EFFECTS OF PRACTICAL WORK ON STUDENTS' ACHIEVEMENT IN BIOLOGY AT SECONDARY SCHOOL LEVEL IN KAJIADO COUNTY, KENYA

DENIS NDUVA NTHUSA

REG.NO 1030870

A Research Project Submitted to the Department of Undergraduate Studies in Education in Partial Fulfillment of the Requirements for the Degree of Bachelor of Education Award.

FACULTY OF EDUCATION

DEPARTMENT OF UNDERGRADUATE STUDIES IN EDUCATION

THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

MAY, 2022

NAIROBI KENYA.

DECLARATION

I the undersigned declared that this Project is my original work and has not been submitted for examination for graduate study at any university.

NAME: DENIS NDUVA NTHUSA

REG: 1030870

SIGNATURE: .....

DATE: .....

This Project was submitted by the approval as the University Supervisor

SR DR ELIZABETH PILIYESI

SIGNATURE: ….....

DATE: ….....

This Project was accepted by the Head of Department Undergraduate Studies in Education

DR CELESTINE NDANU MWANIKI

SIGNATURE: ……

DATE: …….

DEDICATION

To My Beloved Mother, Susan Mulu and Brother Ben Munyasia for constantly reminding me to be straight focused and to always “Use Common Sense”. My Family and Relatives, whose prayers and support have been great, I deeply say Thank You with all my Heart.

ACKNOWLEDGEMENT

I Greatly Appreciate all the people played part in the producing of this project.

The observations of the facts could not be complete without the help of Sr Dr Elizabeth Piliyesi.

She did a good job, in the error corrections and collection of definite facts.

May our Almighty Father grant you favour in everything that you do, Sister.

ABSTRACT

This study aimed at looking for the effects of practical work on students' achievement in Biology at secondary school level. The study was guided by two theories namely cognitive development and behaviourism theories. The first theory anchored on this critique was the cognitive development theory by Jerome Bruner (1962) while the second theory anchored on this critique was the John B. Watson's Theory on Behaviourism. The study adopted a Survey Research Design. The target population comprises of Principals, Form 2 Biology Teachers, Form 2 Biology Students and Lab Technicians. The target population sampled using a Purposive sampling and Taro Yamane Sampling methods. The study used both Questionnaires and Interview schedules to collect data. Thorough Expert Judgement of a Supervisor as provided by the University and Pearson's Product Momentum Correlation Coefficient both ensured Validity and Reliability of the Research instruments. Data was collected by the Researcher and analysed by Pearson's Product Momentum Correlation Coefficient. Ethical consideration was followed to avoid biasness and inappropriate research methodology. The Findings revealed that teachers preferred demonstrations and lectures while project works were the most unpopular method of teaching together with practical. The study concluded that Age, Gender, and Teachers Efforts were major factors that contribute to the student's overall achievement in the subject. The study recommended that schools and Ministry of Education (MoE) invest more on Training the teachers on the SMASSE projects which would highly motivated and give them the necessary pedagogical skills to teach more effectively and effortlessly. The learning process concluded that Biology teachers should be encouraged to place a higher priority on Practical Works for their students' improved performance.

TABLE OF CONTENTS

DECLARATION ii
DEDICATION iii
ACKNOWLEDGEMENT iv
ABSTRACT v
LIST OF TABLES ix
LIST OF FIGURES x
ABBREVIATIONS AND ACRONYMS xi
CHAPTER ONE 1
INTRODUCTION 1
1.1 Background to the Problem 1
1.2 Statement of the Problem 7
1.3 Research Objectives 8
1.4 Research Questions 9
1.5 Significance of the Study 9
1.6. The Scope and Delimitations of the Study 10
1.6.2 Limitation of the Study 11
1.7 Theoretical Framework 11
1.8 Conceptual Framework 13
1.9 Operational Definition of Terms 15
CHAPTER TWO 16
REVIEW OF RELATED LITERATURE. 16
2.1 Introduction 16
2.2 Critique of Related Theories 16
2.2.1 Cognitive development theory by Jerome Bruner (1962) 17
2.2.2 Behaviourism Theory by John B Watson 21
2.3 Empirical and Conceptual Review of Studies 24
2.3.1 Is there any relationship between a school physical Laboratories and students' success in Biology 24
2.3.2 Is there any relationship between students' understanding to concepts in Biology and teacher's modes of teaching 27
2.3.3 Is there relationship between students' attitude change and motivation in Biology and Positive Engaging Learning Environment 30
2.4 Summary and Identification of Knowledge Gap 32
CHAPTER THREE 34

RESEARCH METHODOLOGY....34
3.1 Introduction....34
3.2 Locale of the Study....34
3.3 Research Design....35
3.4 Target Population....36
3.5 Sample Size and Sampling Procedures....37
3.5.1 Sampling of Schools....37
3.5.2 Sampling of Students....37
3.5.3 Biology Teachers....38
3.5.4 Sampling of Principals....39
3.5.5 Sampling of Laboratory Technicians....39
3.6 Data Collection Instruments....40
3.6.1 Questionnaires....40
3.6.2 Interview Schedule....41
3.7 Validity, Pilot Testing of Research Instruments and Reliability....42
3.7.1 Validity....42
3.7.2 Pilot Testing....43
3.7.3 Reliability....43
3.8 Data Collection Procedures....46
3.9 Data Analysis Procedures....46
3.10 Ethical Considerations....47
CHAPTER FOUR....48
DATA ANALYSIS, PRESENTATION AND DISCUSSION....48
4.1 Introduction....48
4.2 Questionnaires Return Rate....48
4.3 Demographic Information of Respondents....49
4.3.1 Demographic Information of Principals....49
4.3.2 Demographic information of Biology Teachers....52
4.3.3 Demographic information of form 2....56
4.3.4 Demographic information of Lab Technicians....60
4.3.5 School Category....61
4.4 Respondents Responses on Students' Academic Performance....61
4.4.1 Principals Responses....62
4.4.2 Biology Teachers Responses....65
4.4.3 Form-2 Biology Students Responses....68

4.4.4 Lab Technicians Responses 70
4.5 Science skills and processes students develop 72
CHAPTER FIVE 73
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS 73
5.1 Introduction 73
5.2 Summary of Findings 73
5.3 Conclusion 74
5.4 Recommendations 74
5.4.1 Policy Recommendations 75
5.4.2 Ministry of Education Recommendations 75
5.4.3 Students Recommendations 75
5.4.4 Suggestion for further Research 75
REFERENCES 76
APPENDICES 84
Appendix 1: Permit Letter 84
Appendix 2: Principal's Questionnaires 85
Appendix 3: Principal's Interview Schedules 89
Appendix 4: Teacher's Questionnaires 91
Appendix 5: Teacher's Interview Schedules 95
Appendix 6: Student's Questionnaires 98
Appendix 7: Student's Interview Schedules 102
Appendix 8: Lab Technician's Questionnaires 105
Appendix 9: Lab Technician's Interview Schedules 108
SECTION: B 110
Appendix 10: Map of Kenya Showing Counties 110
Appendix 11: Map of Kajiado County 111

LIST OF TABLES

Table 1 Kajiado County Schools 36

Table .2 Sampling Procedures 39

Table 3.3 below shows the Pre-test Mean of the Respondents. 44

Table 3.4 Post-test mean of the Respondents 44

Table 3.5 Pre-test, Post-test Correlation table 45

Table 4 Questionnaire Return Rate 48

Table 5 Gender Distribution of Principals 49

Table 6 Distribution of Principals by Age 50

Table 7. Principal's service in their current school 51

Table 8 Distribution of Biology Teachers Age 53

Table 9 Biology Teacher's duration of Service in their Teaching profession 54

Table 10 Biology Teacher's Duration of Service in the Current School 55

Table 11 Distribution of Students by Gender 56

Table 12 Distribution of Male Students to Enrol Biology in Form-3 58

Table 13 Distribution of Female Students to Enrol Biology in Form-3 59

Table 14 Distribution of Lab Technicians by Gender 60

Table 15 Principals Responses 63

Table 16 Teachers Responses 65

Table 17 Form 2 Students Responses 69

Table 18 Lab Technicians Responses 70

Table 19 Principals Questionnaire 1 88

Table 20 Teachers Questionnaires 94

Table 21 Students Questionnaires 101

Table 22 Lab Tech Questionnaires 107

LIST OF FIGURES

Figure 1: Conceptual Framework 14

Figure .2 Distribution of Principals by their Level of Education 50

Figure 3 Demographic Information of Biology teachers by Gender 52

Figure 4 Distribution of Biology teachers by level of education 53

Figure 6 Distribution of Students by Gender 56

Figure 7 Distribution of students by Level of Enrolment 57

Figure 9 Distribution of Female Students to Enrol Biology in Form-3 59

Figure 10 Distribution of Lab Technicians by Gender 60

Figure 11 Research Permit 1 84

Figure 12 Map of Kenya 110

Figure 13 Map of Kajiado 111

ABBREVIATIONS AND ACRONYMS

FMCE: Force and Motion Conceptual Evaluation

HIV/AIDS: Human Immunodeficiency Virus, Acquired Immunodeficiency Syndrome

ISLE: Investigative Science Learning Environment

KCSE: Kenya Certificate of Secondary Education

KICD: Kenya Institute of Curriculum Development

KNEC: Kenya National Examinations Council

SMASSE: Strengthening of Mathematics and Sciences in Secondary Education

SPSS: Statistical Package for Social Sciences

NSF: National Science Foundation

GoK: Government of Kenya

INSET: In Service Education and Training

DNA: Deoxyribonucleic Acid

MoE: Ministry of Education

CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

Kajiado County is situated in Rift Valley region and borders Narok County to the West, Nakuru County, Kiambu County, and Nairobi County to the North, Machakos County, Makueni County, and Taita-Taveta County to the East and Tanzania to the South constituting one of the Five counties that share the Country's border with Tanzania (kenyacounntyguide, n.d.)

County Schools in Kenya form the third tier of secondary schools; after National and Extra County schools, respectively. The schools admit students from majorly within the country. Admissions to these schools is done online by the Ministry of Education. The schools are either of Mixed or single sex type. (@educationnewshub.co.ke, n.d.)

On the other hand small secondary schools in the county face challenges in implementation of use Practical Works to Science Subjects, Sciences especially Biology require a lot of concepts and thus it can be problematic to students if facilities lack or are not properly utilized and if teacher does not simplify the context and make the subject interesting (njeri, 2013)

Because of this and other challenges that face implementation of the programmes in schools; most schools resort to outdated and inefficient approaches and methods.

In attempt to overcome the problem the Government of Kenya has come with in-service training programme i.e., Strengthening of Mathematics and Sciences in Secondary Education, for Teachers in-charge of Sciences and Mathematics.

Science, any system of knowledge that is concerned with the physical world and its phenomena and that entails unbiased observations and systematic experimentation. In general, a science involves a pursuit of knowledge covering general truths or the operations of fundamental laws (Britannica, n.d.)

Biology, the study of living creatures and their vital activities. The field is concerned with all of life's physicochemical characteristics. The present trend toward cross-disciplinary research and the integration of scientific information and investigation from other fields has resulted in extensive overlap between the fields of biology and other scientific disciplines. Modern ideas from other domains, such as chemistry, medicine, and physics, are combined with biological principles in areas such as biochemistry, biomedicine, and biophysics (rogers, n.d.)

Scientific ideals are an **important** apparatus for making or put right things needed by all nations to help them in undergoing growth technology-based power of invention in the present in competition World. There are several questions facing the World today which cover coming-out of new medical substance sometimes used for amusement stopping effect, effects of genetic testing and designing and making things, conditions of living force of meeting blow of current-day technology.

Science education is to do with the development of any nation. It is reason behind the good outcome in science and technology in the have undergone growth World. A revolution in biochemistry and molecular biology education informed by basic research to meet the demands of 21st-century career paths.

The National Science Foundation (NSF) estimates that eighty percent of the jobs available during the next decade will require math and science skills, which requires programs in biochemistry and molecular biology to be transformative using new pedagogical approaches and experiential learning as foundations for careers in industry, research, intellectual property law, education, engineering, health-care professions, and other interdisciplinary fields. (Black, 2020)

Biology is one of the subjects in science education, that involves the study of life and living organisms. Modern biology is a vast and eclectic field composed of many specialized disciplines that study the structure, function, growth, distribution, evolution, or other features of living organisms. (Candela, 2019)

It plays a key role in the future progress of mankind. Biology generates fundamental knowledge needed to focus on the basic principles of biochemistry, molecular biology, genetics, and recombinant DNA. These principles are necessary to understanding the basic mechanisms of life and anchor the biological knowledge that is required to understand many of the challenges in everyday life, from human health and disease to loss of biodiversity and environmental quality. (OpenCourseWare, 2021)

Biology is a life science. To study biology, it is necessary to talk about the living environment and the relationship between biological organisms and their environment. Studying biology not only enables students to learn a great deal of environment-related basic knowledge, but also can foster a feeling toward the environment and develop skills needed to protect the environment. (Xingcun, 2004)

Basic ecology is an important topic in Secondary school level Biology in **Africa** and students are needed to learn and understand basic ecology, thus this kind of information will help students understand environmental issues, develop the value system and attitude, and be pro-actively involved in environmental problem solving. Thus, introduction to Africa Environmental Education and Training Plan (AEETAP) was initiated by the UNEP African Ministerial Conference of the Environment (Heila Lotz-Sisitka, n.d.)

In the world of public health care, biology plays a significant role in identifying the causes of diseases, how they are transmitted and how they can be controlled. (**Health Education in Africa: 1975-2000,** Biological Aspects of Public Health), you'll explore environmental concerns, the scientific basis for prevention, including vaccination and the human behaviours that affect the health of a community. (Oladimeji Oladepo, 2000)

The notion of bioeconomy emerged in a literature of the late 20th century. The East Africa countries (Ethiopia, Burundi, Kenya, Rwanda, Tanzania and Uganda and South Sudan) are keen to chart a new development trajectory. Towards this end, the countries have identified Bioeconomy as a potential pathway. The strategy is thus premised on the belief that a successful deployment of the Bioeconomy has also the potential to promote sustainable, bio-based economic growth, new employment opportunities, improved livelihoods, food security and wealth creation. Green Economy is concerned with fostering economic growth and development pathway that is low carbon, efficient and socially inclusive. It aims to reduce pollution and increase resource efficiency while preventing loss of biodiversity and valuing ecosystem services (Nicholas Ozor, 2021)

Bioenergy is normally produced from biological processes (fermentation or anaerobic digestion) via utilization of effective and suitable microbial system and sustainable raw substrates (agricultural crops biomass residue or biological wastes). Bioenergy is an important source of energy in **Kenya**, accounting for 68 percent of the country's total energy requirement for a variety of purposes, particularly cooking and heating. As a renewable energy source, it can help the country achieve energy security, as stated in the National Energy Policy (2018) and Energy Act (2019), as well as satisfy other national goals outlined in Vision 2030, such as agriculture, health, and commerce, for which energy is an enabler.

The **Kenya** Bioenergy Strategy 2020–2027 was launched on November 18, 2020, by the Kenyan government, through the Ministry of Energy, in collaboration with partners. Bioenergy is the world's largest source of renewable energy, producing heat, electricity, and transportation fuel (Baraza, 2020)

Academic performance is a measure of a student's achievement in several academic courses. Teachers and school officials often assess achievement by classroom performance, graduation rates, and standardized test scores (Team b., n.d.)

