry are presented in a line graph shown in figure 6.

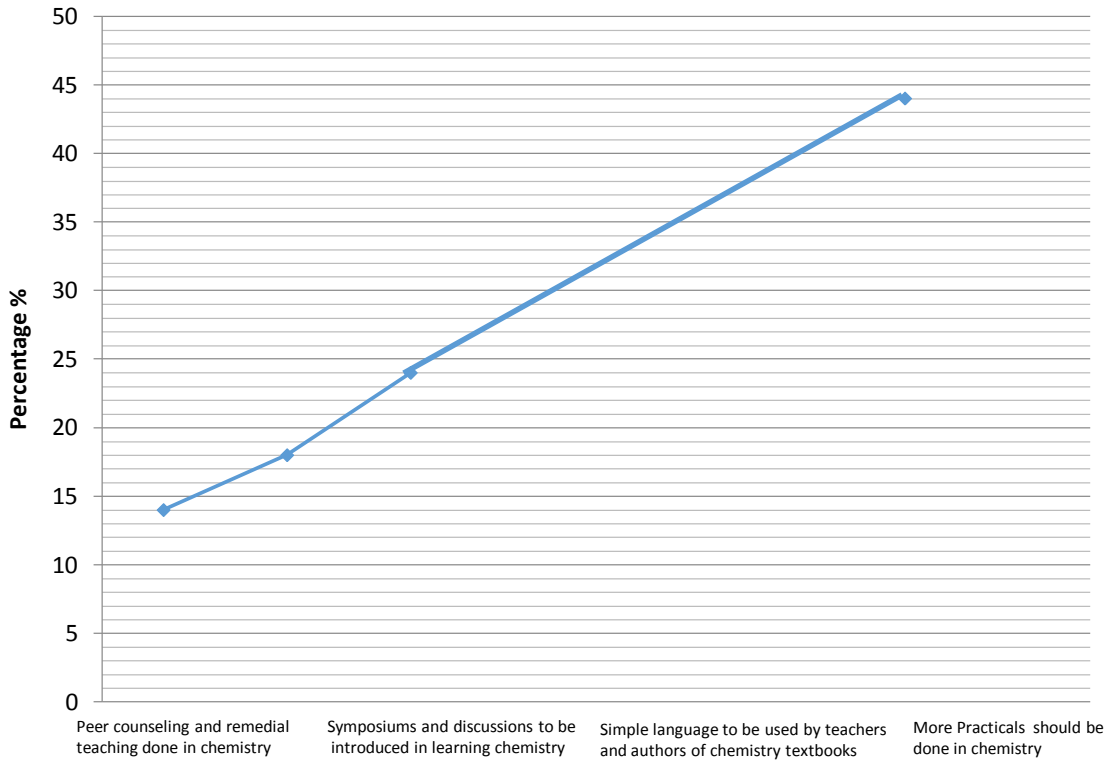


Figure 6: Line graph of the Remedies to the Challenges encountered by Students in understanding Chemistry.

4.6 Application of Indigenous Knowledge in Treatment of Diseases

Do you use herbal medicine in treatment of diseases? Students' interview schedule was used to collect data on the application of indigenous knowledge in treatment of diseases. A

total of 50 students were interviewed, data collected, analyzed and presented in tabular form using figures. Table 17 presents a summary of this information.

Table 17 Use of Herbal Medicine in Treatment of Diseases (N = 50)

Response	Frequency (f)	Percentage (%)
Yes	43	86
No	07	14
Total	**50**	**100**

Source: Field Data, 2013

Results in Table 17 shows that 86% of the respondents interviewed agreed that herbal medicine was highly used in treatment of diseases. While 14% denied the use of herbal medicine in treatment of diseases (see appendix III). The re The findings concur with those of Bowie et al (2005) and Helwig (2010), which indicates that, Western medicine is too expensive for the average African to afford, making it difficult for them to receive proper care. Finally, Western medicine removes native Africans from their culture, tradition and forces them into a setting that they are not comfortable with, away from their family and traditions which are of utmost importance to them. The results for reasons of using herbal medicine in treatment of diseases as revealed by Students' Interview Schedule are presented in Table 18.

Table 18 Reasons for Use of Herbal Medicine in Treatment of Diseases (N = 50)

Reasons	Frequency (f)	percentage (%)
i) Cheap and affordable.	14	28
ii) Readily available.	16	32
iii) Easy to prepare and administer.	15	30
iv) Less side effects.	05	10
Total	**50**	**100**

Source: Field Data, 2013

Results in Table 18 indicate that 32% of the respondents interviewed used herbal medicine because it was readily available, 30% said it was easy to prepare and administer. These are actually high indicators of using community indigenous knowledge where most of the people prefer what was cheap and locally available in treatment of diseases (see appendix III). The results of percentage and reasons for using herbal medicine in treatment of diseases are presented in a line graph shown in figure 7.

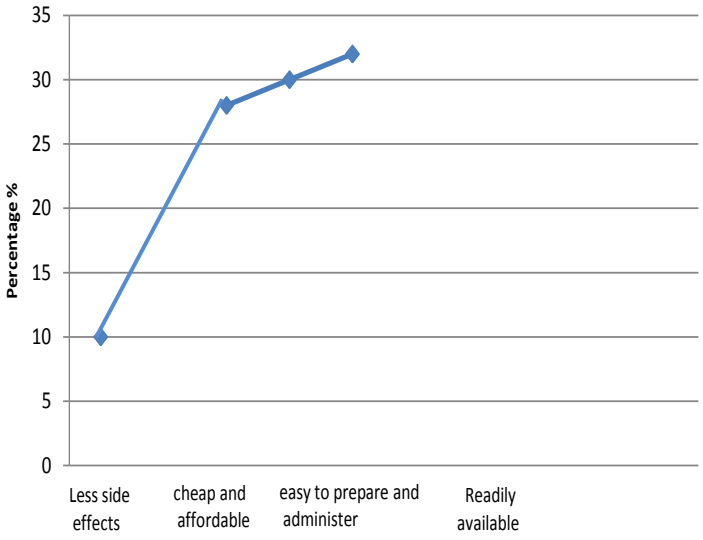


Figure 7: Line graph of the Reasons for using Herbal Medicine in treatment of Diseases.

Do you know the name of any medicinal plant(s) used locally in treatment of malaria disease? Students' Interview Schedule was used to collect data on students' knowledge of medicinal plant(s) used locally in treatment of malaria disease. Table 19a presents a summary of this information.

Table 19a Students' Knowledge of Medicinal Plant(s) used locally in Treatment of Malaria Disease (N = 50)

Response	Frequency (f)	Percentage (%)
Yes	43	86
No	07	14
Total	**50**	**100**

Source: Field Data, 2013

Information obtained in Table 19a; shows that 86% of the respondents interviewed knew some plants that were used in the treatment of malaria disease while 14% did not know. This was a clear indication of the respondents having adequate knowledge of plant's chemistry and its application in learning of science especially chemistry subject (see appendix III). Plants have been used locally and internationally for various uses including treatment of some diseases affecting both plants and animals. Table 19b gives the

summary of the results for some common medicinal plants used in treatment of malaria disease.

Table 19b Common Medicinal Plants used in Treatment of Malaria Disease (N = 50)

Plant Name	Frequency (f)	percentage (%)
i) Neem	24	48
ii) Aloe Vera	22	44
iii) Cinchona	03	06
iv) Olive	01	02
Total	**50**	**100**

Source: Field Data, 2013

Results of Table 19 b; shows that 48% of the respondents interviewed used Neem plant for treatment of malaria disease. 44% of the respondents also used Aloe Vera for treatment of malaria disease hence Neem and Aloe Vera being the most common medicinal plants that were used for treating malaria disease. Results of percentages and frequencies for common medicinal plants used in treatment of malaria disease are presented in a line graph shown in figure 8.

Figure 8: Line graph of the Common Medicinal Plants used in treatment of Malaria Disease.