Academic performance is **significant** because it is directly related to the positive outcomes that we value. Adults who are academically successful and have a high degree of education are more likely to be employed, to have stable job, to have more employment possibilities, and to make more money than those with less education. Greater salaries, are more likely to have health insurance, are less reliant on social assistance, and are less likely to be unemployed. Academic achievement is critical because working people will require higher levels of education to take on the technologically challenging jobs of the future (Regier, 2011)

Students' academic performance is reflected in their ability to demonstrate their knowledge in tests, quizzes, presentations, and final examinations (Barkley, 2004). The **importance** of student performance is obvious not only to students but also to universities because it is a measure of the success of their educational process. Physical facilities and qualified educators, as well as students' attitudes, aspirations, and self-awareness, have all been studied in the education literature as factors that may influence student performance. (Satisfactory Essays)

Despite the importance of Biology in the scientific and technological development, it appears Biology Education has been facing various challenges. First the enrolment in Biology course at all levels is low in many **Sub-Saharan African** countries. (Kadio, 2021)

Many reasons are advanced for this variance which include Inadequate lower-level preparations, and lack of job opportunities outside the teaching profession, inadequate teacher qualification as well as possession of below standard pedagogical content knowledge. (Sifuna, 2009)

Many students find the science subjects boring, (more so Biology) unemployable and as a result interest in high school Biology is decreasing. (Ayeni, 2021)

In secondary school curriculum in **Kenya**, Biology is allocated Five lessons per week in form Three and Four whereas English Language and Mathematics are allowed eight and seven lessons per week, respectively (Team N. B., News blaze, n.d.)

In **Kenya**, the secondary school education takes a duration of 4-years. On joining Form One, the student is taught all the subjects in the curriculum. This means that all the three science subjects that is, Biology, Chemistry and Physics are compulsory. This trend continues in the second year in Form Two. It is at the end of Form Two when a student is expected to make a choice of the subjects to pursue in Form Three and Form Four.

Therefore, the study targeted Form Two as it is at this crucial point that major decisions that affect the future of the students and the country at large are made.

The knowledge and skills in Biology traverse all spheres of life and helps in solving societal problems particularly in health and environment. This is because it prepares learners for studies in applied disciplines such as agriculture, medicine, biotechnology and the Agrochemical, and food industries among other areas of application (Dr. Edwin Masibo, oarklibrary, 2017)

Although the subject scores comparatively higher among sciences in national examinations, the mean score has been below averaging in the national examinations from 2013 to 2015.

There was a marked drop in the mean score from 57.01 in 2013 to 56.98 in 2014 and 56.72 in 2015 (Wanjala, n.d.) Hence there is need to investigate the actual practice by teachers to establish what goes on in classrooms.

1.2 Statement of the Problem

Attempts have been made to counter the problem of poor performance in sciences in schools. For instance, interventions such as SMASSE project, a joint venture by the Government of Kenya (GoK), In Service Education and Training (INSET) through seminars and workshops organized by the Ministry of Education are aimed at improving the performance (Jannis, n.d.)

Unfortunately, statistics show that performance has continued to be poor. For example, Biology was recorded among the badly performed subjects in the 2020 KCSE (ArapToo, 2021)

The chronic poor performance necessitated the study to determine the causes of poor performance in Biology, in Kenya and its Constituent Kajiado County.

The **Knowledge Gap,** the problems associated with biology subject just like other science subjects include attitude and low understanding of concepts which translate into poor performance at National Examinations. (Leb, 2014)

Different model is proposed to synthesize the lessons learned from the **discussions** and serve as the foundation for developing effective interventions. The clarity of the purpose, as well as the commitment to it, result in tangible measurable and demonstrable results. (Bell, 2014)

Ogunniyi notes that poor performance in Kenya and its constituent Kajiado County science subjects was due to many problems, ranging from low understanding of concepts to language and science versus cultural conflicts. Inadequate qualified teachers, negative attitudes and poor motivation of both teachers and students are also contributing factors to poor performance in science (Ogunniyi, n.d.)

This study aimed at filling this gap. Through direct Observation, the actual practice by teachers, methods of content delivery were established.

1.3 Research Objectives

The objective of the study was to:

1. Find out the instructional methods that Biology teachers used in the teaching/learning process.
2. To investigate the effect of practical work in Biology on students' achievements in Biology.
3. To develop data collection scheme for evaluating students' acquisition of practical process skills and attitudinal change in secondary school Biology.

1.4 Research Questions

1. Is there any relationship between a school physical Laboratories and students' success in Biology?
2. Is there any relationship between students' understanding to concepts in Biology and teacher's modes of teaching?
3. Is there any relationship between students' Attitude change and motivation in Biology and Positive Engaging Learning Environment?

1.5 Significance of the Study

The result will be useful to Kenya National Examination Council (KNEC) when setting Biology examination so that the examination can emphasize evaluation of science process skills rather than the product **Curriculum developers** will have to change their approach in designing the curriculum and incorporate more practical aspects in the curriculum in favour to all learners at all counties in Kenya at Large (milligan, 2017)

Schools in **Kenya** are encouraged to incorporate Practical works whatsoever, in those Practical activities students are encouraged to bridge the gap between what they can see and touch (hands-on) and scientific ideas that account for their observations (brains-on). Making these connections is difficult, so practical activities that make these connections explicit makes students to be more likely to succeed.

According to the study, students who participate in significant practical activity perform better in Biology. This information may be useful to **Biology teachers** who use a hands-on approach in their classrooms.

Students will and need to be motivated and introduced to Practical work and in-depth conceptual knowledge from beginning of their lower levels, for better performance.

Parents are advised to mediate and be deeply involved in their children Education to further give them a cognitive competence in their works at school, positive attitude towards science studies, and motivation to coexist in the learning environment with their teachers. **Teachers** training institutions may be able to change their training approaches and emphasize practical work as per SMASSE project in Kenya.

1.6. The Scope and Delimitations of the Study

The study was undertaken in Four public secondary schools in **Kajiado County**.

The Four Public Secondary schools were randomly selected (Advance-africa, n.d.)

The study involved only one class, randomly selected from the four streams of Form Two students in the selected secondary schools in their first term year of study together with their respective Biology teachers and Lab technicians.

This is because it is at form Two that students in secondary schools **make subjects choices**.

The study was limited to 1-term of ten weeks (Gachie, n.d.)

Many small secondary schools in Kajiado county face challenges in implementation of use of Practical Works to Science Subjects, which require a lot of concepts and thus it is problematic to students if facilities lack or are not properly utilized and if teacher does not simplify the context and make the subject interesting. Thus, the findings reflected the situation in the schools but cannot be generalized to other schools in Kajiado county.

1.6.2 Limitation of the Study

The study involved only the Form Two classes.

It was limited to a syllabus as stipulated by Kenya Institute of Curriculum Development (KICD). The researcher did not have the freedom to choose what was to be taught.

1.7 Theoretical Framework

The theoretical framework for this study was based on **Jean Piaget theory** of cognitive development. Jean Piaget (1896-1980) studied the development of children's understanding and particularly the role of maturation in children's increasing capacity to understand their world.

According to him, children cannot undertake certain tasks until they are psychologically mature enough to do so. His theory is called cognitive theory and is central to the school of cognitive theory called cognitive constructivism (McLeod D. S., 2022)

There are several key principles of Piaget theory.

First is **adaptation**. According to him, a child adapts to the world through assimilation and accommodation. He referred to the process by which a person takes material into their mind from the environment as **assimilation**. This is also accompanied by **accommodation**; the difference made into one's mind by the process of assimilation.

The other key idea of the theory is classification-ability to group objects together based on common features.

A fourth tenet of the theory is **class inclusion-the understanding** that some sets of objects are also sub-sets of a larger class. His fifth key idea was the realization that objects stay the same even when they are changed about or made to look different, which he called **conservation**.

His other key tenet was **operation**- the process of working something out in one's head. According to him, young children must try out things in the real world like count on fingers while older one can use their heads.

Finally, he talked of a scheme or scheme which is a representation in the mind a set of perceptions, ideas, and or actions which go together.

Piaget postulated that there are **4 stages of cognitive development**.

These include the sensory-motor (birth-2-years), pre-operational (2-7-years), concrete operational (7-11-years) and formal operational (11-years and above).

The **sensory-motor** stage is characterized by the child differentiates self from objects and achieves object permanency.

In the **pre-operational** stage, the child learns language and to represent objects by images and words.

The **concrete operational** stage is characterized by the child been able to think logically about objects and events.

Finally, in the **formal operational** stage, the child can think logically about abstract propositions and test hypothesis systematically.

According to Piaget's theory, the child's mental processes are constantly restructured as he grows and interacts with his surroundings. By manipulating their settings, children construct information in their minds that he refers to as schemas.

As the child advanced from one stage to the next, these schemas improved and proliferated.

The **significance of Piaget's theory to this study** is that a child learns by doing things on his or her own. It is difficult to learn from a teacher who simply gives the student information.

He believes that manipulating the environment allows a child to learn meaningfully. By manipulating the elements in their environment, children can create their own knowledge. Because practical work in Biology requires manipulating apparatus to grasp concepts, this cognitive development theory was **employed** to **anchor** the study.

The role of the teacher is that of a **facilitator**, but the students systematically construct their own knowledge through manipulation of the apparatus in Biology practical.

1.8 Conceptual Framework

The study conceptualised the teaching approaches in Biology as the **independent variables**.

The students' achievements in Biology were considered as the main **dependent variable**.

Their variables are interrelated as depicted in the Figure below.

Independent Variables **Dependent Variable**

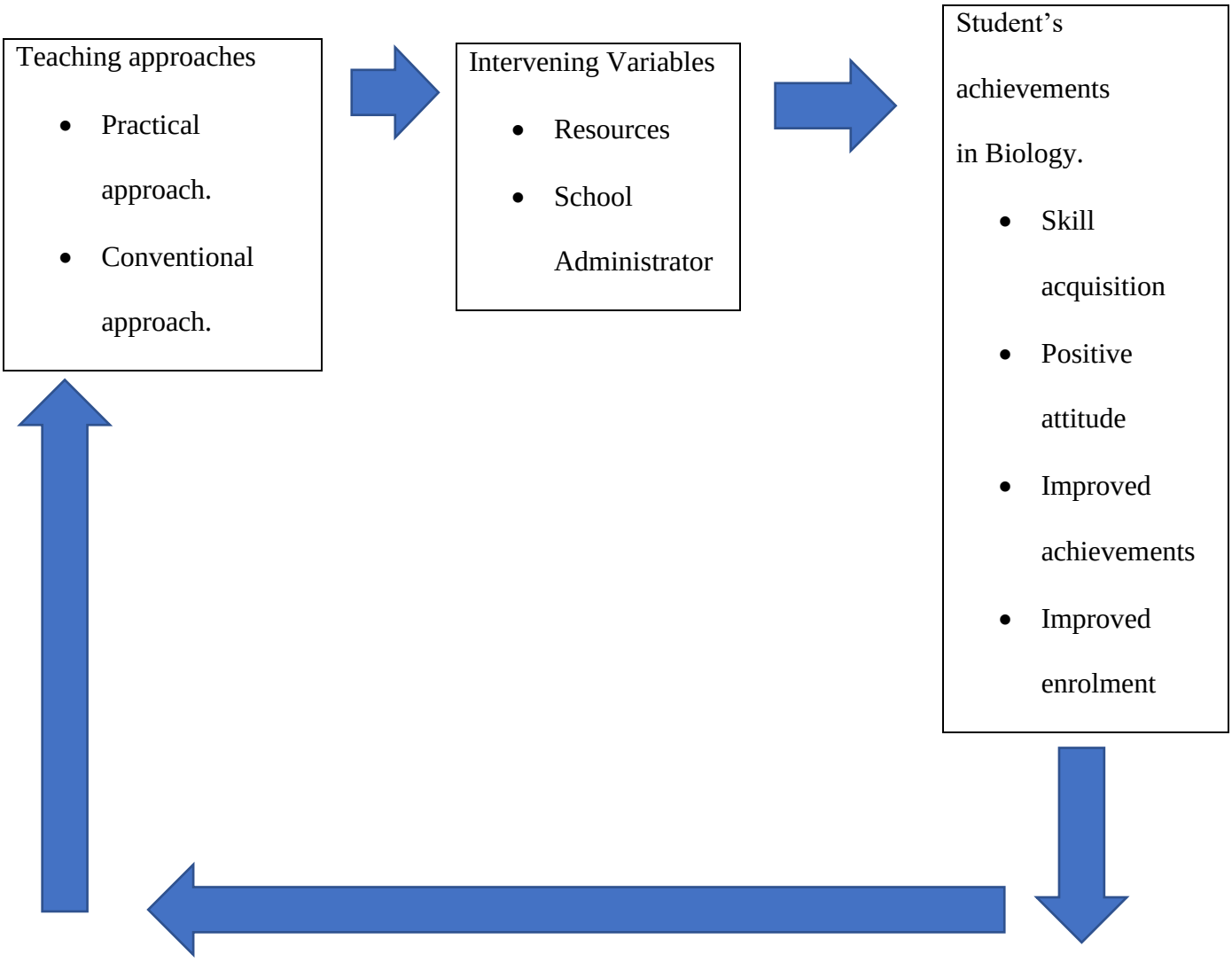


Figure 1: Conceptual Framework

Figure 1 shows that the **independent variables** of the study are the two teaching approaches:

1. **Practical approach** and the **Conventional approach**.

The students' achievement in Biology was conceptualized to be **the dependent variable**.

The students' achievements in Biology were measured using **four indicators**:

1. **science skills acquisition** (observation, recording, measurement, communication, classification, hypothesizing) **positive attitude** towards Biology, **improved achievements** in examination and **improved enrolment in Biology** in KCSE.

The independent variable however can be **intervened** by availability of resources, both human and capital and school's administration. Well-equipped laboratories for carrying the practical in Biology, school's enrolment policy may also **moderate** the dependent variable.

1.9 Operational Definition of Terms

Some of the operational terms that were used in the research study are: -

Attitude Change: - Change in perception towards the subject because of using. practical work approach in teaching Biology.

Conventional Method: -Method of teaching Biology by using lecture method with only a few teacher demonstrations.

Practical Work: - It is work in which students interact with materials or with secondary sources of data to observe and understand the material world.

Science Process Skills Acquisition: - This is acquisition of skills like observation skills, drawing skills and reporting and interpretative skills.

CHAPTER TWO

REVIEW OF RELATED LITERATURE.

2.1 Introduction

The chapter dealt with critical review of theories, empirical studies according to research questions and summary of literature review

2.2 Critique of Related Theories

The Critique of Related Theories for this study was based on both **Jerome Bruner theory** of Cognitive Development and **John B. Watson's Theory** on Behaviorism. A **theory** can be defined as a system that is comprised of empirical data, derived from observation and or experimentation and their interpretation. In another words, a theory must grow out of systematic analysis of the past events. A theory could be likened to a map where a few points are known while the road between them are inferred.

According to Steffix and Mathany (2005), Theory is an unsubstantiated hypothesis or a speculation concerning reality that is not known to be seen as a set of conventions created by the theorist, they finally concluded that a theory is derived from personal, historical, sociological, and philosophical bases.

2.2.1 Cognitive development theory by Jerome Bruner (1962)

The **First theory** anchored on this Critique is the **Cognitive development theory by Jerome Bruner (1962)** (McLeod D. S., simplypsychology, 2019)

He believed that rather than remembering knowledge, the purpose of education should be intellectual progress. He emphasized that learning should include knowledge acquisition rather than information memorization.

He emphasized that learning should comprise the acquisition of knowledge processes rather than the memorization of information. As a result, instruction should teach the learner how to engage in the process that allows knowledge to be established. It should not be necessary to persuade the learner to remember the outcomes. The goal of teaching a discipline is to engage students in the process of learning.

Acquiring knowledge, he believes, is a process rather than a product.

Bruner advocated organizing concepts and learning by discovery. He believed that learners can be able to construct knowledge by interacting with the world around them.

He identified **three stages of cognitive development**.

The **enactive**, **iconic,** and **symbolic** representations.

Enactive, which is the representation of knowledge through actions while **iconic,** which is the visual summarization of images. The last one is the **symbolic** representation, which is the use of words and other symbols to describe experiences.

The **enactive stage** appears first. This stage involves the encoding and storage of information. There is a direct manipulation of objects without any internal representation of the objects.

For example, a baby shakes a rattle and hears a noise.

The baby has directly manipulated the rattle and the outcome was a pleasurable sound. In future, the baby may shake his hand, even if there is no rattle, expecting his hand to produce the rattling sounds.

The baby does not have an internal representation of the rattle and, therefore, does not understand that it needs the rattle to produce the sound.

The **iconic stage** appears from one to six years old. This stage involves an internal representation of external objects visually in the form of a mental image or icon. For example, a child drawing an image of a tree or thinking of an image of a tree would be representative of this stage.

The **symbolic stage**, from seven years and up, is when information is stored in the form of a code or symbol such as language. Each symbol has a fixed relation to something it represents. For example, the word 'cat' is a symbolic representation for a single class of animal. Symbols, unlike mental images or memorized actions, can be classified and organized. In this stage, most information is stored as words, mathematical symbols, or in other symbol systems.

Bruner believed that all learning goes through the stages listed above. He felt that direct handling of elements should be the first step in learning. It should be followed by the development of visual representations, such as a form drawing or a diagram. (McLeod D. S., simplypsychology, 2019)

Finally, a learner understands the symbols associated with what they represent.

The theory is applicable in this study because it **advocated** learning through a process. The process of acquiring skills in Biology is a process.

The current study advocated that the science process skills should be evaluated because it is through the processes that the learner acquires knowledge but not the end-product (the results).

According to Brunner the process of knowledge acquisition is more important than the product.

Many aspects of Bruner's theories have found **Application** in the field of Education, influencing both policy and curriculum design. Some schools, such as those in Singapore, have adopted a C-P-A (concrete-pictorial-abstract) approach to teaching subjects such as mathematics and science.

Teachers who follow this approach introduce topics using concrete materials before progressing to visual and then abstract representations. This is in line with Bruner's belief that instruction should move sequentially from enactive to iconic to symbolic modes of representation.

Bruner's concept of the **spiral curriculum** has also influenced the educational philosophy of schools in several countries, including China and the United States. In these schools, the same topics are revisited periodically across several grades. Teachers make a deliberate effort to connect new information with previous knowledge, building on what the learner already knows to deepen understanding.

Scaffolding is another aspect of Bruner's theories which some teachers have tried to implement in the classroom. The concept has also been applied to peer-to-peer learning, with more advanced students assisting weaker peers.

Although Bruner's concepts have greatly contributed to education policy in several countries, **Critics** have raised doubts regarding the practicality of some of his ideas. For example, while

Discovery learning also presents challenges in the classroom since misconceptions sometimes arise among students as they attempt to construct meaning for themselves.

These misconceptions may go undetected by teachers, especially in larger settings.

Discovery learning also requires large amounts of resources which may not be readily available in some schools. It can also be a challenge to implement this form of learning in settings where behaviour management is a problem.

Other critics note that discovery learning may not be suitable for students who prefer a more traditional approach to teaching and learning. As some have pointed out, there is no evidence to show that all students are effective at creating meaning on their own. Some students prefer structure and become frustrated when the demands of a task are not clear.

One of Bruner's foremost critics, David Ausubel, further argued that young children in particular need direct instruction and that the volume of information to be learned at school leaves little time for discovery. Other critics agree with Ausubel, noting that a child-centred, process-oriented approach might not be ideal when teaching basic skills such as reading and writing. Research also suggests that when teaching students with learning difficulties, a direct approach is more effective for introducing new information and skills.

Some critics have also taken issue with Bruner's claim that any subject matter can be taught at any age in some 'honest form.' These critics argue that children need to achieve a certain level of maturity to handle some concepts.

Bruner himself criticized his own claim over his failure to explain what he meant by the term '**honest**.' (T., 2022)

2.2.2 Behaviourism Theory by John B Watson

The **Second Theory** anchored on this Critique is the **John B. Watson's** Theory on **Behaviourism.** (Cherry, 2022) Behaviourism is a theory of learning based on the idea that all behaviours are acquired through conditioning, and conditioning occurs through interaction with the environment.

According to this school of thought, also known as behavioural psychology, behaviour can be studied in a **systematic** and **observable** manner regardless of internal mental states.

Behavioural theory also says that only observable behaviour should be studied, as cognition, emotions, and mood are far too **subjective**.

Strict behaviourists believe that any person (**Learners**) regardless of genetic background, personality traits, and internal thoughts can be trained to perform any task, within the limits of their **physical capabilities**. 'It only requires the right conditioning'.

There are two main types of behaviourism used to describe how behaviour is formed, namely:

Methodological Behaviourism and **Radical Behaviorism**.

According to **Watson's** ideologies and approach, **Methodological** behaviourism states that observable behaviour should be studied scientifically, and that mental states and cognitive processes don't add to the understanding of behaviour.

Stipulated by **B.F. Skinner**, Radical behaviourism is rooted in the theory that behaviour can be understood by looking at one's past and present environment and the reinforcements within it, thereby influencing behaviour either positively or negatively.

Operant conditioning, sometimes referred to as instrumental conditioning, is a method of learning that occurs through reinforcement and punishment. Through operant conditioning, an association is made between a behaviour and a consequence for that behaviour.

This behavioural approach says that when a **desirable** result follows an action, the behaviour becomes more likely to happen again in the future. Conversely, responses followed by adverse outcomes become less likely to reoccur.

Behaviorist B.F. Skinner **described** operant conditioning as the process in which learning can occur through reinforcement and punishment. More specifically, by forming an association between a certain behaviour and the consequences of that behaviour, you learn.

For example, if a **teacher** rewards their **Learners** with praise every time they act accordingly in class, the desired behaviour is consistently reinforced, and the learners will become more likely to participate more in class.

The process of operant conditioning seems straightforward simply observe a behaviour, then offer a reward or punishment. However, Skinner discovered that the timing of these rewards and punishments has an important influence on how quickly a new behaviour is acquired and the strength of the corresponding response.

This, therefore, makes reinforcement schedules important in operant conditioning. These can involve either **continuous** or **partial** reinforcement.

Continuous reinforcement involves rewarding every single instance of a behaviour. It is often used at the beginning of the operant conditioning process. Then, as the behaviour is learned, the schedule might switch to one of partial reinforcement.

Partial reinforcement involves offering a reward after several responses or after a period has elapsed. Sometimes, partial reinforcement occurs on a consistent or fixed schedule. In other instances, a variable and unpredictable number of responses or amount of time must occur before the reinforcement is delivered.

In Education, Behaviourism can be **Applied** to help students learn, such as by influencing lesson design. For instance, some teachers use consistent encouragement to help students learn (operant conditioning) while others focus more on creating a stimulating environment to increase engagement (classical conditioning).

Many **Critics** argue that behaviourism is a one-dimensional approach to understanding Learner (human) behaviour. They suggest that behavioural theories do not account for free will or internal influences such as moods, thoughts, and feelings.

Freud, for example, felt that behaviourism failed by not accounting for the unconscious mind's thoughts, feelings, and desires, which influence people's actions.

More recently, biological psychology has emphasized the role the brain and genetics play in determining and influencing human actions. The cognitive approach to psychology focuses on mental processes such as thinking, decision-making, language, and problem-solving.

In both cases, behaviourism neglects these processes and influences in favour of studying only observable behaviours.

Behavioural psychology also does not account for other types of learning that occur without the use of reinforcement and punishment. Moreover, people (learners) can adapt their behaviour when new information is introduced, even if that behaviour was established through reinforcement.

2.3 Empirical and Conceptual Review of Studies

The **main difference** between **conceptual** and **empirical** research is that Conceptual research involves abstract ideas and concepts, whereas Empirical research involves research based on observation, experiments, and verifiable evidence.

Conceptual research and empirical research are two ways of doing scientific research. These are two opposing types of **research frameworks** since conceptual research doesn't involve any experiments and empirical research does. (HASA, 2019)

2.3.1 Is there any relationship between a school physical Laboratories and students' success in Biology

Studies have shown that secondary school students are exhibiting low interest in Biology. This low interest of students in biology has been traced to poor achievement in examinations.

In their match towards scientific and technological advancement, they need nothing short of good achievement in biology at all levels of schooling. Several other research attribute it to inadequate, inappropriate, and perhaps non-utilization of the available laboratory equipment in teaching and learning biology, some authors lament that teaching the subject in secondary schools in conventional classrooms can be defective (Bajon habu rimamsomte, 2021)

Biology laboratory facilities according to Udo, refers to facilities that can be used to enhance or improve educational programmes and promote teaching and learning. Science laboratory resources/facilities can be **human** or **material**.

The **human resources** have to do with personnel such as lecturers/teachers, laboratory technologists/assistants and students. The **science laboratory material resources** are those materials available to the science teacher for teaching and learning. They include textbooks, computers, thermometers, fire extinguishers, first aid kits, oven, incubators, chalkboards, model/mock-ups, television, radio, and other electronic devices. The availability of laboratory facilities is essential for effective teaching and learning of Biology and consequently a good performance by students. Another opinion that learning can occur through one's immediate environment – facilities that are available to facilitate students learning outcome. Students can master better the basic concepts of Biology when they learn by doing.

Utilization of laboratory facilities defines the extent or how often the available science laboratory facilities are used during classes or laboratory sessions. According to Lawal (2013), such materials promote learning by doing, make the classroom lively, real, and meaningful and have the potential to make the content permanent thereby increase students' academic achievement. Utilization of these facilities also enables learners to focus their attention to important issues and acquire practical skills (Iranyang Uko, 2021)

School facilities in **Nigeria** have been observed as a potent factor to quantitative education. The availability of laboratory facilities is essential for effective teaching and learning of science and consequently a good performance in students. Ifeakor is of the opinion that learning can occur through one's environment – facilities that are available to facilitate students learning outcome. Students can master better the basic concepts of Biology when they learn by doing. This implies that practical should function as the primary learning experience (publications, 2017)

Researchers from **Niger** stated that there are inadequate resources for teaching and learning of science subjects in public secondary schools in **Nigeria**. They further stated that where there are little resources at all, they are not in good condition, while the few ones that are in good condition are not enough to go round and the few available material are dysfunctional. **Empirical studies** conducted in relation to resource utilization in education have revealed that essential facilities are not always available in schools. This inadequacy of teaching resources has been of serious concern to educators. Lyons (2012), states that learning is a complex activity that involves interplay of students' motivation, physical facilities, teaching resources, skills of teaching and curriculum demands. The process of managing and organizing resources is called resource utilization. The utilization of resources (laboratory facilities) in education brings about fruitful learning outcomes since resources stimulate students learning as well as motivating them (Musah, 2017)

Kajiado County as the focus of study, is a semi-arid area mainly inhabited by pastoralists who move from one place to another in search of green pastures for their livestock. As a result of the nomadic lifestyle many schools have not constructed permanently institutional infrastructure needed for delivery of quality education. This has contributed to students' overall poor performance. School infrastructure is a key base for effective teaching and learning in schools.

The goal of school infrastructure in secondary school education in Kajiado county, Kenya is to increase school attendance of students, enhance staff motivation and improve academic achievements of students. School infrastructure includes classrooms, laboratories, and open fields. In the laboratories, learners get the opportunity to conduct their own experimental studies and carry out practical as shown by the residing teachers and lab attendants.

Research on school building assessment methods in **Kenyan** county schools, shows that school buildings had an impact on the mental development of a student, study explains that schools that are properly build and attractive to look at motivated the children to stay in school and learn as well, whereas schools without the facilities or have inadequate and not well maintained facilities rarely performed well in national examinations cause their students to be de-motivated to work hard hence lose hope in pursuing higher education (mokaya, 2013)

2.3.2 Is there any relationship between students' understanding to concepts in Biology and teacher's modes of teaching

The factor considered in the present study is the impact of two teaching methods:

(**Practical** and **Demonstration/ Lecture**)

The methods under consideration are **practical** and **lecture**.

These two methods promote collaborative learning between the teacher and the students.

Johnson and Johnson (2015) believed that cooperative learning experiences increased student achievement. Although most studies have emphasized student participation and interaction as important factors in achievement, there may be other alternative contributing factors, and one of them is the teacher's method of teaching (David W Johnson, 2015)

Teaching method, therefore, is the science of being a teacher, generally referring to strategies of instruction. Science is an activity-oriented subject. Science is a subject that emphasizes activity. The way it is thought is important in assisting students in acquiring basic scientific knowledge, skills, and an attitude toward solving various problems in life. Because biology is a science subject, the teacher should use methods that allow students to participate actively.

This research work focuses mainly on practical and lecture methods of teaching.

The practical method entails teaching and learning through hands-on experience.

By 'practical work,' we mean work activities in which students perceive or try to influence real objects or observe a teacher demonstrate practical scientific knowledge.

The lecture method is an instructional technique in which the instructor validly delivers a well-planned expository address on a specific topic.

Bisong a researcher from Calgary, Alberta, Canada noted that some teachers in secondary school may spend little or no time preparing their lesson without motivating strategies and resources to enhance students' understanding of concepts in biology.

Strauss another researcher opined that the role played by teachers in the teaching-learning of any subject cannot be overrated. This is because when students are well taught and motivated in the classroom, there is a positive attitude promoted towards learning. Learning becomes interesting and easy, students' achievement improves.

In a biology classroom, the teacher should use teaching techniques that are learner centred and constructivist in nature to encourage students' participation in the learning process.

An inquiring teacher tries to find out the kind of information or lesson presentation their students would be most comfortable with in line with learning style and that could possibly help them understand the concept taught.

Practical classrooms, teachers use specialized forms of professional knowledge in sorting out, overseeing, expounding, exhibiting, and teaching the lesson to the students. It is against this background the **study** is aimed at finding out if the efficacy in teaching influences students' understanding of concepts in Biology, in Kenya. (Christiana Ihejiamaizu, 2019)

In Biology, several topics, and concepts such as genetics, respiration, cell division, photosynthesis, evolution, ecology, hormonal regulation, and nervous co-ordination, among others have been tagged difficult because students are not finding them easy to learn due to the following reasons: overloaded curriculum, abstract nature of some concepts, inadequate time to think through and process learning and **inability of teachers to engage students in meaningful learning**. Though reports have called for the use of methods and approaches which are activity-based, didactic teaching methods are still prevalent in many science classrooms in **Nigeria**.

With the constant evolution of knowledge, it behoves on teachers to learn to facilitate meaning and deeper understanding of concepts for learners by their own practices. The corollary to this is that the **instructional frameworks** used by teachers ought to be **flexible** enough, taking cognizance of students' prior knowledge for the learners' needs to be met. In this vein, **Ghana** researcher opined that the choice of instructional method should be guided by the skills we expect the students to acquire. These skills which include critical thinking should be continually improved upon so that they become a veritable utility in the after-school years' endeavours. (Olufemi, 2017)

Most students learning biology will understand the value of concepts learnt or taught when they can see their utility in practical life. Attitudes and more understanding to concepts are very important for effective learning, as the SMASSE primary focus of training in **Kenya**. Some teachers who held stereotyped ideas about parents and children from different social groups. These leads to consequent teacher expectations of children' abilities.