Are local herbs more effective in treatment of animal diseases than conventional medicine? The results for efficacy of local herbs in treatment of animal diseases as

compared to conventional medicine revealed by Students' Interview Schedule are presented in Table 20a.

Table 20a Efficacy of Local Herbs in Treatment of Animal Diseases as Compared to Conventional Medicine (N = 50)

Response	Frequency (f)	Percentage (%)
Yes	32	64
No	18	36
Total	**50**	**100**

Source: Field Data, 2013

Results in table 20a; Shows that 64% of the respondents interviewed claimed that herbal medicine was more effective than conventional medicine in the treatment of animal diseases, while 36% of the respondents denied (see appendix III). The findings were consistent with those of Mokaila (2001), which indicates that, there has been more interest expressed recently in the effects of some of the medicinal plants of Africa. The results for reasons of efficacy of local herbs in treatment of animal diseases as compared to conventional medicine are presented in Table 20b.

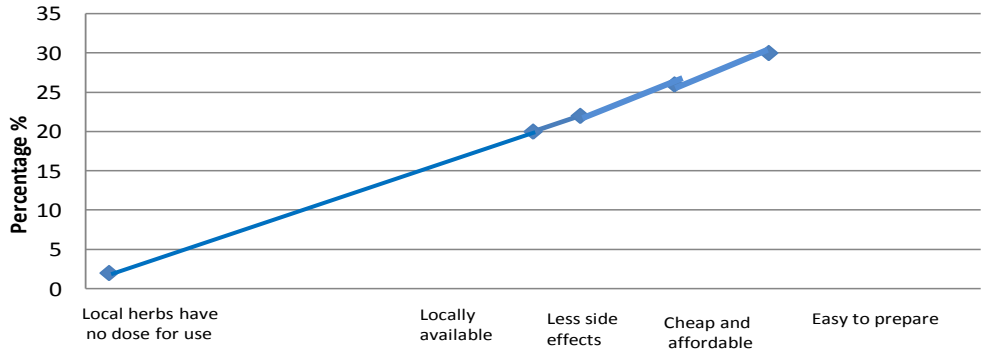
Table 20b Reasons for Efficacy of Local Herbs in Treatment of Animal Diseases as compared to Conventional Medicine (N = 50)

	Reasons	Frequency (f)	Percentage (%)
i.	Locally available.	10	20
ii.	Cheap and affordable.	13	26
iii.	Easy to prepare and administer.	15	30
iv.	Have fewer side effects.	11	22
v.	Local herbs have no prescribed dosage for its use.	01	02
Total		**50**	**100**

Source: Field Data, 2013

Results in Table 20b; Shows that 30% of respondents interviewed agreed that herbal medicine was easy to prepare and administer. 26% of the respondents also agreed that herbal medicine was cheap and affordable to many (see appendix III). The results of percentages and frequencies for the reasons of efficacy of local herbs in treatment of

animal diseases as compared to conventional medicine are presented in a line graph shown in figure 9.



Reasons

Figure 9 : Line graph of the reasons for efficacy of Local herbs in treatment of Animal diseases as compared to Conventional Medicine.

Are local herbs more effective in treatment of plant diseases than conventional medicine? The results for efficacy of local herbs in treatment of plant diseases as compared to conventional medicine are presented in Table 21a.

Table 21a Efficacy of local Herbs in Treatment of Plant Diseases as Compared to Conventional Medicine (N = 50)

Response	Frequency (f)	Percentage (%)
Yes	36	72
No	14	28
Total	**50**	**100**

Source: Field Data, 2013

Results in Table 21a; shows that 72% of the respondents interviewed agreed that local herbs are more effective than conventional medicine in treatment of plant diseases while 28% disagreed with this fact. The findings concur with those of Bowie et al (2005) and Helwig (2010), which indicates that, Western medicine is too expensive for the average African to afford, making it difficult for them to receive proper care. Finally, Western medicine removes native Africans from their culture, tradition and forces them into a

setting that they are not comfortable with, away from their family and traditions which are of utmost importance to them.

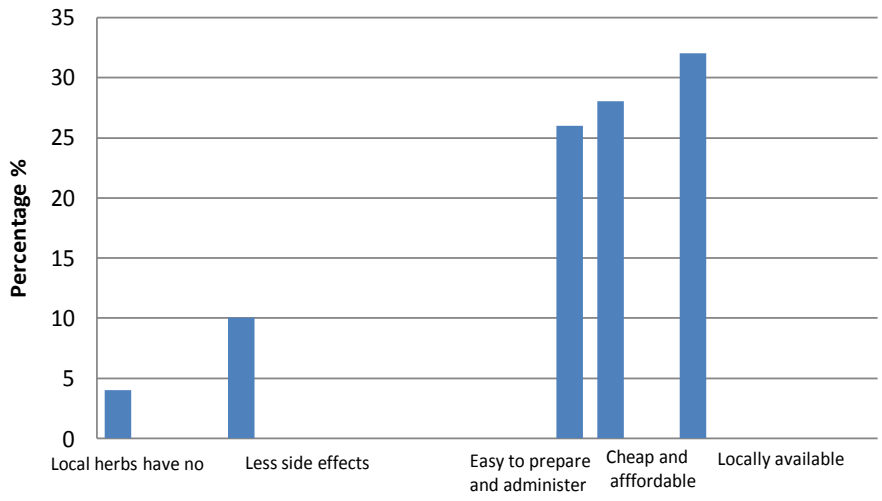
The results for reasons of efficacy of local herbs in treatment of plant diseases as compared to conventional medicine are presented in Table 21b.

Table 21b Reasons for Efficacy of Local Herbs in treatment of Plant Diseases as Compared to Conventional Medicine (N = 50)

Reasons	Frequency (f)	Percentage (%)
i) Locally available.	16	32
ii) Cheap and affordable.	14	28
iii) Easy to prepare and administer.	13	26
iv) Fewer side effects.	05	10
v) Local herbs have no prescribed dosage for its use.	02	04
Total	**50**	**100**

Source: Field Data, 2013

Information obtained in Table 21b; indicates that 32% of respondents interviewed agreed that local availability of herbal medicine made it to be more effective than conventional medicine. Also 28% of the respondents agreed that low cost and affordability of herbal medicine makes it more effective than conventional medicine in treatment of plant diseases (see appendix III). The results of percentages and frequencies of the reasons for efficacy of local herbs in treatment of plant diseases as compared to conventional medicine are presented in a bar graph shown in figure 10.



Reasons

Figure 10: Bar graph of the reasons for efficacy of Local herbs in treatment of Plant diseases as compared to Conventional Medicine.

Does Indigenous Knowledge of using local herbs in treatment of various plant and animal diseases help you understand Chemistry? Students' Interview Schedule was used in collecting data on the use of Indigenous Knowledge in treatment of various plant and animal diseases using local herbs and its influence in understanding of Chemistry. Table 22a presents a summary of this information.

Table 22a The use of Indigenous Knowledge in treatment of Various Animal and Plant Diseases using Local Herbs and its Influence in Understanding of Chemistry (N = 50)

Response	Frequency (f)	Percentage (%)
Yes	46	92
No	04	08
Total	**50**	**100**

Source: Field Data, 2013

Results in Table 22a; indicates that 92% of the respondents interviewed agreed that the use of indigenous knowledge in treatment of various animal and plant diseases using local herbs had a greater influence in the understanding of chemistry, while 8% disagreed with it (see appendix III). The results for reasons of using Indigenous Knowledge in treatment of various animal and plant diseases using local herbs and its influence in understanding of Chemistry are presented in Table 22b.