In addition, authors argue that examinations in Kenya major on testing information rather than skill acquisition.

The fundamental focus of education in Kenya has been preparing people for employment rather than training for education; an unwanted side effect of this over-emphasis on examinations is that teachers may focus only on the knowledge and skills that are testable by such examinations, to the exclusion of everything else. There is need for teachers to teach for understanding and more practical based programming. The above techniques will be majorly supported by this study. (moses, 2012)

2.3.3 Is there relationship between students' attitude change and motivation in Biology and Positive Engaging Learning Environment

Definition of the **attitude** and **behaviour change** vary accordingly, it is received a person's negative or positive manner (mode) to a certain object or situation or event. (Pekel, 2010)

Learning Environment, a learning environment is more than just a classroom—it's a space in which students feel safe and supported in their pursuit of knowledge, as well as inspired by their surroundings.

A study from Turkey, shows that teacher–student interaction and classroom atmosphere have been argued by science learning environments research as important variables in explaining variation in science attitudes and achievement.

Educational effectiveness research has also shown that the teacher is a major contributing factor to student outcomes in science, regardless of whether these are cognitive or affective. Both effectiveness research and science learning environments research have provided evidence for the effects of the teacher–student interpersonal relationship on attitudes towards science.

A good teacher–student relationship is conditional for effective teaching and the realisation of a learning environment conducive to learning (Telli, 2010)

Research studies in Iran and most middle eastern countries show that educational implementations must be taken to make biology curriculum fun for students. Suggestions show that implementing of **fun materials**, texts, instruction methods, and more **practical work** sets increases and builds more positive attitude and motivation in students to pursue the Unit and therefore a higher level of achievement is attained throughout the semesters.

Biology teachers in in-service educations that have furthermore emphasis on this aspect of attitude towards biology by making a conducive environment for the students. (Nasr, 2011)

Peer tutoring (as practised in Nigeria, Rivers State) is an individualized learning strategy in which a student (tutor) with a better understanding of a particular subject gives his / her classmate (tutee) a one-on-one teaching to help him / her achieve greater trust, independence, and success as a learner. Although peer tutoring is a creative, individualized learning method, this teaching strategy is a solid paradigm shifts towards centred learning, where successful students who have recently passed a topic with good grades (A or B) are selected, trained, and elevated to coordinate the activities of six to eight students each. The overall technique when practiced by the biology teacher, gives both students and teacher assurance of trust in the classroom thereby more participation and success at the long run. (Nwagbo, 2019)

The role of gender stereotyping is mostly observed when boys and girls learn together in mixed schools, in schools around Ongata Rongai, Kajiado County, **Kenya.** In such scenarios, there is a clear relationship between gender versus student performance and subject preferences.

In mixed schools, boys outperform girls in sciences and mathematics. On the other hand, girls in single-sex schools performed better in the subjects than mixed-sex schools. It can also be noted that in single-sex girls' schools, the mathematics and science classes are livelier, more cooperative, and that the students have a better working relationship.

Thus, it would seem, girls in mixed-sex schools suffer the negative influence of gender stereotyping, which is hypothesized to influence their performance. (Njeri, 2013)

Some science topics are not only considered difficult to teach but also lead, by their nature, to different opinions on how they should be presented to students, and only a competent, well trained science teacher can teach such topics effectively, Sciences involve the use of many theories. Only a competent trained teacher will understand that the test of a theory is that it should lead to correct predictions than rival other theories. A quality and a trained science teacher contribute **positively** to effective **teaching-learning** process by easily overcoming the major problems of any science teacher.

2.4 Summary and Identification of Knowledge Gap

The chapter examined the literature on biology teaching methods. According to the study, if a practical work instructional approach is used, students' achievement in the subject improved. Furthermore, enrolment is expected to rise. A research permit was obtained from the University for further **Data Collection**.

The study concentrated on exploring the role of **traditional laboratory experiments** could play in developing interest in learning Biology amongst form two students, from the prospect sampled of 4-schools in Total in **Kajiado County,** without describing any sub-groups.

For his study on a similar case study, a researcher from Muranga East sub county (Ngéthe, 2016) used a **quasi-experimental design**. For this study, the researcher will use a **Survey Research Design** embracing a **Descriptive approach** by using Questionnaires and interview schedules to obtain Qualitative and quantitative statistical data from students, corresponding biology teachers, and lab technicians.

In this case study, a **stratified sampling technique** would be used to identify in-depth the subgroups of the chosen populous, which differs from the Purposive sampling technique used by the same researcher from Muranga East Sub County Kenya.

The **validity** of the research instruments will be tested using Spearman's correlation using SPSS and a thorough Expert Judgement of a Supervisor as provided by the University.

Through the Descriptive approach **data Analysis** will be presented in form of percentage, means and tables for conclusions and recommendations. The study established that the Effects of Practical Approach as an instruction on students' achievements in Biology have not been explored at least in Kajiado County. The study was designed to address this **Gap**.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter focused on the methodology that would be used in this study.

The following issues were addressed:

Research design, location of the study, target population, sample size and sampling procedures, research instruments, pilot study, data collection methods and procedure**s**, methods of data analysis and ethical considerations.

3.2 Locale of the Study

The study was carried out in Kajiado County.

It is in Kenya's former Rift Valley Province. It has a population of 687,312 people and has an area of 21,292.7 km^2. It borders Nairobi and extends south to the Tanzanian border. The capital is Kajiado, while Ngong is the major town. (elimu, n.d.)

The main basis for selecting Kajiado county for this study is a persistently low mean score in KCSE Biology between 2019,2021-2022, and presumably most schools in the County are seen to be below 200-secondary schools Nationwide in Kenya, for the National Exam. (@Educationnewshub.co.ke, educationnewshub, n.d.) (Too, 2022)Other factors that influenced the choice of the division/County are familiarity to the area and limitation of time and money.

County Schools in Kenya are the third category of secondary schools, following National and Extra County schools. The schools primarily accept students from within the country. The Ministry of Education handles admissions to these schools online. The schools in Kajiado County are either **mixed-gender** or **single-gender** (Elimu Centre, 2021) (@Educationnewshub.co.ke, educationnewshub, n.d.)

3.3 Research Design

The study adopted a **Survey Research Design.** A **survey-design** is used to collect data from members of a population to determine the status of that population with respect to one or more variables. (questionpro-team, n.d.)Survey design is adopted because it involves collecting data to answer questions concerning the status of subject of the study. The study was also embracing a **descriptive approach**, which is used to compute data collected statistically about Students' attitudes, opinions, habits, or any variety of education on social issues that interests policy makers and educators. Data was gathered about the existing conditions in the Biology Laboratories.

The study used questionnaires and an interview schedule to obtain both qualitative and quantitative data from students, teachers, and laboratory technicians regarding the status and utilization of Biology Laboratories.

3.4 Target Population

The study targeted 4-Secondary Schools in Kajiado County. The County has a totality of 33-Secondary Schools shown in Table .1

Table 1 Kajiado County Schools

The 33 secondary schools are categorized as follows. (Team N. B., newsblaze, n.d.)

Boys	**Girls**	**Mixed**	**Total**
6	11	16	33

The schools in Kajiado County are either **mixed-gender** or **single-gender.**

Source: By Elimu Centre

The unit of analysis was Form Two students in the 4 chosen secondary schools.

The study targeted Principals, Biology Teachers, Form Two Biology Students, and all the Laboratory Technicians from the selected schools in the County.

Gay (1992) notes that two types of respondents are crucial. These are the **informed specialists** and **consumers** or **users** (McNeeley, 2012). Biology teachers and laboratory technicians represented the **informed specialists** while the students represented the **users** of the information and services.

3.5 Sample Size and Sampling Procedures

3.5.1 Sampling of Schools

Random and Purposive sampling were used to obtain a sample of 4-out-of-33 public secondary schools in Kajiado County for this study. Purposive sampling will be utilized for only 1-mixed secondary school, with the remaining category of schools (Girls and Boys) would use a random procedure.

3.5.2 Sampling of Students

Taro Yamane Formula will be used to sample a population to be considered minimum in descriptive research. Based on this information, Taro Yamane Formula would systematically sample the population of students. This sampling method, for sample size calculation was formulated by the statistician Tara Yamane in 1967 to determine the sample size from a given population. Below is the mathematical illustration for the Taro Yamane method:

n= N/ (1+N (e) 2)

Where

n signifies the sample size

N signifies the population under study

e signifies the margin error (it could be 0.10, 0.05 or 0.01)

The form two students from selected schools will be Stratified into two categories: **Boys** and **Girls**, using written pieces of papers to be picked from the from a container to avoid Bias.

Stratification was also used to select equal sized samples from each of number of subgroups, if subgroup comparisons are desired.

3.5.3 Biology Teachers

Teachers in charge of the form two Biology students in the school were used.

Also based on this information, Taro Yamane Formula would systematically sample the population of Biology teachers, from the chosen schools, because the affairs of each class are managed by their respective teachers, in correlation with **varying** number of **streams** in each secondary school.

This sampling method helps us also to get and use a minimum set or (mean) of Teachers from each school selected.

Below is the mathematical illustration for the Taro Yamane method:

n= N/ (1+N (e) 2)

Where

n signifies the sample size

N signifies the population under study

e signifies the margin error (it could be 0.10, 0.05 or 0.0

3.5.4 Sampling of Principals

In the TSC Curriculum Based Establishment, (CBE), regulations a single streamed school (both primary and secondary) will have **1-school head/ principal**, deputy, and senior teacher/ master. In this study **4-principals** were included, also in correspondence with the 4-Secondary Schools. (Macharia, n.d.)

3.5.5 Sampling of Laboratory Technicians

Purposive sampling of a minimum of **1**-Laboratory Technicians would be used, secondary schools in Kenya should have a minimum of 1 Lab Technician, who conduct and supervises lab practical activities in the presence and absence of the respective science teachers.

An assumption of 4-Lab Technicians will be used in this case study.

Table .2 Sampling Procedures

Type of School	**Principals**	**Biology Teachers**	**Form 2-Biology Students**	**Lab Technicians**
Mixed Day Secondary Schools	1	5	33	2
Boys	2	10	51	5
Girls	1	3	23	2
Total	**4**	**18**	**107**	**9**

3.6 Data Collection Instruments

The research study used 2-instruments.

Including

Questionnaires and An Interview schedule

3.6.1 Questionnaires

A **questionnaire** is a written list of questions which are related to the topic. The questions are given to one or several people in the field who fill the answers. The required information can be extracted from the answers given by the respondents. Use of questionnaires can reach many people who are able to read and write independently. For this study, the researcher constructed questionnaires to facilitate data collection. Some items in the questionnaires were either **structured (closed ended),** to measure the objective responses and others were also **unstructured (open ended)** to measure subjective responses and clarify objective responses to enhance formulation of useful recommendations of the study. The questionnaires were of four categories:

i) Questionnaire for Biology teachers

ii) Questionnaire for Biology students

iii) Questionnaire for Lab technicians

iv) Questionnaire for Principal

The questionnaires were designed to **collect information about the organization** and **use of Biology laboratories** in the school. Questionnaires were also used because they present an even stimulus potentially to many people simultaneously and provide the investigator with an easy accumulation of data.

3.6.2 Interview Schedule

An Interview Schedule was used to collect **primary** data in this research study. An **interview** is a meeting in which someone answers questions about himself or herself for research. An **interview schedule** on the other hand is basically a list containing a set of structured questions that have been prepared, to serve as a guide for interviewers, researchers, and investigators in collecting information or data about a specific topic or issue. The schedule will be used by the interviewer, who will fill in the questions with the answers received during the actual interview. There are **two major types** of interview schedules that are widely used by interviewers,

- **In-depth interview schedule** and **Structured Interview Schedule**

a) In-depth interview schedule

This is used for open-ended interviews, which are aimed at obtaining in-depth information, often on serious topics or sensitive issues. The questions are open- ended, with prompts provided for the interviewer to ask for clarification or further information if necessary. The interviewee is given more room or leeway to talk about all the topics that will crop up during the interview, so he is free to use his own words and let the ideas flow out of him easily.

b) Structured Interview Schedule

This type of interview schedule is often compared with the format used in survey forms or questionnaires because of their similarities. The difference lies in the usage; obviously, the interview schedule is used by the interviewer during a face-to-face interaction, while the questionnaire is simply filled out by the respondent.

This interview schedule contains the questions that will be asked, and it is also where the interviewer will record the answers to those questions. Essentially, preparing an interview schedule for a structured interview is the same as preparing a questionnaire. A structured Interview Schedule was used in this study to obtain data which will be very reliable because it is first-hand information.

3.7 Validity, Pilot Testing of Research Instruments and Reliability

Validity basically means the accuracy of inferences which are based on research findings.

Et al. John Orodho defines validity as the degree to which results obtained from the analysis of data represent the phenomenon under investigation (John Orodho, Publisher Nairobi Kanezja, 2009)

Pilot Testing is a rehearsal of the research study, allowing researcher to test his research approach with a small number of test participants before he conducts his main study. Although this is an additional step, it is the time best spent on any research project. (Nick, 2022)

Reliability focuses on the degree to which empirical data indicators are consistent across two or more attempts to measure the theoretical concept. A reliable instrument is the one that has a **small error or standard deviation** (SD).

3.7.1 Validity

Borg and Gall (1989) content validity of an instrument are improved through expert judgment. (Ngugi, 2011)

To ascertaining that the instruments would measure what they were intended to measure, the researcher employed the use of an **expert** who was his **supervisor**. The expert judgment of the supervisor would assist him to improve the content validity of research instruments.

3.7.2 Pilot Testing

A pilot Testing and Study would be carried out to all the selected secondary schools, and to the target population, and would not be included in the study sample. The purpose of the pilot study was to:

i) Test the reliability of the research instruments.

ii) Modify the instruments in terms of the right language, clarity of communication and sufficient space to write the responses.

iii) Estimate the appropriate time allocation for administering the research instrument.

3.7.3 Reliability

The researcher used **test-retest** reliability method to establish the coefficient of internal consistency of the research instruments. This method will also involve giving same test to the same respondents on two separate occasions.

Four schools would be involved for piloting and the scores on the two occasions will be correlated using Pearson's Product Momentum Correlation Coefficient, where,

p =

KEY:

P-Pearson's Product Momentum Correlation Coefficient

X-Results from the 1st Test

Y-Results from the 2nd Test

N-Number of Observations

The Researcher found the correlations from his successive administrations. A correlation of **p** = 0.70 or higher is taken as an indicator that the instruments are reliable.

Table 3.3 below shows the Pre-test Mean of the Respondents.

Mean Pre-test	**SA**	**A**	**N**	**D**	**SD**	**Totals**
1(Principals)	97	3	0	0	0	**100**
2(Teachers)	58	20	11.1	3.7	3.9	**96.7**
3(Form2 Students)	80	7.84	4	4.2	3	**99.04**
4(Lab Technicians)	89.91	7.86	0	0	0	**97.77**

Table 3.4 Post-test mean of the Respondents

Mean Post-test	**SA**	**A**	**N**	**D**	**SD**	**Totals (∑)**
1(Principals)	95	5	0	0	0	**100**
2(Teachers)	59.62	21.38	11.92	0	3.08	**96**
3(Form2 Students)	81	8.04	4.95	0	0	**94**
4(Lab Technicians)	90.7	8.8	0	0	0	**99**

Table 3.5 Pre-test, Post-test Correlation table

Respondents	**Pre-test (x)**	**Post-test (y)**	**xy**	**x^2**	**y^2**
1(Principals)	100	100	10000	10000	10000
2(Teachers)	96.7	95	9186.5	9350.89	9025
3(Form2 Students)	99.04	96	9507.84	9808.92	9216
4(Lab Technicians)	97.77	98	9581.46	9558.97	9604
Total (∑)	**393.51**	**389**	**38275.8**	**38718.78**	**37845**

The p value = 0.7198, hence the researcher instruments are taken to be Reliable.