Table 22b Reasons for the use of Indigenous Knowledge in Treatment of Various Animal and Plant Diseases using Local Herbs and its Influence in Understanding of Chemistry (N = 50)

Reasons	Frequency (f)	Percentage (%)
i. Relate plants to diseases they treat and gain practical skills needed in Chemistry.	41	82
ii. Understand plants and their chemical Values in treatment of diseases.	09	18
Total	**50**	**100**

Source: Field Data, 2013

Results in Table 22 b; shows that 82% of the respondents interviewed agreed that the use of herbal medicine in treatment of plant and animal diseases influenced relating plants to the diseases they treat hence promoting gaining of practical skills required in understanding of chemistry. While 18% of respondents could only understand plants and their chemical values in treatment of diseases.

4.7 Influence of Attitude towards Community Indigenous Knowledge of Science on Students' Performance in Chemistry

Chemistry Performance Test (CPT) scores of students and total attitude scores obtained from Students' Questionnaires were used in computing the correlation between attitude towards Community Indigenous Knowledge of Science and Students' Performance in Chemistry. Table 23 presents a summary of this information.

Table 23 Correlation between Attitude towards Community Indigenous Knowledge of Science and Students' Performance in Chemistry (N = 174)

CPT Marks	Total Attitude Score	Pearson's correlation co-efficient (r)	P value(Sig. 2-tailed)
6.5	612	- 0.446	0.375
20.5	606		
34.5	459		
48.5	477		
62.5	486		
76.5	566		

The correlation is not significant at 0.05 level (2-tailed)

r- Critical = 0.811, $p > 0.05$

Source: Field Data, 2013

Table 23, shows the correlation results between students' attitude towards community indigenous knowledge of science and students' performance in chemistry. Question five of the study sought to find out whether attitude towards community indigenous knowledge of science has an influence on students' performance in chemistry. From the results of a correlation carried out on relationship between students' attitude towards community indigenous knowledge of science and students' performance in chemistry in Table 23, it was found out that there was no significant correlation between the variables at alpha (α) equal to 0.05 ($r = - 0.446$, $N = 174$, $P > 0.05$). This could be attributed to students' negative attitude towards sciences. Since r-critical was greater than r-calculated (r- crit. >

r-cal). (See appendix I and II). In response to the challenges posed by the influence of community Indigenous knowledge of science on students' performance in Chemistry and low enrolment in science subjects, several studies have been carried in Kenya to investigate the possible causes (Eshiwani, 1974; Kyalo, 1984; Mondoh, 1986 & Wachanga, 2002). Majority of previous studies centered on the instructional methods used by the teachers, however, Haimowitz (1989), noted that the causes of most failures in schools might not be due to insufficient or inadequate instructions but perhaps by negative attitude of the learners towards science subjects.

4.8 Discussion of Results

The following sections represent a discussion of the results based on each analysis of the chemistry performance test (CPT) and for the five research questions.

4.8.1 Results on Students' Chemistry Performance Test (CPT)

The results reveal that, boy's schools performed better than girl's and co-educational schools. From the results, boy's schools had a percentage of 40.8%, girl's schools with 31.9% and co-educational schools with 27.3%. The mean percentage for all boys sampled was 36.9%, girls, 30.98% while the overall mean percentage for the whole sample was 34.55%. The general performance was below average. The findings of this study are consistent with those of Changeiywo (2000) and Aduda (2003) which indicate that, many students in Kenya choose to drop science subjects when given a choice and even for those who take them, the performance is below average. At this point then, it's important to point out that students' background is a broad concept which comprises of very many factors and varies from community to community. This is for example perception towards education varies depending on the community. Poverty lowers the parent's ability to pay fees and purchase learning materials for their children. Cultural factors are also another community based factor which condemns women to be married off at an early age before completing their education. These factors contribute to poor performance in academics and also leading to school dropout particularly at secondary school level (Oxfam Uk, 1999).

4.8.2 Influence of Community Indigenous Knowledge on Students' Performance in Chemistry

The results obtained in this study, concur with the findings of Thrupp (1998) that, indigenous knowledge evolves in the local environment so that it's specifically adapted to

the requirements of local people and conditions. It's also creative and experimental, constantly incorporating outside influence and inside innovations to meet new conditions. It's usually a mistake to think of indigenous knowledge as non-confirmative to contemporary issues in the community. From the results on the correlation between community indigenous knowledge and students' performance in chemistry, results revealed a negative relationship between community indigenous knowledge and students' performance in chemistry, at alpha (α) equal to 0.05 ($r = 0.283$, $N = 174$, $P > 0.05$). This means that community indigenous knowledge had a negative influence on students' performance in chemistry. The findings of this study also concurs with the research findings of Emery (1996) that, utilizing indigenous knowledge in research projects and management plans gives it legitimacy and credibility in the eyes of both local people and outside scientists, increasing cultural pride and thus motivation to solve local problems with local ingenuity and resources. Local capacity - building is a crucial aspect of sustainable development, researchers and development specialists should design approaches with support and strengthen indigenous knowledge and institutions.

Secondly, indigenous people can provide valuable input about the local environment and how to effectively manage its natural resources. Outside interest in indigenous knowledge systems has been fueled by the recent worldwide ecological crisis and the realization that its causes lie partly in the overexploitation of natural resources based on inappropriate attitudes and technologies. Researchers in science, now recognize that indigenous people have managed the environments in which they have lived for generations, often without significantly damaging local ecologies (Emery, 1996). Many researchers in science feel that indigenous knowledge can thus provide a powerful basis from which alternative ways of managing resources can be developed.

4.8.3 Influence of Community Indigenous Knowledge of Students' beliefs in Cultural Interpretations of Scientific Phenomena on Students' Performance in Chemistry

The results on community indigenous knowledge of students' beliefs in cultural interpretations of scientific phenomena on students' performance in chemistry revealed a negative correlation between community indigenous knowledge of students' beliefs in cultural interpretations of scientific phenomena and students performance in chemistry, alpha (α) equal to 0.05 ($r = -0.366$, $N = 174$, $P > 0.05$). This could be attributed to students' not being able to fit their beliefs in cultural interpretations of scientific phenomena to modern scientific knowledge especially in chemistry.

The findings are consistent with those of Hills (1989) and Ogunleye (2009) who asserted that cultural influences on science education boils down to how local community thinks about science and what they believe that are different from modern scientific thinking. The Ibo of Nigeria, Maasai, Turkana and Samburu of Kenya are still very much engrossed with superstitious beliefs. For instance, someone with medical ailments (such as heart attack or cancer) instead of seeking appropriate medical attention from the hospital would prefer to seek supernatural help from traditional healers or 'unfaithful pastors' who tell them that their problems are caused by their enemies or next door neighbours. To receive curative measures they would be asked to bring white clothes, goats or pigeons to appease the oracles. There are scientific explanations for every ailment which has nothing to do with superstition (Hills, 1989). Again, a member of the Ibo community had blamed his step-mother for contributing to the swollen of his leg, just to claim their late father's assets. He was persuaded to visit a hospital and his leg was diagnosed to be diabetes. Ignorance and superstition have dominated the thinking and behaviour of some Nigerians and these do not guarantee scientific growth (Ogunleye, 2009).

4.8.4 Influence of Community Indigenous Knowledge of Chemistry on Students' Performance in Chemistry

The results on the influence of Community Indigenous Knowledge of Chemistry on Students' Performance in Chemistry revealed that 100% of all the 50 respondents interviewed agreed that, Indigenous Knowledge of Chemistry promoted understanding of Chemistry concepts. From research findings 26% agreed that IK promoted critical thinking, understanding plants and their chemical components and lastly development of scientific skills required in understanding of nature. The findings concur with those of Hall (2000), which indicated that, the promotion of indigenous methods of education and the inclusion of traditional knowledge also enables those in Western post-colonial societies to re-evaluate the inherent hierarchy of knowledge systems. Indigenous Knowledge systems were historically denigrated by Western educators; however, there is a current shift towards the valuing of these traditions. The inclusion of aspects of Indigenous education requires us to acknowledge the existence of multiple knowledge's rather than one standard, benchmark system.