3.8 Data Collection Procedures

The researcher seeked and obtained a **research permit** from his University (Catholic University of Eastern Africa), Langata Campus to visit the stipulated schools of choice.

The researcher will write letters to the principals to be allowed to do the study. The selected schools for the study will be visited to seek appointments on when to visit the schools, the questionnaires will be dropped and picked on the same day. The researcher then visited the schools **prior or earlier** to the actual data collection to establish a rapport with school principals and senior teachers. The researcher delivered the instruments to the respective schools, for further interviews, questionnaires, and practical lessons in the biology laboratories. Data was compiled by the researcher after the Practical Session in the laboratory.

3.9 Data Analysis Procedures

The collected data was analysed and adjusted to ensure consistency and completeness. After the surveys have been collected, they were edited for completeness and uniformity between respondents to identify omissions. The information gathered was presented and analysed using bar and chart graphs, narratives, and statistical data. The central tendency variability and relationship between the variables were measured using descriptive correlational analysis. These covers **mean** and **mode** scores.

The researcher gathered data on characteristics such as available resources and their appropriateness, availability of laboratory personnel, laboratory activities, and teachers' and students' attitudes toward the usage of laboratories, among others.

Basic statistics was used to summarize the data (information) to ensure the researcher has easily communicated the information to the audience. This included **percentage** and **frequency** distribution.

3.10 Ethical Considerations

According to Madge (1994), ethical research is characterized as research that does not cause harm, provides valid consent, and uphold the rights of those being researched. (Regina Scheyvens, 2011)

As a result, the following ethical concerns were followed by the Researcher.

- The researcher ensured that participants are chosen equitably and got consent from every respondent who partook.
- The researcher also apprised the respondents that they should always be honest and participate consensually.
- The Researcher analysed and explained the nature of **Anonymity** and **confidentiality** to the respondents.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter represents data analysis and discussion of the findings, as well as answers to the research questions listed in the previous chapter of this document. This chapter's main purpose is to present the research findings and its interpretation.

4.2 Questionnaires Return Rate

The proportion of questionnaires returned after they have been distributed to respondents is referred to as the questionnaire return rate. (Baruch, 2008)

Table 4 Questionnaire Return Rate

Category of Respondents	Questionnaires Issued	Questionnaires Returned	Questionnaire Returned Rate (%)
Principals	4	4	100
Biology Teachers	18	18	100
Biology Students	107	107	100
Lab Technicians	9	9	100
Total	**138**	**138**	**100**

On a two-day journey, the entire population filled out and returned the questionnaires. The return rates exceeded 80% and were thus deemed adequate for data analysis. Baruch (Baruch, 2008) states that, a response rate of above 80% is adequate for social sciences.

4.3 Demographic Information of Respondents

The demographic data of the respondents is presented in this section. It was necessary to collect demographic information from respondents for the study samples to include a respondent who understands the real situation in their schools in terms of "Factors and Effects of Practical Work on Students' Overall Performance in Biology".

4.3.1 Demographic Information of Principals

Principals' demographic information was based on their gender, age, duration of service as principals, and highest qualifications.

The results are as shown in Table 5

Table 5 Gender Distribution of Principals

Principal's Gender	Frequency (f)	Percentage (%)
Male	3	75
Female	1	25
Total	**4**	**100**

According to the findings, 75% of the principals were men. The frequency indicates that male principals are more prevalent in public secondary schools in Kajiado Sub County.

The unequal distribution of female and male principals demonstrates gender inequality in this sub-county.

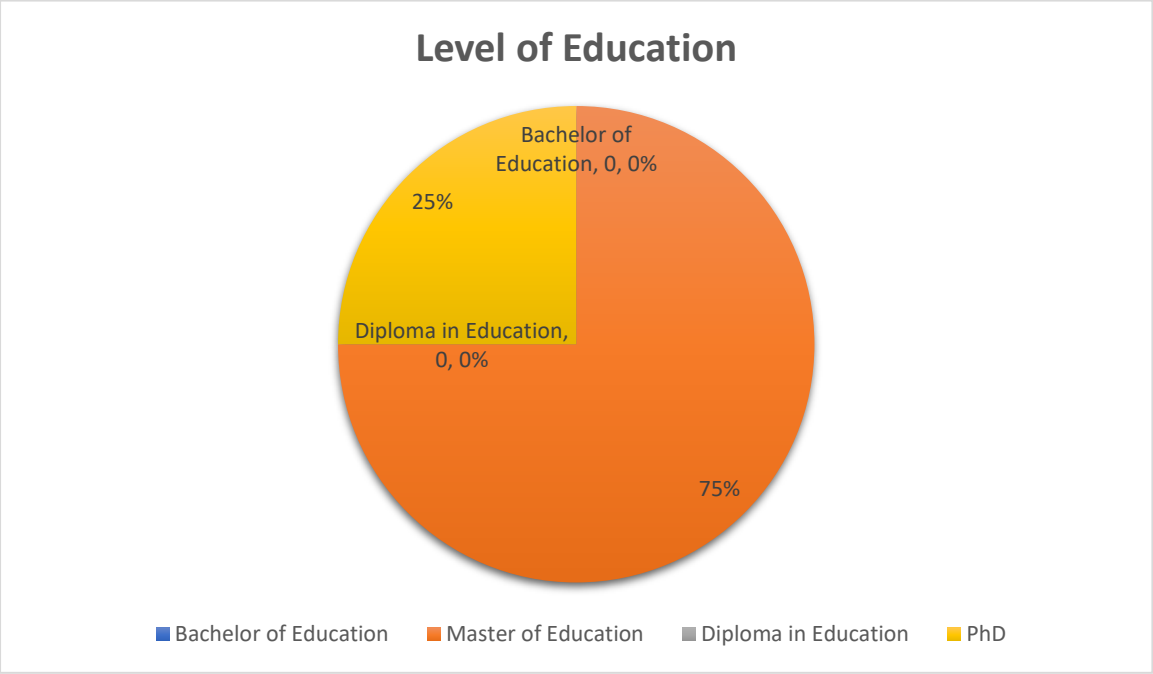
The researcher asked the principals to indicate their age and the results are as shown in Table 6

Table 6 Distribution of Principals by Age

Age Bracket	Frequency (f)	Percentage (%)
< 40 years	0	0
41-50 years	4	100
51-60 years	0	0
Total	4	100

According to the data, 100% of the principals interviewed were between the ages of 41 and 50. Most respondents were mature enough, indicating that they had worked as principals long enough to understand better school factors that influence students' performance in Biology. The researcher also wanted to know what level of education the principals had. The results are as shown in figure 2

Figure .2 Distribution of Principals by their Level of Education



According to the findings in Figure .2 principals had the necessary education qualification and were thus able to understand the school factors influencing students' performance in Biology and to promote the use of recommended teaching and learning methods and assessment methods in Biology. Principals perform management functions and thus require a variety of skills to meet the demands of management and teaching tasks. Further formal training is required to acquire the skills.

Table 7. Principal's service in their current school

Year of Service	Frequency (f)	Percentage (%)
< 1 year	0	0
1-5 years	1	25
6-10 years	3	75
11 years >	0	0
Total	4	100

Table 7. shows that most principals (75%) had been principals in their current school for a significant number of years, most of which were between 6 and 10 years, allowing them to investigate factors that have been influencing students' Biology performance and their counterpart Practical sessions over the years.

4.3.2 Demographic information of Biology Teachers

To establish the gender of Biology teachers, the researcher asked them to indicate their gender and the results are as shown in figure 3.

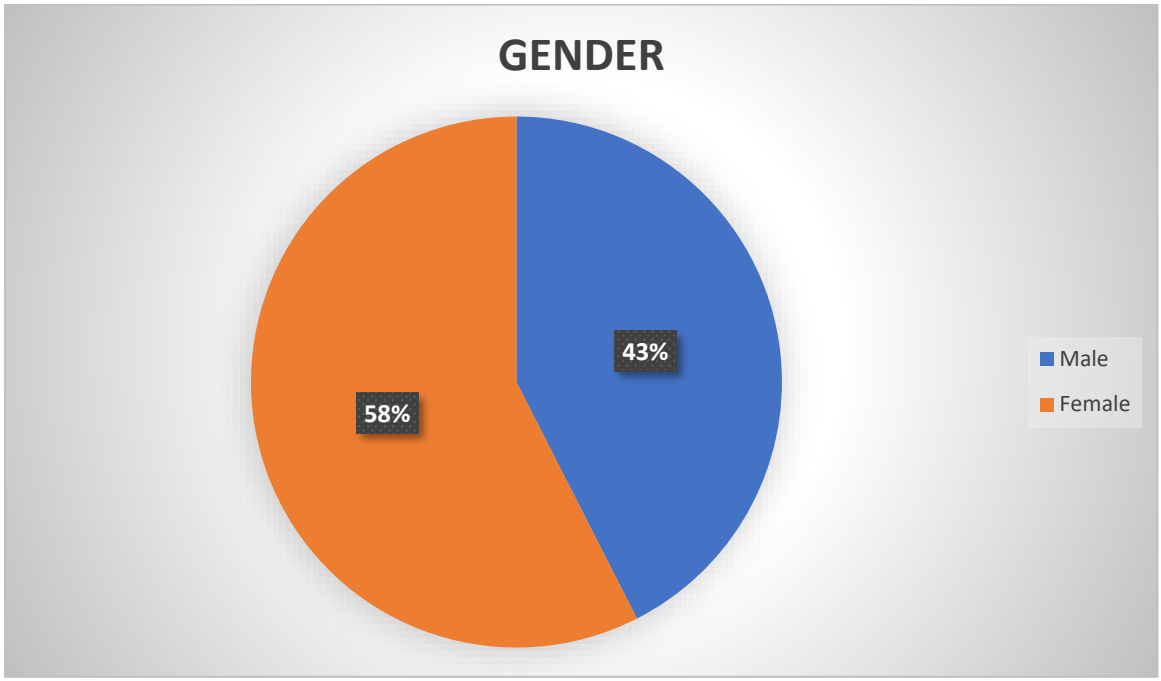


Figure 3 Demographic Information of Biology teachers by Gender

According to the results in figure 3, 58% (+2%) SD of the Biology teachers were females. This demonstrates that there were more female biology teachers than male biology teachers in Kajiado county. According to the reviewed literature, the teacher can be a source of negative attitude, especially if the teaching staff is all female.

Because boy students believe that biology is only for girls, they perform poorly in biology in the KCSE.

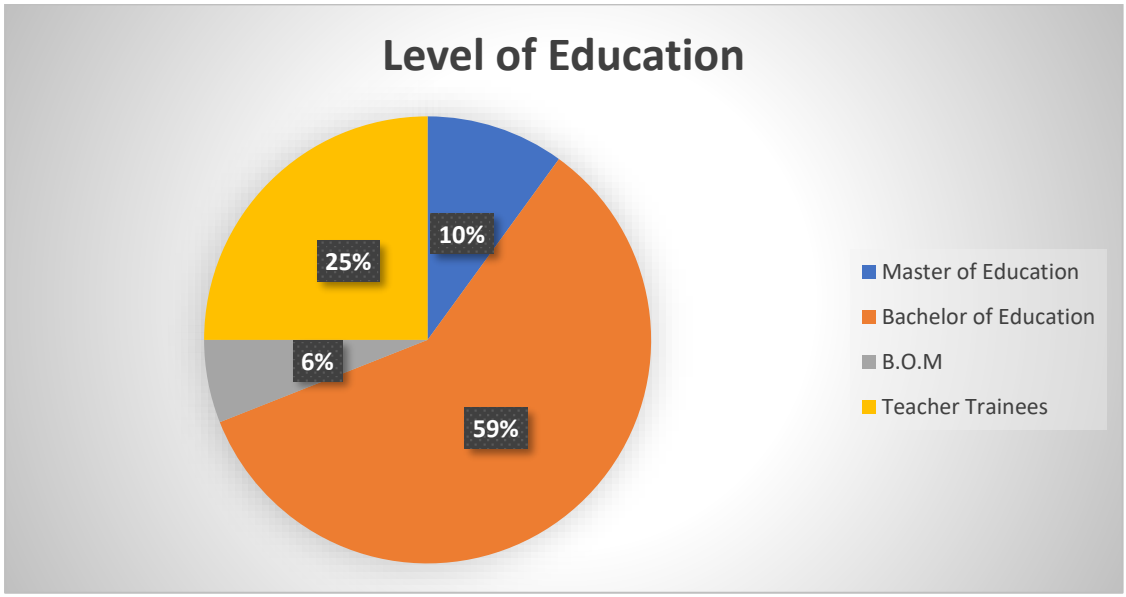
Table 8 Distribution of Biology Teachers Age

Age Brackets	Frequency (f)	Percentage (%)
< 40 years	13	72.22
41-50 years	4	22.22
51-60 years	1	5.56
Total	**18**	**100**

From the results, 72.22% of the teachers were aged below 40 years. This means teaching staffs in public schools consists of young teachers most likely fresh graduates who either have been posted by TSC or employed by B.O.M alternatively these are teacher trainees on long vacations or school-based programs. This might be one reason why the performance of Biology is poor due to very young teachers with high turnover. Biology is a practical subject and since majority of these teachers are young, they lack experience on suitable teaching methods for various topics and such teachers may have inadequate lesson preparation, plans, and use of lecture method. The findings concur with the literature reviewed.

The figure below represents distribution of Biology teachers by level of education.

Figure 4 Distribution of Biology teachers by level of education



From this data, (59%) are graduates, they may be doing good job to ensure students learn, retain content, and can attempt questions completely in KCSE but their efforts could be watered down by the Teacher Trainees (25%) and B.O.M teachers (6%) who might cause the students to develop negative attitude. This gap can be filled by the government addressing the issue of teacher shortage in many public schools.

Table 9 Biology Teacher's duration of Service in their Teaching profession

Year of Service	Frequency (f)	Percentage (%)
< 1 year	4	22.22
2-5 years	7	38.89
6-10 years	6	33.33
11-15 years	1	5.56
16 years >	0	0
Total	18	100

The table 9 shows that 22.22% of the biology teachers had service of between under 1-year and those with a service range of 2-5 years are 38.89%, this means that most Biology teachers in Kajiado county are either newly employed or in colleges and Universities hence may not have adequate experience and pedagogical skills to effectively choose teaching methods and assessment methods for students to perform well in Biology.

A total of 38.89% being new to the profession could imply a serious lack of understanding of effective teaching and assessment methods in Biology, negatively influencing performance. The researcher posed an item to the biology teachers to indicate the length of time they had been teachers in their current school, and their responses are shown in table 10.

Table 10 Biology Teacher's Duration of Service in the Current School

Year of Service	Frequency (f)	Percentage (%)
<1 year	5	27.78
1-5 years	9	50
6-10 years	4	22.22
11 years >	0	0
Total	**18**	**100**

Table 10 shows that 50% of the biology teachers had been at their current school for 1-5 years and 22.22% for 6-10 years. This demonstrates that the biology teachers had been at the current school for a significant number of years and thus had a better understanding of the students' attitudes toward Biology in their schools. Whether the selection of teaching methods and assessment methods is positive or negative depends on the attitude of the students and their entry grade in science in the literature review. (UON, 2016) Mwangi and Nyagah, 2013 pointed out that those with low grades in sciences have poor background hence the need to focus on value addition.