The findings of this study on the importance of IK of chemistry in herbal Medicine revealed that 70% of the respondents agreed that herbal medicine helped in understanding

of various parts of plants and their medicinal values while 30% were of the idea that IK helped in classification of plants according to their medicinal uses in treatment of Animal and plant diseases. The findings concur with those of Tshikalange (2006), which indicated that, the success rate of traditional healers in treating sexually transmitted diseases (STDs) depends on the chemical analysis of some plants used by traditional healers. Many traditional medicinal practitioners are people without education, who have rather received knowledge of medicinal plants and their effects on human body from their bearers (Helwig, 2010). They have a deep and personal involvement in the healing process and protect the therapeutic knowledge by keeping it a secret.

The findings of this study on presence of IK of chemistry in witchcraft revealed that 62% of the respondents agreed that IK of chemistry had its use in witchcraft while 38% disagreed with this statement. On the reasons for use of IK of Chemistry in witchcraft, 34% agreed that plant parts and their extracts were used in harming other people. 32% said that, it did not promote critical thinking needed in understanding science subjects. The findings concur with those of Horn (2005), which indicated that, scientists in South Africa and other countries in Africa are testing many different plants that seem to have potential for healing illness like Malaria, TB and diabetes. Others are being considered for use as immune modulators for liver transplant patterns. *Sutherlandia frutescence* is commonly known as Cancer bush. According to a traditional healer, Credo Mutwa, the Cancer bush radiates energy and well-being, cleans blood and tonic combats.

The findings of this study on challenges encountered by students in learning of Chemistry revealed that, 30% of respondents pointed out that language used by authors in writing chemistry text books and teachers being difficult for most students to understand. 26% pointed on chemistry calculations being too difficult for many students to handle, 22% cited on inadequacy of chemistry practical skills. 12% focused on poor influence towards chemistry and lastly 10% cited on inadequate teaching and learning materials.

The findings also revealed that, the remedies to the challenges faced by students in learning chemistry were as follows; 44% of the respondents proposed that more practicals of chemistry to be done in schools, 24% settled on chemistry authors and teachers to use simple language in writing chemistry text books and teaching. 18% were for symposiums and group discussions to be introduced in schools and used in learning of chemistry and lastly 14% proposed that peer counseling and remedial teaching to be done in chemistry

subject in schools. The findings are consistent with those of Malatest (2002) who asserted that, in terms of educational context, the inclusion of indigenous knowledge, traditions, perspectives, world views and conceptions within curricula, instructional materials, text books and course books have largely the same effects as the inclusion of indigenous methods in education. Indigenous students and teachers benefit from enhanced academic effectiveness, success and learning outcomes, while non-indigenous students/learners and teachers often have greater awareness, respect and appreciate for indigenous communities and people in consequence of the context that is shared during the course of education pursuits.

4.8.5 Influence of Community Indigenous Knowledge Application in Treatment of Diseases on Students' Performance in Chemistry

The results on the influence of community indigenous knowledge application in treatment of diseases on students' performance in chemistry revealed that, 86% of the respondents interviewed agreed on the use of herbal medicine in treatment of diseases. 14% denied the use of herbal medicine in treatment of diseases. The finding concurs with those of Horn (2005), which indicates that, it's important to understand how indigenous African people relate to a globalized economy. Africans cannot avoid becoming part of what the west has achieved in the world, without forgetting that they too have something to offer from their cultures and knowledge. One needs to arrive at a new integration of indigenous knowledge and that of the rest of the world. The findings of this study on reasons for use of herbal medicine in treatment of diseases revealed that 32% of the respondents said it was readily available, 30% easy to prepare and administer, 28% were for the idea of it being cheap and affordable while 10% agreed that use of herbal medicine in treatment of diseases had less side effects to the users.

The findings of this study are consistent with Bowie et al (2005), which indicate that, the symptoms of flu, could be used to combat cancer and STDs using local medicinal herbs. Researchers have realized that this indigenous shrub common in South Africa has potent medical qualities that were known in early times by the Khoi, San and Zulu healers. Early people have observed that people suffering from cancer respond well to extract made from this plant. (*Sutherlandia frutescence* or cancer bush). This has made the hypothesize that *Sutherlandia frutescence* may assist cancer patients since there are active ingredients in this plant that assist the immune system to fight diseases. Recent (western) research has shown that the shrubs contain an amino acid that fights depression, pinitol (which help

patients to gain weight) and canavanine (which is successful in treating retroviruses). It is used to treat AIDS patients today. Although it does not cure AIDS, it definitely helps people with AIDS to enjoy a better quality of their life. This is an interesting example of how modern science is giving status to the work of traditional healers.

The results on awareness of any medicinal plant used locally to treat malaria disease revealed that 86% of the respondents were aware of some local herbs used in treating malaria disease while 14% had no idea of any medicinal plant used in treating malaria disease. Also the results revealed that 48% of the respondents were familiar with Neem plant used for treating malaria disease, 44% used Aloe Vera plant, 6% were familiar with the use of Cinchona plants and lastly 2% agreed that Olive plant could also be used locally in treatment of malaria disease. The results were consistent with those of Helwig (2010), which indicates that herbalist are becoming more and more popular in Africa with an emerging herb trading market in Durban that is said to attract between 700,000 and 900,000 traders per year from south Africa, Zimbabwe and Mozambique. Smaller trade markets exist in virtually every community. Their knowledge of herbs has been invaluable in African communities and they were the only ones who could gather them in most societies. Healers commonly ‘‘described and explain illness in terms of social interaction and act on the belief that religion permeates every aspect of human existence.’’

The findings of this study on the efficacy of local herbs used in treatment of animal diseases as compared to conventional medicine revealed that 64% of the respondents had agreed on the use of local herbs in treatment of animal diseases being more effective than conventional medicine. 36% of the respondents disagreed with this statement. Also the findings of this study on the reasons for efficacy of local herbs usage in treatment of animal diseases as compared to conventional medicine revealed that 30% of the respondents agreed that local herbs were easy to prepare and administer, 26% said local herbs were cheap and affordable, 22% were of the opinion that local herbs had less side effects to animals when used for treatment, 20% said that the local herbs were locally available while 2% said that, the local herbs had no prescribed dosage for its use.

These findings were also consistent with those of Tshikalange (2006) and Helwig (2010) which indicate that, although western medicine was successful in developed countries, it does not have the same positive impact in many of the underdeveloped African countries. Though western practices can make an impact in health care practices in certain areas such

as in the spread of various diseases, it cannot integrate wholly in to the culture and society. This makes the traditional African practitioner a vital part of their health care system. There are many reasons why the western medicinal system does not work in Africa. Hospital and medicinal facilities are difficult for Africans to get to. With vast areas of land and poor roads and transportation system, many native Africans have to travel to immense distances on foot to reach help. Once they arrive, they are often required to wait in line up to 8 hours, especially in urban areas, as the lack of clinics and resources cause overcrowding. Patients are often not told the cause of their illness or much information about it all, so they have no way to prevent or prepare for it. The technology used is usually of poor quality, which affects the quality of treatment.

Western medicine is also too expensive for the average African to afford, making it difficult for them to receive proper care. Finally, Western medicine removes native African from their culture and tradition and forces them into a setting that they are not comfortable with, away from their family and traditions which are of utmost importance to them. They do not get the proper spiritual healing that their culture seeks and traditional ideology requires. (http:www.conserve africa.org.uk/medicinal-plants).

The findings on the efficacy of local herbs in treatment of plant diseases as compared to conventional medicine revealed that, 72% of the respondents agreed that, local herbs were more effective than conventional medicine in treatment of plant diseases. 28% of the respondents on the other hand disagreed with this statement. Also the findings on the reasons for efficacy of the local herbs in treatment of plant diseases in comparison to the conventional medicine revealed that, 32% of the respondents said that local herbs were locally available, 28% were of the opinion that the local herbs were cheap and affordable, 26% said that the local herbs were easy to prepare and administer, 10% said that the local herbs had less side effects to plants when used for treatment and lastly 4% had agreed that local herbs had no prescribed dosage for its use in treatment of plant diseases. The findings concur with those of Bowie et al (2005) and Helwig (2010), which indicates that, Western medicine is too expensive for the average African to afford, making it difficult for them to receive proper care. Finally, Western medicine removes native Africans from their culture, tradition and forces them into a setting that they are not comfortable with, away from their family and traditions which are of utmost importance to them.