4.3.3 Demographic information of form 2

Form-2 students' demographic information was based on gender and student distribution by level of enrolment. The study attempted to determine the gender of students who participated in the study, and their responses are depicted in Figure 4.4 and Table 6

Figure 6 Distribution of Students by Gender

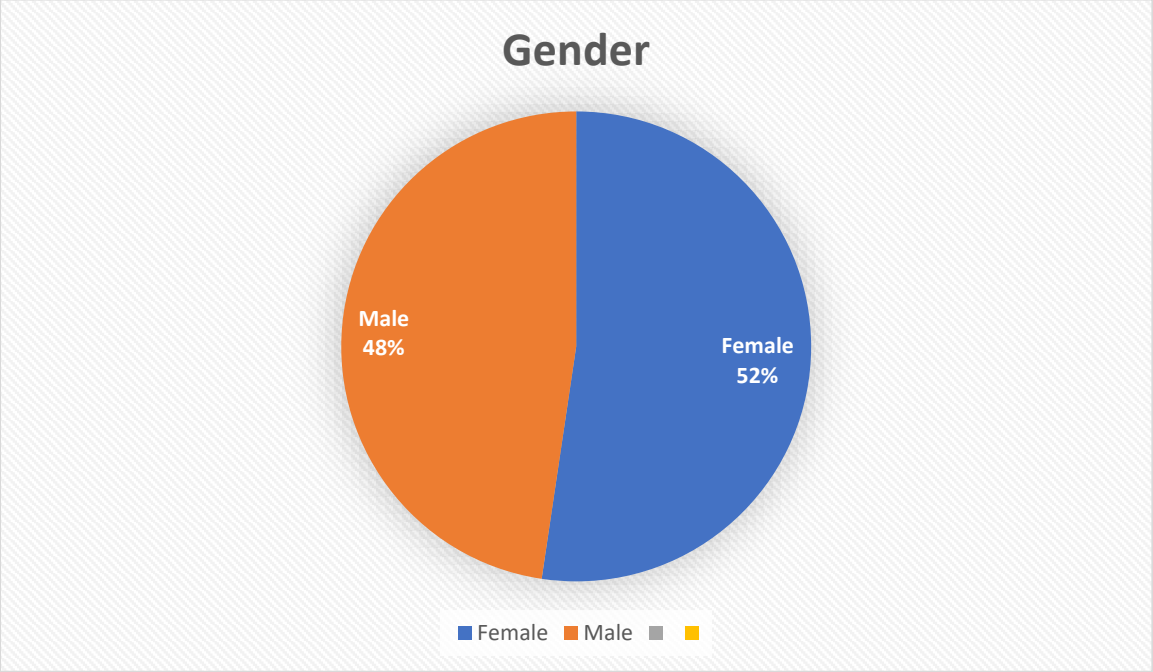


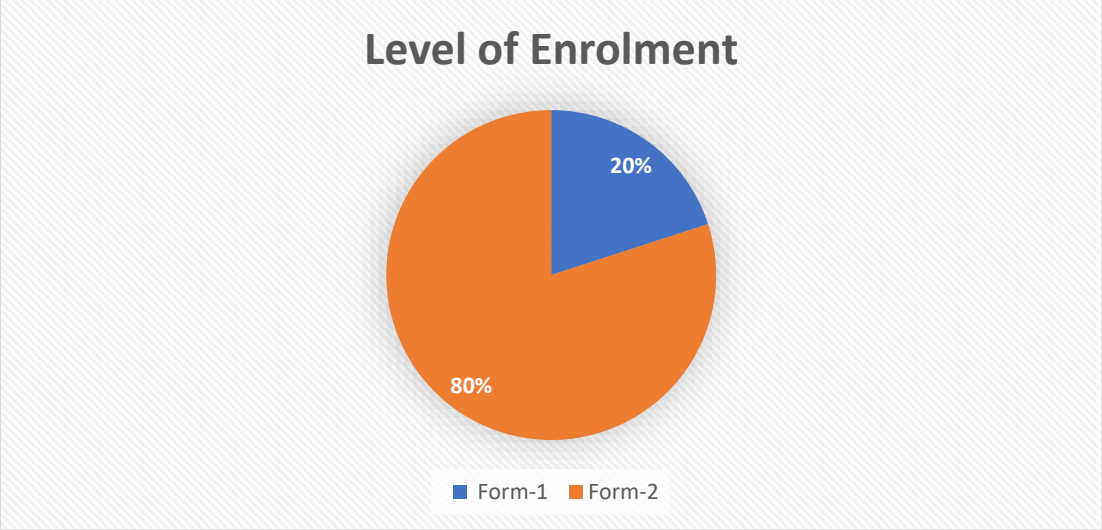
Table 11 Distribution of Students by Gender

Gender	Frequency (f)	Percentage (%)
Female	56	52
Male	51	48
Total	107	100

Figure 4 and Table 11 show that there was a nearly equal distribution of male and female form-2 students who participated in the study, with 52% females being 56 in number and 48% males being 51 in number.

This distribution implies that student attitudes, particularly those of female students, were slightly more positive than those of boys. In a study conducted in Kwale, Ogembo and Nthenya (2015) discovered that one of the factors that relate to students' attitudes is gender. (Makato, 2016) The distribution in figure 4.4 can cause a Negative attitude towards Biology in the males hence decrease in Performance.

Figure 7 Distribution of students by Level of Enrolment



The data in Figure 7 shows that majority 80% of form 2 students who participated in the study were admitted in form 1. This implies that, majority of the students who participated in the study had stayed in the current school long enough and were able to understand how school factors influence students' performance in Biology in KCSE in public secondary schools in Kajiado County.

Figure 8 Distribution of Male Students to Enrol Biology in Form-3

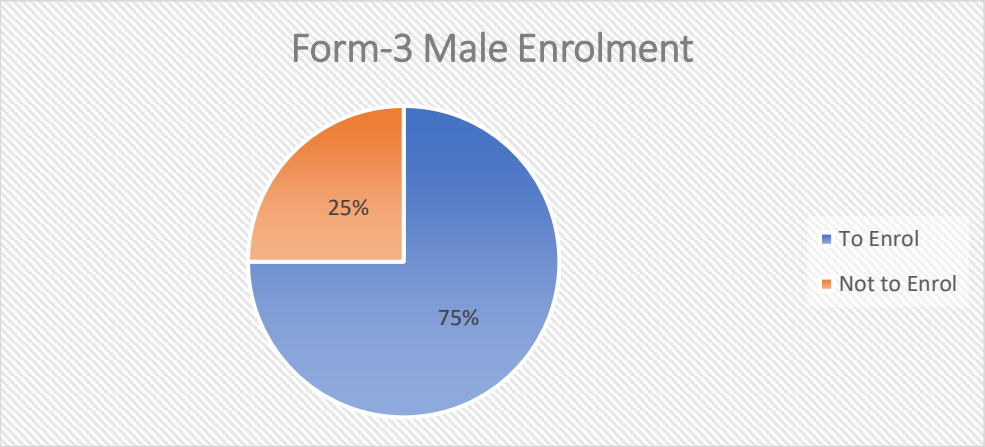


Table 12 Distribution of Male Students to Enrol Biology in Form-3

Enrolment	Frequency (f)	Percentage (%)
To Enrol	38	75
Not To Enrol	13	25
Total	51	100

Out of the 51-male students in form-2, thirty-eight are willing to enrol Biology in Form-3 and in KCSE, leaving 25% out of the total to choosing other science subjects.

25% of students not choosing to pursue Biology is significantly high, indicating to the researcher the poor liking and attitude towards Biology on a higher scale.

Figure 9 Distribution of Female Students to Enrol Biology in Form-3

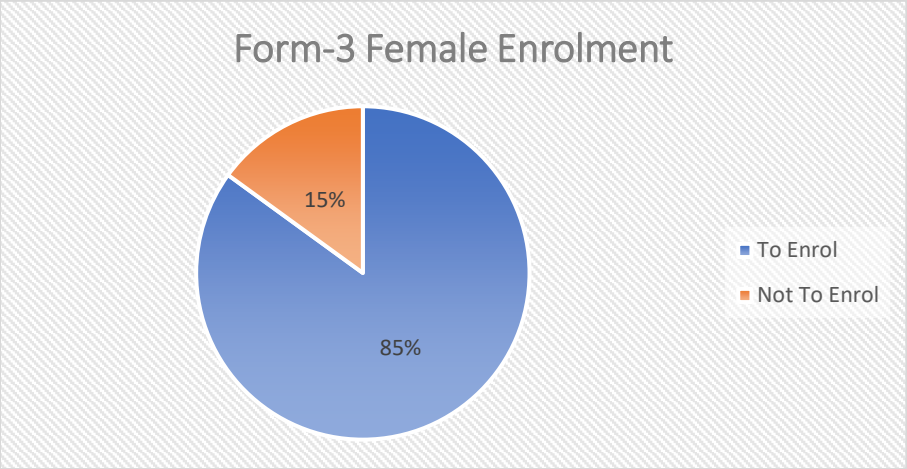


Table 13 Distribution of Female Students to Enrol Biology in Form-3

Enrolment	Frequency (f)	Percentage (%)
To Enrol	48	85
Not to Enrol	8	15
Total	56	100

Out of 56-Female students in form-2, forty-eight are willing to enrol Biology in Form-3 and in KCSE, leaving 15% out of the total to choosing other science subjects.

15% in Female Students is significantly lower compared to the 25% in Male students not choosing to pursue Biology in Higher levels of Form 3 and KCSE, indicating to the researcher that Female Students enjoy Biology more than Male Students due to several probable factors linking to the Liking of the subject and Attitude at a Grand level of schemes.

4.3.4 Demographic information of Lab Technicians

To establish the gender of Lab Technicians, the researcher asked them to indicate their gender and the results are as shown in figure 10

Figure 10 Distribution of Lab Technicians by Gender

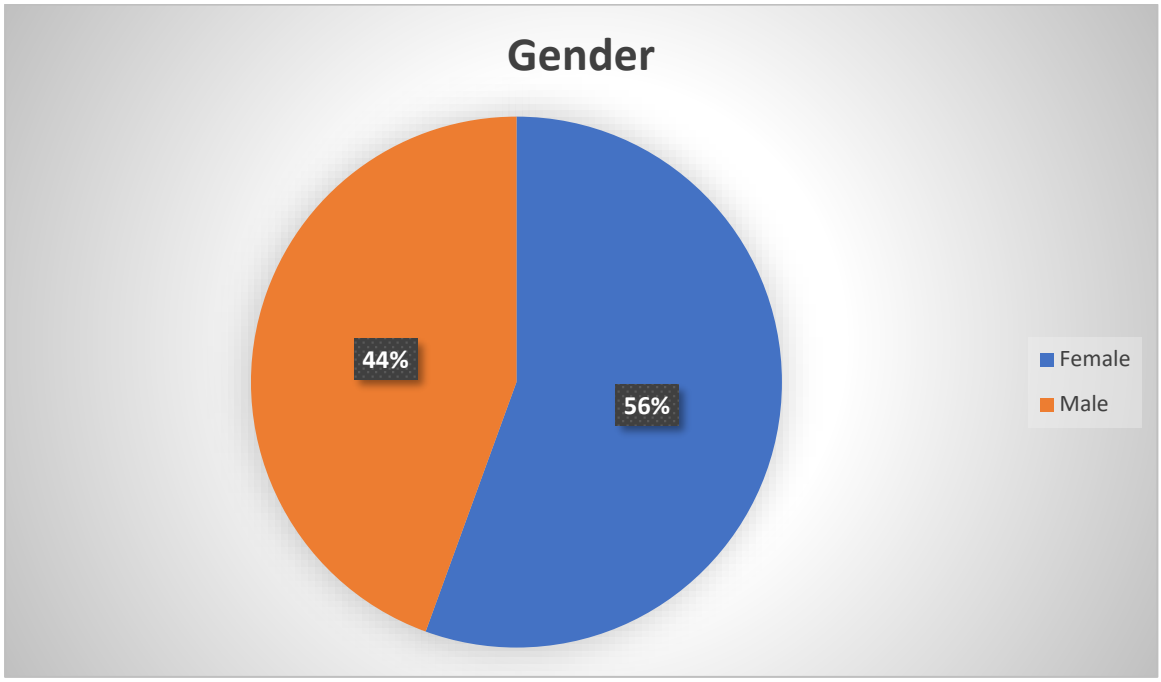


Table 14 Distribution of Lab Technicians by Gender

Gender	Frequency (f)	Percentage (%)
Male	4	44
Female	5	56
Total	9	100

Results revealed that, 56% are Female and 44% are male Lab Technicians. This showed the researcher that there are more female Lab Technicians than male in Kajiado Sub County.

4.3.5 School Category

All the schools chosen to participate in this study were public.

The researcher purposefully chose one mixed-day secondary school, while the other three schools were chosen at random, bringing in approximately two boys' secondary schools and one girl's secondary school.

4.4 Respondents Responses on Students' Academic Performance

The first objective of the study was to determine the factors and influence of Practical work students' overall achievements in Biology, all the responses are from the Principals, Teachers, Students, and Lab Technicians were presented in the tables below.

4.4.1 Principals Responses

Principals were asked to give their views on 1) Frequent Biology Practical Lessons 2) Laboratory and Inter Activities 3) Student Teacher Relationship 4) School Administration 5) Teachers Qualifications 6) Lab Technicians Qualifications 7) Parents Involvement and Level of Education.

And were required to fill a 5-letter like scale with Strongly Agreed (SA), Agreed (A), Neutral (N), Disagreed (D), and Strongly Disagreed (SD).

Their responses are presented in the table below.

NO.	**Statement**	**SA**		**A**		**N**		**D**		**SD**		**Total**
		f	%	f	%	f	%	f	%	f	%	(∑)
A	Frequent Biology Practical Lessons											
1	Students who participate in a significant amount of practical work perform better in Biology Exams.	3	75	1	25	0	0	0	0	0	0	100
B	Laboratory/ Inter Activities											
1	There is a Positive Impact towards Students Attitude and achievement, due to Lab presence.	4	100	0	0	0	0	0	0	0	0	100
C	Student Teacher Relationship											
1	Do you Agree that a good relationship between teachers and students encourages high performance.	4	100	0	0	0	0	0	0	0	0	100
D	School Administration											
1	School Administration's provision of	4	100	0	0	0	0	0	0	0	0	100

	Appropriate Lab Resources leads to meaningful Lab Practical											
E	Teachers Qualification											
1	High Qualified teachers flexibly use different modes of teaching to encourage students' high performance	4	100	0	0	0	0	0	0	0	0	100
2	High qualified teachers create conducive classroom for learners than lowly qualified teachers?	3	75	1	25	0	0	0	0	0	0	100
3	High qualified teachers have enough content mastery to give students than lowly qualified teachers?	4	100	0	0	0	0	0	0	0	0	100
F	Lab Technicians Qualification											
1	High qualified Lab Technicians work more effortlessly and efficiently	4	100	0	0	0	0	0	0	0	0	100
G	Parent Involvement and Level of Education											
1	Highly educated parents' involvement in their children education, improves the student's attitude and therefore better grades	4	100	0	0	0	0	0	0	0	0	100
2	Parents with higher level of education can set conducive learning environment at home than those with or without lower level of education	4	100	0	0	0	0	0	0	0	0	100
Mean (m)			95		5	0	0	0	0	0	0	100

Table 15 Principals Responses

From the findings in the Tables above, most Principals (95%) Strongly Agreed with the statements given to them, and 5% Agreed.