The findings also revealed that, 92% of the respondents agreed that, use of Indigenous Knowledge in treatment of Animal and plants diseases had a greater influence in understanding of chemistry. 8% of the respondents disagreed with this statement. The findings were consistent with those of Mokaila (2001), which indicates that, there has been more interest expressed recently in the effects of some of the medicinal plants of Africa. The Pharmaceutical industry has to consider traditional medicine as a source for identifying some of bio-active agents that can be used in the preparation of the synthetic medicine (http:www.conserveafrica.org.uk/medicinal-plants)**.** Pharmaceutical industries are looking into medicinal effects of the most commonly and widely used plants to use in drugs. It's apparent that there are some things that can be learned from traditional African practice.

The findings on the reasons for use of Indigenous Knowledge in treatment of various Animal and plant diseases revealed that, 82% of the respondents agreed that IK had helped in the process of relating plants to the diseases they could cure and hence helping the learners/students to acquire more practical skills required in Chemistry, while 18% of the respondents said that IK helped the learners to understand plants and their chemical values in treatment of diseases. The findings concur with those of Mokaila (2001), which indicates that, in comparing the techniques of African healers and Western techniques, Adeoze Lambo, a Nigerian psychiatrist stated that, ''At about three years ago, we made an evaluation, a programme of their work, and compared this with our own, and we discovered that actually they were scoring almost sixty percent success in their treatment of neurosis and we were scoring forty percent- in fact, less than sixty percent''. Horn (2005), asks the important question of what kind of knowledge natural healers have and how it differs from the knowledge taught and researched in Western Universities.

This question has a determining influence on the way Indigenous African Knowledge is perceived in the Western countries, and also on how western knowledge is used in Africa. Thus it is important to understand how Indigenous African people relate to a globalized economy. Africans cannot avoid becoming part of what the West has achieved in the world, without forgetting that they to have something to offer from their cultures and knowledge one needs to arrive at a new integration of IK and that of the rest of the world.

4.8.6 Influence of Attitude towards Community Indigenous Knowledge of Science on Students' Performance in Chemistry

The result on the influence of attitude towards community indigenous knowledge of science on students' performance in chemistry revealed a significant negative correlation between influence of attitude towards community indigenous knowledge of science and students' performance in Chemistry, alpha (α) equal to 0.05 ($r = -0.446$, $N = 174$, $P > 0.05$). This was attributed to students' negative attitude towards sciences. The findings of this study are not consistent with those of Papanastasiou (2001), who reported that, those who have positive attitude towards science tend to perform either in the subject.

The effective behaviours on the classroom and strongly related to achievement, and science attitudes are learned (George & Kaplan, 1998). Teachers play a significant role during the learning process and they can directly or indirectly influence the students' attitude towards science which in consequence can influence students' performance. What teachers like and dislike, appreciate and how they feel about their learning or studies could have a significant effect on their students. By extension, how teachers teach, how they behave and how they interact with students can be more significant than what they teach.

Students' attitude towards the learning of Chemistry is a factor that has long attracted attention of researchers. Ojo (1989) and Adesokan (2002) asserted that in spite of realization of the recognition given to Chemistry among the science subjects, it is evident that students still show negative attitude towards the subject, thereby leading to poor performance and low enrolment. In response to the challenges posed by the influence of community Indigenous knowledge of science on students' performance in Chemistry and low enrolment in science subjects, several studies have been carried in Kenya to investigate the possible causes (Eshiwani, 1974; Kyalo, 1984; Mondoh, 1986 & Wachanga, 2002). Majority of previous studies centered on the instructional methods used by the teachers, however, Haimowitz (1989), noted that the causes of most failures in schools might not be due to insufficient or inadequate instructions but perhaps by negative attitude of the learners towards science subjects.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of research findings, conclusions drawn from the findings of the study and recommendations based on the conclusions. The implications are discussed and suggestions made on possible areas for further research.

5.2 Summary of Research Findings

One of the purposes of this study was to determine the influence of Community Indigenous Knowledge on Students' performance in Chemistry in secondary schools of Samburu County. The correlation results between Community Indigenous Knowledge and Students' performance in Chemistry revealed a negative correlation between the variables. This means that Community Indigenous Knowledge has a negative influence on students' performance in chemistry. This was attributed to Community Indigenous Knowledge and practices having fewer skills required in learning of sciences.

The study also sought to find out the influence of Community Indigenous Knowledge of Students' beliefs in Cultural interpretations of Scientific Phenomena on Students' performance in Chemistry. The results revealed a negative correlation between the variables. This was attributed to students not being able to interpret their beliefs in Cultural interpretations of scientific phenomena to modern Science especially in Chemistry.

Another purpose of the study was to investigate the influence of Community Indigenous Knowledge of Chemistry on students' performance in Chemistry. The findings of this study revealed that Community Indigenous Knowledge of Chemistry promoted students' understanding of Chemistry. The main reason as revealed by the interview results was that Community Indigenous Knowledge of Chemistry helped students develop critical thinking required in learning of sciences.

The study also sought to find out the influence of Community Indigenous Knowledge applications in treatment of diseases on students' performance in Chemistry. The findings of this study revealed that 86% of the respondents interviewed had prior knowledge of

plants, their chemical components and diseases they treat. Thus helped students in acquiring more practical skills needed in understanding chemistry.

Finally the study sought to determine the influence of attitude towards Community Indigenous Knowledge of Science on Students' performance in Chemistry. The findings of this study revealed a negative correlation between the variables. This was attributed to students' negative attitude towards sciences.

5.3 Conclusions

Based on the findings of the study, the following conclusions were made.

i. The correlation between community indigenous knowledge and students' performance in Chemistry, results revealed a significant negative relationship between community indigenous knowledge and students' performance in chemistry. This means that, community indigenous knowledge had a negative influence on students' performance in chemistry.

ii. The correlation between community indigenous knowledge of students' beliefs in cultural interpretations of scientific phenomena and students' performance in chemistry, results revealed a negative correlation between the variables. This means that community indigenous knowledge of students' beliefs in cultural interpretations of scientific phenomena had a negative influence in understanding of chemistry.

iii. Community indigenous knowledge of chemistry promoted understanding of Chemistry concepts by the students. This is because it promotes critical thinking and development of scientific skills required in understanding of chemistry.

iv. Community indigenous knowledge application in treatment of both Animal and plant diseases using local medicinal plants, promotes understanding of chemistry. This was because students were able to relate plants to the diseases they cure and hence developing more practical skills required in understanding of chemistry.

v. The correlation between attitude towards community indigenous knowledge of science and students' performance in chemistry, results revealed a negative

correlation between the variables. This means that, students' attitude towards community indigenous knowledge of science did not promote students' understanding of chemistry.

5.4 Implications of the Study

There are a number of implications that can be inferred from the findings of this study. The results imply that:

i. Community indigenous knowledge is significant in influencing students' performance in chemistry. This is evidenced by the relationship between community indigenous knowledge and students' performance in chemistry. Therefore the Government should train teachers in community indigenous knowledge in Teachers' Training Colleges and Universities. This will boost students' understanding of community indigenous knowledge thus enhancing the teaching and learning process. If this is achieved, students' performance in chemistry will be significantly enhanced.

ii. Community indigenous knowledge of students' beliefs in cultural interpretations of scientific phenomena has resulted to negative influence on students' performance in chemistry. This is because of students' not being able to interpret their cultural beliefs in scientific phenomena to modern science. Therefore students' performance in chemistry is adversely affected resulting to poor learning outcomes in Chemistry and other Sciences.

iii. Community indigenous knowledge of chemistry has resulted to more understanding of chemistry concepts. This is because it helps students develop critical thinking and acquisition of scientific skills required in understanding of Chemistry. Therefore students' performance in chemistry is highly enhanced.

iv. Application of community indigenous knowledge in treatment of diseases has resulted to better understanding of chemistry. This is because students' are able to relate various plants to the diseases they treat and also developing practical skills required in understanding of chemistry.

v. Attitude towards community indigenous knowledge of science has resulted to poor understanding of chemistry concepts. This is because of students' having a negative attitude towards science subjects.

5.5 Recommendations

On the basis of the results of this study, the following recommendations are made:

(i) The Ministry of Education should initiate in-service courses for science teachers to equip themselves with the skills of Community Indigenous Knowledge so as to enhance their effectiveness in teaching of science subjects.

(ii) Learning of Chemistry and other science subjects in secondary school curriculum should be practical oriented and student centred. This could help students interpret their cultural beliefs in scientific phenomena to modern science hence enhancing understanding of chemistry and other sciences.

(iii) The Government of Kenya through the ministry of Education should integrate Indigenous Knowledge of Science in to secondary school curriculum so as to enhance the teaching and learning of Chemistry and other sciences.

(iv) Students in secondary school should be exposed to more practical activities using locally available materials for example plant parts or their extracts so that they can perform simple chemical analysis and relate it to their applications in real life situations.

(v) The ministry of Education, NGO's and school sponsors should initiate educational seminars or workshops for science teachers and students to equip them with the skills of attitude change towards Community Indigenous Knowledge of Science so as to enhance their efficacy in teaching and learning of science subjects.

5.6 Recommendations for Further Research

The findings of this Study indicate that Influence of Community Indigenous Knowledge of Science on Students' Performance in Chemistry promotes students' understanding of chemistry. However there are areas that warrant further investigation. These include the following;

(i) Teachers' indigenous knowledge of science should be studied to determine its influence on students' performance in chemistry.

(ii) The study concentrated on the influence of community indigenous knowledge of science on students' performance in chemistry. Such a study should be done at middle level colleges and universities to investigate whether students' performance and generally the quality of education has been influenced by this factor.

(iii) Community indigenous knowledge of science should be studied at secondary level of education to determine its influence on students' performance in other science subjects such as biology, physics and agriculture.

(iv) Parents' indigenous knowledge of science should be studied at secondary level of education to determine its influence on students' performance in chemistry.

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APPENDICES

APPENDIX: 1

Chemistry Performance Test (CPT)

Date: _____

Time: (Start) _____End._____

Serial No._____

Gender._____Male/Female

Class/Form_____

Name of the school._____

School category_____Girls/Boys/Co-educated.

Division_____Kirisia/Leroki

INSTRUCTIONS

- This question paper has a total of 30marks.
- Please, answer all the questions.
- Read the question carefully to ensure that you understand it before writing your answer.
- Answer the questions in the spaces provided.

1. a). Define Boyle's law. (2mks)

   b). Draw a graph of relationship between volume and pressure to represent Boyle's law. (3mks)

2. a). Define the term empirical formula. (2mks)

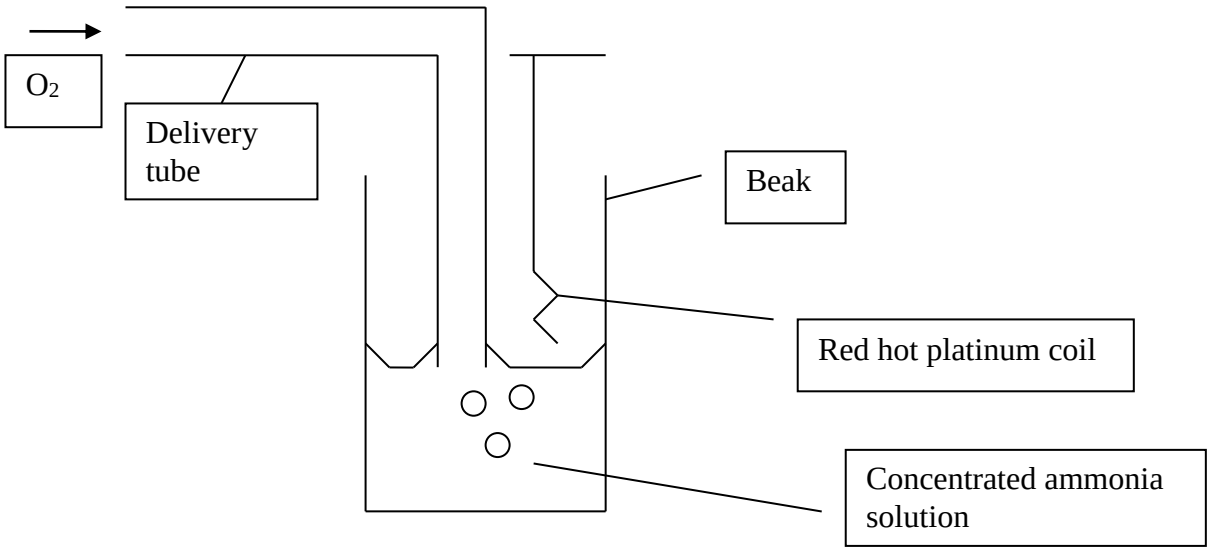
   b). 2.8g of Iron reacted with 1.2g of Oxygen gas to form Iron oxide. Determine the empirical formula of the oxide. (3mks)
   (R.A.M: Fe = 56, O = 16)

3. a). What are hydrocarbons? (1mk)

b). Complete the following table by giving the correct molecular and structural formula of the Hydrocarbons given. (4mks)

No. of carbon Atoms in a chain	Name of Hydrocarbon	Molecular Formula	Structural formula
1.	Methane	CH_4	_____
3.	Propene	_____	$CH_2=CHCH_3$
5.	Pent-2-yne	C_5H_8	_____
7.	Heptane	_____	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$

4. Study the set-up in figure 1 below and answer the questions that follow.



a). Explain the observations made on the hot platinum wire. (3mks)

b). Explain the presence of brown fumes in the beaker. (2mks)

5. Using equations show the reactions of concentrated Sulphuric (VI) acid as:-

a). A dehydrating agent. (3mks)

b). As an Oxidizing agent. (2mks)

6. a) Using a diagram, explain how hydrogen chloride solution (hydrochloric acid solution) can be prepared in the Laboratory . (2mks)

b)

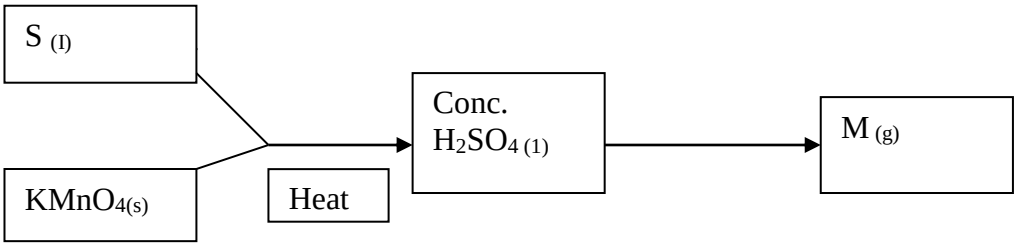


Figure: 2

Study the flow chart above in figure 2 and use it to answer the following questions:-

i. Identify liquid S (l) and M (g) in the flow chart above. (2mks)

S (l) _____

M (g) _____

ii. What is the role of concentrated H_2SO_4 (l) acid in the reaction above? (1mk)

END

APPENDIX: II

Students` Questionnaire

Date……..……

Serial no ……

INRODUCTION

The questions below seek to find out the influence of Community Indigenous Knowledge of Science on Students' Performance in Chemistry in Secondary Schools of Samburu County. You have been chosen to provide information in regard to the topic and you are requested to answer all questions as honestly as possible by ticking (✓) against Strongly agree (SA), Agree (A), Undecided (U), Disagree (D) or Strongly Disagree (SD). The questionnaire has three main areas and each area has six close-ended questions. If a question is not clear, you are requested to seek help from the researcher. The information you give is confidential and will be used only for the purpose of this research. The types of questions used are on agreement scales.