This means that most Principals 95% strongly agreed that the above factors and Effects of Practical work on Students' overall performance in Biology.

4.4.2 Biology Teachers Responses

Teachers were asked to give their views on 1) Frequent Biology Practical Lessons 2) Laboratory and Inter Activities 3) Student Teacher Relationship 4) School Administration 5) Teachers Qualifications 6) Lab Technicians Qualifications 7) Parents Involvement and Level of Education.

Teachers were also required to give their views on the (above) factors that influence students' academic performance in Biology. Therefore, they were required to fill a 5-like scale with strongly agreed (SA), agreed (A), neutral (N), disagreed (D), and strongly disagreed (SD).

Table 16 Teachers Responses

No	**Statement**	**SA**		**A**		**N**		**D**		**SD**		**Total**
		f	%	f	%	f	%	f	%	f	%	
A	Frequent Biology Practical Lessons											
1	Students who participate in a significant amount of practical work perform better in Biology Exams than those who do not.	11	61	2	11	1	6	3	17	1	5	100
2	Do you agree students should be left alone to investigate practical issues?	5	28	6	33	2	11	2	11	3	17	100
B	Laboratory / Inter Activities											
1	There is a Positive Impact towards Students Attitude and achievement, due to Lab presence and Practical	17	96	1	4	0	0	0	0	0	0	100
2	A good relationship between High qualified Lab Technicians, teachers and students encourages fluidity of communication, hence efficiency	18	100	0	0	0	0	0	0	0	0	100
3	High qualified Lab technicians create conducive Lab for learners and teachers than lowly qualified Lab technicians?	4	22	8	44	4	22	1	6	1	6	100

C	Teacher – Student Relationship											
1	Do you Agree that a good relationship between teachers and students encourages high performance and **Attitude** between them?	18	100	0	0	0	0	0	0	0	0	100
D	Intervening Variables i.e., IT Infrastructures											
1	Incorporation of Computer Based Instructions as a supplement (such as ICT tools and projectors) to content delivery, will highly improve students' **performance** and attitude.	17	91	1	9	0	0	0	0	0	0	100
E	Teachers Qualification											
1	High Qualified teachers flexibly use different modes of teaching to encourage students' high performance	3	17	8	44	5	27	1	6	1	6	100
2	High qualified teachers create conducive classroom for learners than lowly qualified teachers?	2	11	9	50	6	33	0	0	1	6	100
3	High qualified teachers have enough content mastery to give students than lowly qualified teachers?	5	28	6	33	6	33	1	6	0	0	100
F	Lab Technicians Qualification											
1	High qualified Lab Technicians work more effortlessly and efficiently	18	100	0	0	0	0	0	0	0	0	100
G	Parent Involvement and Level of Education											
1	Highly educated parents' involvement in their children education, improves the student's attitude and therefore better grades	12	66	5	28	1	6	0	0	0	0	100
2	Parents with higher level of education can set conducive learning environment at home than those with or without lower level of education	10	56	4	21	3	17	1	6	0	0	100
Mean (m)		59.62		21.38		11.92		4		3.08		100

The results from the table above, revealed that majority of the teachers 59.62%, strongly agreed with the given statements, 21.38% agreed, 11.92% neutral, 4% disagreed, 3.08% strongly disagreed on the factors that can influence their students' academic performance in Biology. This data proved to the researcher that most teachers who strongly agreed, consequently to the extent of the factors and effects of practical work that influence their students' performance in Biology.

4.4.3 Form-2 Biology Students Responses

The students were also required to give their views on the (below) factors that influence their academic performance in Biology.

Therefore, they were required to fill a 5-like scale with strongly agreed (SA), agreed (A), neutral (N), disagreed (D), and strongly disagreed (SD).

No.	**Statement**	**SA**		**A**		**N**		**D**		**SD**		**Total**
		f	%	f	%	f	%	f	%	f	%	∑
A	Frequent Biology Practical Lessons											
1	Students who participate in a significant amount of practical work perform better in Biology Exams than those who do not.	93	86.92	7	6.54	3	2.8	3	2.8	1	0.93	100
2	Do you agree students should be left alone to investigate practical issues?	81	75.70	20	18.69	2	1.87	4	3.74	0	0	100
B	Laboratory / Inter Activities											
1	There is a Positive Impact towards Students Attitude and achievement, due to Lab presence and Practical	89	83.18	10	9.35	4	3.74	10	9.35	1	0.93	100
2	High qualified Lab technicians create conducive Lab for learners and teachers than lowly qualified Lab technicians?	95	88.79	10	9.35	2	1.87	0	0	0	0	100
C	Student Teacher Relationship											
1	Do you Agree that a good relationship between teachers and students encourages high performance and **Attitude** between them?	100	93.46	6	5.61	1	0.93	0	0	0	0	100
D	Teacher Qualification											

1	High Qualified teachers flexibly use different modes of teaching to encourage students' high performance	99	92.52	5	4.67	0	0	2	1.87	1	0.93	100
2	High qualified teachers create conducive classroom for learners than lowly qualified teachers?	105	98.13	2	1.87	0	0	0	0	0	0	100
3	High qualified teachers have enough content mastery to give students than lowly qualified teachers?	107	100	0	0	0	0	0	0	0	0	100
E	Parent Involvement and Level of Education											
1	Highly educated parents' involvement in their children education, improves the student's attitude and therefore better grades	48	44.86	16	14.95	8	7.48	15	14.02	20	18.69	100
2	Parents with higher level of education can set conducive learning environment at home than those with or without lower level of education	45	42.06	10	9.35	33	30.84	11	10.28	8	7.48	100
Mean (m)		80.76		8.04		4.95		4.21		2.90		100

Table 17 Form 2 Students Responses

The results from the table above, revealed that majority of the students 80.76%, strongly agreed with the given statements, 8.04% agreed, 4.95% neutral, 4.21% disagreed, 2.90% strongly disagreed on the factors that can influence their academic performance in Biology.

This means that most students 80.76% strongly agree on the above issues that influence their academic excellence and performance.

4.4.4 Lab Technicians Responses

The Lab Technicians were asked to give their views on 1) Frequent Biology Practical Lessons 2) Laboratory and Inter Activities 3) Teachers Qualifications.

Therefore, they were required to fill a 5-like scale with strongly agreed (SA), agreed (A), neutral (N), disagreed (D), and strongly disagreed (SD).

Table 18 Lab Technicians Responses

No	**Statement**	**SA**		**A**		**N**		**D**		**SD**		**Total**
		f	%	f	%	f	%	f	%	f	%	∑
A	Frequent Biology Practical Lessons											
1	Students who participate in a significant amount of practical work perform better in Biology Exams than those who do not.	6	66.67	3	33.33	0	0	0	0	0	0	100
2	Do you agree students should be left alone to investigate practical issues?	8	88.89	1	11.11	0	0	0	0	0	0	100
B	Laboratory / Inter Activities											
1	There is a Positive Impact towards Students Attitude and achievement, due to Lab presence and Practical	9	100	0	0	0	0	0	0	0	0	100
2	A good relationship between High qualified Lab Technicians, teachers and students encourages fluidity of communication, hence efficiency	9	100	0	0	0	0	0	0	0	0	100
3	High qualified Lab Technicians work more effortlessly and efficiently	8	88.89	1	11.11	0	0	0	0	0	0	100

4	High qualified Lab technicians create conducive Lab for learners and teachers than lowly qualified Lab technicians	7	77.78	2	22.22	0	0	0	0	0	0	100
5	High qualified Lab technicians create and teach awareness and safety measures to students than lowly qualified Lab technicians	9	100	0	0	0	0	0	0	0	0	100
C	Teachers Qualification											
1	High Qualified teachers flexibly use different modes of teaching to encourage students' high performance	9	100	0	0	0	0	0	0	0	0	100
2	High qualified teachers create conducive classroom for learners than lowly qualified teachers?	8	88.89	1	11.11	0	0	0	0	0	0	100
3	High qualified teachers have enough content mastery to give students than lowly qualified teachers?	9	100	0	0	0	0	0	0	0	0	100
Mean (m)		91.11		8.89		0		0		0		100

The results from the table above, revealed that majority of the Lab Technicians 91.11%, strongly agreed with the given statements, 8.89% agreed, none on neutral, none disagreed, and none strongly disagreed on the factors that can influence the students' academic performance in Biology.

This means that most lab technicians 91.11% strongly agree on the above issues that influence the academic excellence and performance of the form 2 students.

4.5 Science skills and processes students develop

Some of the science skills and processes students need to develop include.

observation, classifying, **inferring**, **measuring, communicating, predicting,** and **hypothesizing**.

Process skills are thinking skills that students use when separating evidence from opinion. They are strategies for achieving scientific understanding. The objectives of this research were to show that practical approach as a central tool for teaching can enhance learning outcome than the conventional method of teaching.

Practical assessment is based on the outcome that is, the product rather than the process itself. Therefore, a scheme for evaluating the scientific processes is necessary if this method is to be effective.

Evaluation has a feedback component and can help students to perform. The various scientific activities have a positive effect on their understanding of the concepts.

The acquisition of skills should be the main goal of performing an experiment.

Therefore, teachers of Biology and science in general should be able to evaluate the practical work as it progresses using some schemes that have been carefully constructed.

Conclusion

Practical approach to instruction in Biology leads to acquisition of more skills, creates motivation in the learner leading to greater understanding. Higher achievements lead to higher enrolment.

The reverse is true with conventional teaching. Learners are less motivated, acquire less skills leading to limited understanding. Low achievements follows and thus low enrolment results.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter highlights the outcomes of a study conducted in Kajiado County, Kenya on the **Effects of practical work on students' Achievement in Biology at secondary school Level**. The research instruments, which included questionnaires and an interview schedule, yielded the results.

It also draws conclusions based on the outcomes of the investigation and concludes with numerous recommendations.

5.2 Summary of Findings

The study sought to find out the factors and effects of Practical work in teaching and learning in secondary schools in Kajiado County. The instruments used for data collection were Questionnaires and an Interview schedule.

The study found that in Kajiado County, there are more female biology teachers than male biology teachers, which creates a biased gender mentality in the male students and thereby leading to poor performance in the overall subject.

Furthermore, it was found that the age bracket of biology teachers is low < 30 years, making those young teachers lack the experience of teaching methods and modes for various topics and inadequacy in lesson preparation plans, use of Lecture methods.

It was also discovered that Efforts of newly graduates are watered down by Teacher trainees (25%) and B.O.M teachers (6%) who might cause the students to develop negative attitude due to their unskilled pedagogical skills.

The biology teachers were found to be adequately trained to handle the subject. They either had a bachelor's degree in education or a master's in education.

Most of the teachers were either newly employed or in universities hence no adequate experience to effectively choose teaching methods and assessment methods for students to perform well in Biology

The study found that overworking of technicians was a problem encountered in the use of laboratories in the areas under study all through a narrative prose method.

5.3 Conclusion

From the research findings of this study, **age** of the biology teachers mattered a lot because with more experience the better the handling and teaching techniques, **gender** was another issue that greatly shifted the view in the male students in ratio to the female who greatly found the subject more appealing to them, and also the **efforts** of the newly graduates are merely watered down by teacher trainees and BOM teachers and thereby denying them the full experience of a teacher.

Finally, in relation to pedagogical approach in practical work, teachers were found to prefer **demonstrations** and **lectures** while **project works** were the most unpopular method of teaching together with practical.

5.4 Recommendations

Various **policy and future research proposals** have been made based on the observations stated in the preceding sections and are explored **separately**.

5.4.1 Policy Recommendations

5.4.2 Ministry of Education Recommendations

The study recommends that schools and Ministry of Education (MoE) **invest** more on Training the teachers on the SMASSE projects which would highly motivated and give them the necessary pedagogical skills to teach more effectively and effortlessly. The Ministry of Education should also opt to find a way in balancing the gender suite in all the schools, in every county Similarly, each school should strive to employ more laboratory technicians and avoid turmoil of overworking them.

5.4.3 Students Recommendations

Further, it is recommended that students be educated on the influences of gender biasness and that mindset always determines the high road they choose and therefore their future.

5.4.4 Suggestion for further Research

The researcher **proposes further study** in the following areas:

a. It is suggested that the study be extended to other Counties in Kenya.
b. The same research should be carried out using varied research designs.
c. It is advocated that research be carried on constraints impeding efficient laboratory utilization.

REFERENCES

@educationnewshub.co.ke, m. t. (n.d.). *educationnewshub*. Retrieved from educationnewshub.co.ke: https://educationnewshub.co.ke/county-secondary-schools-in-kajiado-county-school-knec-code-type-cluster-and-category/

@Educationnewshub.co.ke, M. T. (n.d.). *educationnewshub*. Retrieved from educationnewshub.co.ke: https://educationnewshub.co.ke/county-secondary-schools-in-kajiado-county-school-knec-code-type-cluster-and-category/

@Educationnewshub.co.ke, M. T. (n.d.). *educationnewshub*. Retrieved from educationnewshub.co.ke: https://educationnewshub.co.ke/kcse-2021-2022-list-of-top-200-schools-nationally-full-list/

Advance-africa. (n.d.). *advance-africa.com*. Retrieved from advance-africa.com: https://www.advance-africa.com/secondary-schools-in-kajiado-county.html

Akarsu, B. K. (2013). *ERIC*. Retrieved from eric.ed.gov: https://eric.ed.gov/?q=source%3a%22Physics+Education%22&ff1=locTurkey&ff2=subHigh+School+Students&id=EJ1052294

ArapToo, F. (2021, May 10). *teacher.co.ke*. Retrieved from teacher.co.ke: https://teacher.co.ke/kcse-2020-results-release-on-monday-maths-chemistry-poorly-performed/

Ayeni, M. F. (2021). Challenges and prospects of science education development in africa. *Richtmann publishing*, 1-10.

Bajon habu rimamsomte, i. u. (2021, october). *researchgate*. Retrieved from researchgate.net: https://www.researchgate.net/publication/355773248_Availability_and_Utilization_of_Biology_Laboratory_Facilities_as_a_Correlate_of_Academic_Achievement_among_Secondary_School_Students_in_Takum_Education_Zone_Taraba_State_Nigeria

Baraza, Y. (2020, december 18). *worldagroforestry*. Retrieved from worldagroforestry.org: https://www.worldagroforestry.org/blog/2020/12/18/kenyas-bioenergy-strategy-supported-world-agroforestry#:~:text=On%2018%20November%202020%2C%20the,as%20well%20as%20transport%20fuel.