Age_____Years.

Gender_____ Female ( ), Male ( ).

Class/Form————————————

Name of the School _____

School Category _____Girls ( ), Boys ( ), Co-educational ( )

Division _____Kirisia ( ), Leroki ( )

PART ONE

Community Indigenous Knowledge

How much do you agree with each of the following statements?

	Strongly agree (SA):5	Agree (A):4	Undecided (U):3	Disagree (D):2	Strongly Disagree (SD):1
1. Most of the high School	( )	( )	( )	( )	( )

Students are familiar with the Indigenous Knowledge of herbal medicine.					
2. Indigenous Knowledge of Witchcraft help students develop scientific skills useful in learning of Science subjects.	( )	( )	( )	( )	( )
3. Indigenous knowledge of herbal treatment of plants diseases help students develop practical skills useful in understanding chemistry.	( )	( )	( )	( )	( )
4. Indigenous knowledge of herbal treatment of animal diseases help students develop practical skills useful in understanding chemistry.	( )	( )	( )	( )	( )
5. Indigenous knowledge forms the basic foundation in understanding of scientific concepts especially in chemistry.	( )	( )	( )	( )	( )
6. Indigenous knowledge help in determining the science discipline one can be affiliated to in the learning process.	( )	( )	( )	( )	( )

PART TWO

Students' Beliefs in Cultural Interpretations of Scientific Phenomena

How much do you agree with each of the following statements:-

	Strongly Agree (SA):5	Agree (A):4	Undecided (U):3	Disagree (D):2	Strongly Disagree (SD):1
7. Indigenous Knowledge helps in understanding students' beliefs in interpretations of scientific phenomena such as earthquake, lightning, volcanicity among others.	( )	( )	( )	( )	( )
8. Students develop scientific skills by understanding their beliefs in interpretations of scientific phenomena.	( )	( )	( )	( )	( )
9. Traditional beliefs on curses help Students develop critical thinking in learning of Chemistry.	( )	( )	( )	( )	( )
10. Indigenous Knowledge of traditional taboos and beliefs help students develop high order thinking skills which are good for learning of Chemistry.	( )	( )	( )	( )	( )
11. Students beliefs in superstitions help them develop a better understanding of Chemistry concepts.	( )	( )	( )	( )	( )

12. Indigenous knowledge of students' beliefs in interpretations of scientific phenomena has a positive influence on their academic performance especially in Chemistry.	( )	( )	( )	( )	( )

PART THREE

Students' Attitude towards Community Indigenous Knowledge of Science

How much do you agree with each of the following?

	Strongly Agree (SA):5	Agree (A): 4	Undecided (U):3	Disagree (D):2	Strongly Disagree (SD):1
13. Students' have a high affinity to herbal medicine, hence more Understanding of Chemistry concepts.	( )	( )	( )	( )	( )
14. Indigenous Knowledge Plays a vital role in learning of all science Subjects.	( )	( )	( )	( )	( )
15. Integration of indigenous knowledge in to education curriculum, will boost performance of students' in Chemistry.	( )	( )	( )	( )	( )
16. Indigenous knowledge is more practical oriented and help students develop	( )	( )	( )	( )	( )

Practical skills relevant to Chemistry understanding.					
17. Indigenous knowledge is Very easy to understand and apply in solving scientific problems especially in Chemistry.	( )	( )	( )	( )	( )
18. Indigenous knowledge is Adapted to local culture and Environment hence promoting students' deeper understanding of Chemistry.	( )	( )	( )	( )	( )

END

THANK YOU FOR YOUR CO-OPERATION!

APPENDIX: III

Students' Interview Schedule

Date of interview_____

Time (Start) _____End_____

Serial no_____

Introduction

Hello, my name is_____

The questions below seek to find out the influence of community indigenous knowledge of science on students' performance in Chemistry in Secondary schools of Samburu County. You have been chosen to provide information in regard to the topic and you are requested to answer all the questions as honestly as possible. I want to assure you that your answers will remain confidential and will be used only for the purpose of this research and cannot be connected with you in any way in future. You are one of a large cross-section of students I will be interviewing around the county and your answers are necessary and you are a representative of other students.

PART ONE

Community Indigenous Knowledge of Chemistry

1. Does Indigenous Knowledge help you in understanding of Chemistry concepts?
   a).Yes ( ), b). No ( )
2. Give appropriate reason(s) for the answer you have given in 1 above.
   i. _____
   ii. _____
   iii. _____
   iv. _____
3. What is the importance of Indigenous Knowledge of Chemistry in herbal medicine?

4. Is there any Indigenous Knowledge of Chemistry in witchcraft? a).Yes ( ), b). No ( )
5. Give appropriate reason(s) for the answer you have given in 4 above.
   i. _____

ii. _____

iii. _____

iv. _____

6. (a) what challenges do you usually encounter in understanding of Chemistry?

i._____

ii._____

iii._____

iv._____

(b) Give appropriate remedy for each of the challenges you have named in 6 (a) above.

i._____

ii._____

iii._____

iv._____

PART TWO

Application of Indigenous Knowledge in Treatment of Diseases

7. Do you use herbal medicine in treatment of diseases? a).Yes ( ), b). No ( )
8. Give appropriate reason(s) for the answer you have given in 7 above.

i. _____

ii. _____

iii. _____

iv. _____

9. Do you know the name of any medicinal plant used locally in treatment of malaria? a). Yes ( ), b). No ( )
10. (i) Are local herbs more effective in treatment of animal diseases than conventional Medicine? a).Yes ( ), b). No ( )

(ii) Give appropriate reason(s) for the answer you have given in 10 (i) above.

i. _____

ii. _____

iii. _____

iv. _____

11. (i). Are local herbs more effective in treatment of plant diseases than Conventional Medicine? a).Yes ( ), b). No ( )

(ii). Give appropriate reason(s) for the answer you have given in 11 (i) above.

i. _____

ii. _____

iii. _____

iv. _____

12. (i). Does Indigenous Knowledge of using local herbs in treatment of various plant and Animal diseases help you understand Chemistry? a). Yes ( ), b). No ( )

(ii). Give appropriate reason(s) for the answer you have given in 12 (i) above.

i. _____

ii. _____

iii. _____

iv. _____

END

THANK YOU FOR YOUR CO-OPERATION!

APPENDIX: IV

Sample Size Determination

The sample size (n) was determined as with Kothari (2003) method of Sample size determination from a finite population.

$$n = \frac{Z^2PqN}{(N-1)e^2 + Z^2Pq}$$

Where: -

n = Required sample size.

Z = Value of standard variate = 1.96 @ 95% Cl,

N = The given population size (752),

e = Acceptable error and Degree of Accuracy = 0.05,

P = Proportionate Target population with the particular characteristics (P = 0.141),

q = 1 – p = 0.859. Therefore: - $n = 1.9^2 \times 0.141 \times 0.859 \times 752 / (751 \times 0.05^2) + (1.96^2 \times 0.141 \times 0.859) = 149.353$.

Since, n = 149.353 was the minimum size of the Sample that would be used in this study, a convenient approximate of 149 Students was taken together with 10% of 752 allowed for attrition making a total of 224 Students.

APPENDIX: V

Number of Form Three Students Sampled per School and Gender

School	F.3 Students Enrolment: Girls	No. Sampled.	Boys	No. sampled.
1. Kisima Girls.	64	25	-	-
1. A.I.C Moi Girls.	76	30	-	-
3. Kirisia Mixed.	23	10	64	24
4. Good Shepherd Boys.	-	-	30	14
5. Maralal Boys.	-	-	120	48
6. Bishop Perlo Girls	30	14	-	-
7. Nkuroto Day Mixed	10	05	15	09
8. Samburu High Mixed	12	06	18	07
9. Baragoi Boys	-	-	52	32
TOTAL	**215**	**90**	**299**	**134**

Source: School class registers, 2013

APPENDIX: VI

Number of Form Three Students Sampled for Interview Schedule per School and Gender

School	F. 3 Students Enrolment			
	Girls	No. Sampled	Boys	No. Sampled
1. Kisima Girls	64	06	-	-
2. A.I.C Moi Girls	76	07	-	-
3. Kirisia Mixed	23	02	64	06
4. Good Shepherd Boys	-	-	30	03
5. Maralal Boys	-	-	120	12
6. Bishop Perlo Girl	30	03	-	-
7. Nkuroto Day Mixed	10	01	15	02
8. Samburu High Mixed	12	01	18	02
9. Baragoi Boys	-	-	52	05
TOTAL	**215**	**20**	**299**	**30**

Source: School class registers, 2013

APPENDIX: VII

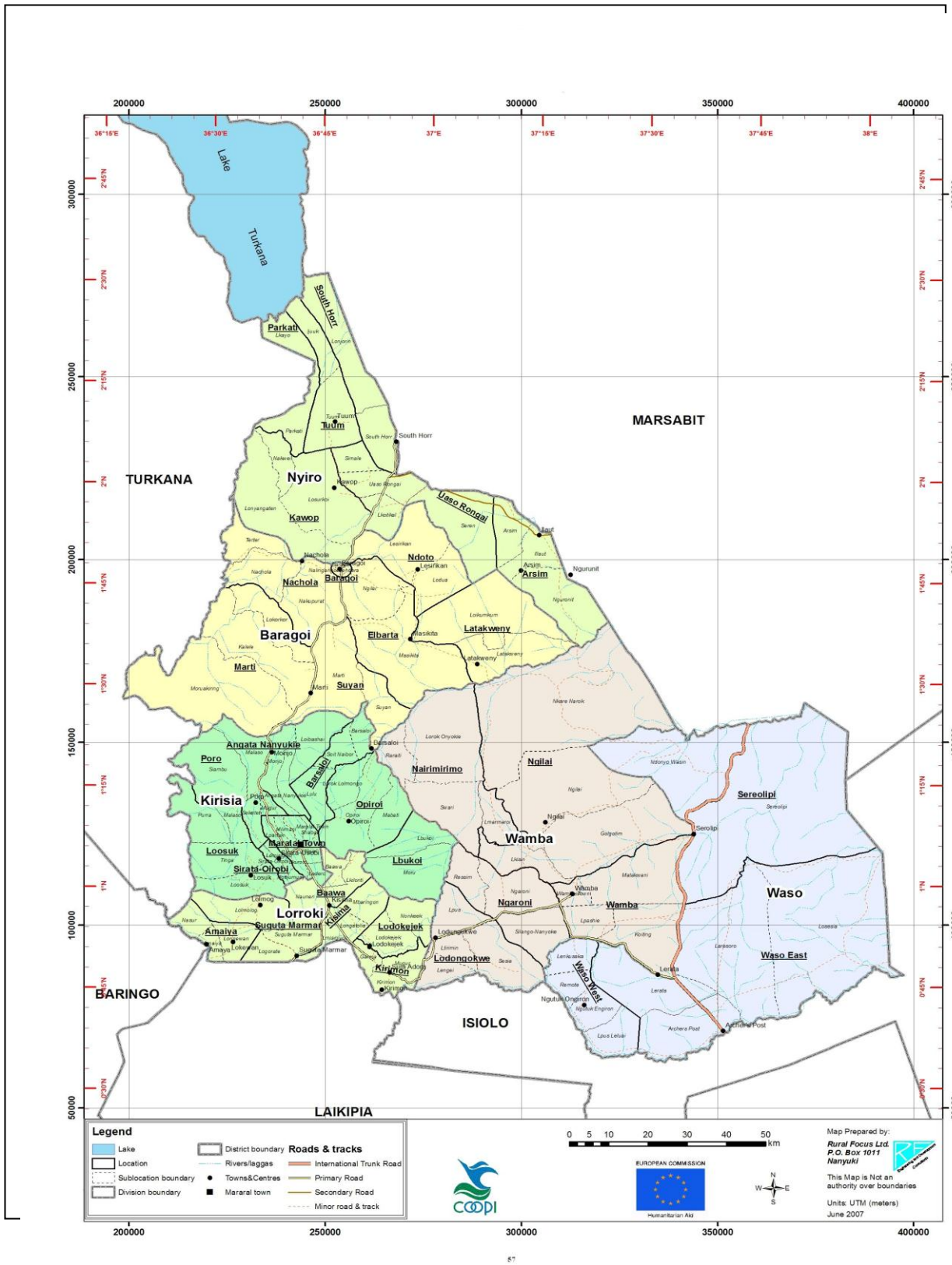
High Schools' Student Population per School in Samburu County, Kenya, 2013

Schools	Enrolment (F. 1 - 4)
1. KISIMA GIRLS	320
2. MARALAL BOYS	540
3. AIC MOI GIRLS	350
4. KIRISIA MIXED	450
5. BISHOP PERLO GIRLS	115
6. GOOD SHEPHERD SECONDNDARY	120
7. SAMBURU HIGH	120
8. BARAGOI BOYS	298
9. NKUROTO MIXED	102
10. BARAGOI GIRLS	106
11. NYIRO BOYS	120
12. TUUM GIRLS	90
13. ST. THERESAS GIRLS	120
14. WAMBA BOYS	210
15. UASO BOYS	125
TOTAL	**3,186**

Source: Samburu County D.E. Office, 2013

APPENDIX: VIII

Map of Study Area



Source: Samburu County Education Office, 2013

APPENDIX: IX

Research Authorization

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telephone: 254-020-2213471, 2241349, 254-020-2673550
Mobile: 0713 788 787 , 0735 404 245
Fax: 254-020-2213215
When replying please quote
secretary@ncst.go.ke

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: **NCST/RCD/14/013/196**

Date: **5th March, 2013**

Lomonyang' Ekwam
Egerton University
P.O.Box 536
Egerton.

RE: RESEARCH AUTHORIZATION

Following your application dated ***21st February, 2013*** for authority to carry out research on "***Influence of community indigenous knowledge of science on students' performance in Chemistry in secondary schools of Samburu County, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Samburu County** for a period ending **31st December, *2013.***

You are advised to report to **the District Commissioners and the District Education Officers, Samburu County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR M.K. RUGUTT, PhD, HSC.
DEPUTY COUNCIL SECRETARY

Copy to:

The District Commissioners
The District Education Officers
Samburu County.

APPENDIX: X

Research Clearance Permit

CONDITIONS

1. You must report to the District Commissioner and the District Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.
2. Government Officers will not be interviewed with-out prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) four(4) bound copies of your final report for Kenyans and non-Kenyans respectively.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

GPK6055t3mt10/2011

REPUBLIC OF KENYA

RESEARCH CLEARANCE PERMIT

(CONDITIONS–see back page)

PAGE 2

THIS IS TO CERTIFY THAT:
~~Prof./Dr./Mr./Mrs./Miss/Institution~~
Lomonyang' Ekwam
of (Address) Egerton University
P.O.Box 536, Egerton.
has been permitted to conduct research in
Location
District
Samburu
County

on the topic: Influence of community indigenous knowledge of science on students' performance in Chemistry in secondary schools of Samburu County, Kenya.

for a period ending: 31st December 2013.

Applicant's Signature

Secretary
National Council for Science &Technology

PAGE 3

Research Permit No. *NCST/RCD/14/013/196*
Date of issue *5th March, 2013*
Fee received *KSH. 1,000*