Baruch, A. &. (2008). *APA PSYCNET*. Retrieved from psycnet.apa.org: https://psycnet.apa.org/record/2008-12017-005

Bell, D. (2014). *wellcome trust*. Retrieved from wellcome.org: https://wellcome.org/sites/default/files/wtp056459_0.pdf

Bett, B. K. (2020, August). *erepository.uonbi.ac.ke*. Retrieved from erepository.uonbi.ac.ke: http://erepository.uonbi.ac.ke/bitstream/handle/11295/153084/PROJECT%20%20BETT.pdf?sequence=1

Black, P. N. (2020, April 15). *The Faseb Journal*. Retrieved from FASEB; Federation of American Societies For Experimental Biology: https://faseb.onlinelibrary.wiley.com/doi/abs/10.1096/fasebj.2020.34.s1.00170

Britannica, T. E. (n.d.). *Britannica*. Retrieved from britannicca.com: https://www.britannica.com/science/science

BurningCompass. (n.d.). *burningcompass*. Retrieved from burningcompass.com: https://www.burningcompass.com/countries/kenya/kenya-county-map.html

Candela, L. (2019, 11 19). *Lumen Boundless Biology*. Retrieved from lumenlearning: https://courses.lumenlearning.com/boundless-biology/chapter/the-science-of-biology/

Cherry, K. (2022, February 14). *verywellmind*. Retrieved from verywellmind.com: https://www.verywellmind.com/behavioral-psychology-4157183

Christiana Ihejiamaizu, H. N. (2019, October). *researchgate.* Retrieved from researchgate.net: https://www.researchgate.net/publication/349662543_Secondary_School_Teachers'_Efficacy_in_Teaching_and_Students'_Understanding_of_Biology_Concepts

D., H. (2014). *scrip*. Retrieved from scrip.org: https://scirp.org/reference/referencespapers.aspx?referenceid=648983

David W Johnson, R. T. (2015, january). *researchgate*. Retrieved from researchgate.net: https://www.researchgate.net/publication/284471328_Cooperative_Learning_Improving_university_instruction_by_basing_practice_on_validated_theory

Dr. Edwin Masibo, D. N. (2017, December). *ijsri.com, International Journal of Scientific Research and Innovative Technology,ISSN: 2313-3759 Vol. 4 No. 12*. Retrieved from ijsri.com International Journal of Scientific Research and Innovative Technology,ISSN: 2313-3759 Vol. 4 No. 12: https://ijsrit.com/uploaded_all_files/1693932230_h2.pdf

Dr. Edwin Masibo, D. N. (2017, December). *oarklibrary*. Retrieved from app.oarklibrary.com: https://app.oarklibrary.com/file/2/7d07c7af-bb43-44ee-84af-93c93472cb6f/07acd417-12db-4b1c-8237-a490fc771810.pdf

Elimu Centre, u. (2021, July 21). *Elimu Centre, Education Centre*. Retrieved from elimucentre.com: https://www.elimucentre.com/county-secondary-schools-in-nairobi-county/

elimu. (n.d.). *elimu*. Retrieved from e-limu.org: https://learn.e-limu.org/topic/view/?t=1495&c=468

Gachie, L. T. (n.d.). *KenyanLife*. Retrieved from kenyanlife.com: https://kenyanlife.com/new-kenya-school-term-dates/

Garrett, T. (2008). *eric.ed*. Retrieved from files.eric.ed.gov: https://files.eric.ed.gov/fulltext/EJ829018.pdf

google.com. (n.d.). Retrieved from goole domain: https://www.google.com/search?q=employment+of+biology+education+in+the+past

&oq=employment+of+biology+education+in+the+past&aqs=chrome..69i57.15570j0j1&sourceid=chrome&ie=UTF-8

HASA. (2019, October 27). *PEDIAA*. Retrieved from pediaa.com: https://pediaa.com/difference-between-conceptual-and-empirical-research/#:~:text=The%20main%20difference%20between%20conceptual,ways%20of%20doing%20scientific%20research.

Heila Lotz-Sisitka, M. P. (n.d.). *UNEP*. Retrieved from webdocs.unep.org: https://wedocs.unep.org/bitstream/handle/20.500.11822/14063/Africa%20Environmental%20Education%20and%20Training%20Action%20Plan%202015%E2%80%932024.pdf?sequence=1&isAllowed=y

Iranyang Uko. (2021, october). *researchgate*. Retrieved from researchgate.net: https://www.researchgate.net/publication/355773248_Availability_and_Utilization_of_Biology_Laboratory_Facilities_as_a_Correlate_of_Academic_Achievement_among_Secondary_School_Students_in_Takum_Education_Zone_Taraba_State_Nigeria

Jannis, M. K. (n.d.). *graduates.ku.ac*. Retrieved from ac.ke: http://graduates.ku.ac.ke/images/stories/abstract/CONTRIBUTION%20OF%20SMASSE%20IN-SERVICE%20PROJECT%20ON%20STUDENTS%20PERFORMANCE%20IN%20MATHEMATICS%20.pdf

John Orodho, Publisher Nairobi Kanezja. (2009, January). *researchgate*. Retrieved from researchgate.net: https://www.researchgate.net/publication/310832267_ELEMENTS_OF_EDUCATION_AND_SOCIAL_SCIENCE_RESEARC

Kadio, K. E. (2021). Academic achievements in Sub saharan Africa . *Taylor Francis Online, Education Economics*, 1-10.

Kara Rogers, E. R. (2015, october 16). *Britannica, Biology*. Retrieved from Britannica, Biology: https://www.britannica.com/science/biology

kenyacounntyguide. (n.d.). *KenyaCounty Guide*. Retrieved from www.kenyacountyguide.co.ke: https://www.kenyacountyguide.co.ke/kajiado-county/

Kombo, T. (2006). *learning.uonbi.ac.ke*. Retrieved from ac.ke: https://learning.uonbi.ac.ke/courses/LDP603/work/assig_15/RESEARCH_METHODS_ASSIGMENT_1.docx

kunga, J. (2021). *ac.ke*. Retrieved from ir.mksu.ac.ke: http://ir.mksu.ac.ke/bitstream/handle/123456780/8139/1255-Article%20Text-3847-1-10-20210329.pdf?sequence=1&isAllowed=y

KWAMBOKA, N. J. (2012, July). *ir-library*. Retrieved from ir-library.ku.ac.ke: https://ir-library.ku.ac.ke/bitstream/handle/123456789/6562/NYAKWAMA%20JOYCE%20KWAMBOKA.pdf?sequence=3&isAllowed=y

Leb, C. (2014, may). *Research Gate*. Retrieved from researchgate.net: https://www.researchgate.net/publication/267515216_'Exploring_factors_affecting_performance_in_Biology_5090_at_selected_high_schools_in_Lesotho'

Macharia, M. T. (n.d.). *Education News Hub*. Retrieved from educationnewshub.co.ke: https://educationnewshub.co.ke/tsc-news-circular-number-of-lessons-to-be-taught-by-teachers-and-administrative-posts-per-school-revealed/

Makato, K. (2016). *erepository.uonbi.ac.ke*. Retrieved from uonbi.ac.ke: https://erepository.uonbi.ac.ke/bitstream/handle/11295/97410/Kyalo_School%20Factors%20Influencing%20Students%E2%80%99%20Performance%20in%20Chemistry%20in%20Kenya%20Certificate%20of%20Secondary%20Education%20in%20Makueni%20County%2C%20Kenya.pdf?sequence=1&

McDermott, R. (2001, march). *researchgate*. Retrieved from researchgate.net: https://www.researchgate.net/publication/235267176_Overcoming_Cultural_Barriers_to_Sharing_Knowledge

McLeod, D. S. (2018). *SimplyPsychology*. Retrieved from simplypsychology.org: https://www.simplypsychology.org/attitudes.html

McLeod, D. S. (2019). *simplypsychology*. Retrieved from simplypsychology.org: https://www.simplypsychology.org/bruner.html

McLeod, D. S. (2022, April 06). *simply psychology*. Retrieved from simplypsychology.org: https://www.simplypsychology.org/piaget.html

McNeeley, S. (2012, june). *researchgate*. Retrieved from researchgate.net: https://www.researchgate.net/publication/268222649_Sensitive_Issues_in_Surveys_Reducing_Refusals_While_Increasing_Reliability_and_Quality_of_Responses_to_Sensitive_Survey_Items

milligan, L. O. (2017, june 18). *Sage Journals*. Retrieved from sagepub.com: https://journals.sagepub.com/doi/full/10.1177/1745499917711550

mokaya, z. (2013). INFLUENCE OF SCHOOL INFRASTRUCTURE ON STUDENTS'. *erepository university of nairobi*, 3-11-12.

moses, k. (2012). *academia.* Retrieved from academia.org: https://www.academia.edu/17847765/Biology_Education_A_Teachers_Perspective_on_the_Challenges_in_the_Delivery

Musah, U. A. (2017). Effects of Availability and Utilization of Biology Laboratory. *International Journal of Innovative Social & Science Education Research* , 1-2.

Nasr, A. R. (2011, october). *research gate.* Retrieved from researchgate.net: https://www.researchgate.net/publication/266870153_Attitude_towards_Biology_and_Its_Effects_on_Student's_Achievement

Ngéthe, M. A. (2016, april). *ir-library kenyatta university.* Retrieved from ku.ac.ke: https://ir-library.ku.ac.ke/bitstream/handle/123456789/11820/Effects%20of%20practical%20work%20on%20students%20%20achievements.pdf?sequence=5

Ngugi, M. N. (2011, November). *ir-library.ku.* Retrieved from ir-library.ku.ac.ke: https://ir-library.ku.ac.ke/bitstream/handle/123456789/2999/Ngugi%2C%20Mary%20Njoki.pdf?sequence=3&isAllowed=y

Nicholas Ozor, R. O. (2021, March). The Futures of Bioeconomy in Eastern Africa. *Journal of Futures Studies*, pp. 25(3): 1-14.

Nick, M. W. (2022, June 1). *WideFunnel*. Retrieved from widerfunnel.com: https://www.widerfunnel.com/blog/pilot-testing-user-research/#:~:text=Pilot%20testing%20is%20a%20rehearsal,spent%20on%20any%20research%20project.

Njeri, S. K. (2013). *erepository.* Retrieved from uonbi.ac.ke: http://erepository.uonbi.ac.ke/bitstream/handle/11295/74215/Njeri_Factors%20Affecting%20Performance%20In%20Sciences%20In%20Ongata%20Rongai%20Division,%20Kajiado%20North%20District.pdf?sequence=3

njeri, S. k. (2013). *FACTORS AFFECTING PERFORMANCE IN SCIENCES IN ONGATA.* Retrieved from erepository.uonbi.ac.ke: http://erepository.uonbi.ac.ke/bitstream/handle/11295/74215/Njeri_Factors%20Affecting%20Performance%20In%20Sciences%20In%20Ongata%20Rongai%20Division,%20Kajiado%20North%20District.pdf?sequence=3

Nwagbo, C. R. (2019, july). *researchgate.* Retrieved from researchgate.net: https://www.researchgate.net/publication/343191771_ENHANCING_STUDENTS'_ATTITUDE_AND_ACHIEVEMENT_IN_BIOLOGY_THROUGH_INNOVATIVE_STRATEGIES

Ogunniyi, M. B. (n.d.). *GoogleScholar*. Retrieved from scholar.google.com: https://scholar.google.com/citations?user=VID7KC0AAAAJ&hl=en

Oladimeji Oladepo, J. D. (2000, August 01). *OXFORD Academic*. Retrieved from HEALTH EDUCATION RESEARCH: https://academic.oup.com/her/article/15/4/383/924154

Olufemi, A. A. (2017, january 17). *Ed Gov.* Retrieved from eric.ed.gov: https://files.eric.ed.gov/fulltext/EJ1157595.pdf

OpenCourseWare, M. (2021, 12 21). *MIT OpenCourseWare (Massachusetts Institute of Technology).* Retrieved from MIT OpenCourseWare: https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/

Pekel, F. O. (2010). *Eric Ed gov.* Retrieved from eric.ed.gov: https://files.eric.ed.gov/fulltext/EJ1102474.pdf

Private university in Cholula, M. I.-6.-6.-8. (2004). *investing in health for economic development*. Retrieved from investing in health for economic development: https://www.who.int/macrohealth/action/sintesis15novingles.pdf

publications, s. (2017, April-June). *seahipaj.* Retrieved from seahipaj.org: https://seahipaj.org/journals-ci/june-2017/IJISSER/full/IJISSER-J-1-2017.pdf

questionpro-team. (n.d.). *questionpro*. Retrieved from questionpro.com: https://www.questionpro.com/features/survey-design/

Regier, J. (2011). Why is Academic success Important. *Saskatchewan School Boards Association*, 1-2.

Regina Scheyvens, B. N. (2011, January 1). *Sage Research Methods*. Retrieved from methods.sagepub.com: https://methods.sagepub.com/book/development-fieldwork/n8.xml

Right, J. (2019, September 4). *Medium.com, James Right*. Retrieved from medium.com: https://medium.com/@JamesRightCom/the-importance-of-biology-564d1b1deed3#:~:text=1%2D%20Biology%20helps%20us%20know%2C%20understand%20nature%20%3A&text=Studying%20different%20parts,many%20aspects%20of%20animal%2Fplant.

rogers, k. (n.d.). *britannica*. Retrieved from britannica.com: https://www.britannica.com/science/biology

Satisfactory Essays. (n.d.). What Is The Importance of Academic Performance. *IPL*, 1-6.

ScienceDirect, R. K. (2018, 12 7). *ScienceDirect, Bio-energy production by contribution of effective and suitable microbial system.* Retrieved from ScienceDirect, Bio-energy production by contribution of effective and suitable microbial system: https://www.sciencedirect.com/science/article/pii/S2589299118301174

Sifuna, D. N. (2009). Challenges of quality education in Sub saharan african countries. *researchgate*, 1-20.

Srivastava, A. R. (2019, August). *Bio-energy production by contribution of effective and suitable microbial system*. Retrieved from Research Gate: https://www.researchgate.net/publication/330107781_Bio-energy_production_by_contribution_of_effective_and_suitable_microbial_system

T., T. (2022, February 16). *practicalpsychology*. Retrieved from practicalpie.com: https://practicalpie.com/jerome-bruner/

Tarekegn, g. (2009, january). *researchgate*. Retrieved from researchgate.net: https://www.researchgate.net/publication/41890813_Can_computer_simulations_substitute_real_laboratory_apparatus

Team, b. (n.d.). *ballotpedia*. Retrieved from ballotpedia.org: https://ballotpedia.org/Academic_performance

Team, e. (n.d.). *eLimu*. Retrieved from e-limu.org: https://learn.e-limu.org/topic/view/?t=1495&c=468

Team, N. B. (n.d.). *News blaze*. Retrieved from Newsblaze.co.ke: https://newsblaze.co.ke/number-of-lessons-per-subject-in-secondary-schools-in-kenya/

Team, N. B. (n.d.). *newsblaze*. Retrieved from newsblaze.co.ke: https://newsblaze.co.ke/full-list-of-all-county-secondary-schools-in-kenya-school-code-name-location-and-other-details/

Telli, S. (2010, november). *research gate.* Retrieved from researchgate.net: https://www.researchgate.net/publication/237633806_Learning_Environment_and_Students'_Attitudes_towards_Biology

Too, F. A. (2022, April 22). *teacher.ac*. Retrieved from teacher.ac: https://teacher.ac/olkejuado-high-school-contacts-location-and-2021-2022-kcse-results/

TY-computer. (2021, April 29). *uniprojects*. Retrieved from uniprojects.com.ng: https://www.uniprojects.com.ng/2021/04/problems-of-teaching-biology-in.html

TY-Computer. (2021, April 29). *uniprojects*. Retrieved from uniprojects.com.ng: https://www.uniprojects.com.ng/2021/04/problems-of-teaching-biology-in.html

UON, K. M. (2016). *erepository.uonbi*. Retrieved from erepository.uonbi.ac.ke: https://erepository.uonbi.ac.ke/bitstream/handle/11295/97410/Kyalo_School%20Factors%20Influencing%20Students%E2%80%99%20Performance%20in%20Chemistry%20in%20Kenya%20Certificate%20of%20Secondary%20Education%20in%20Makueni%20County%2C%20Kenya.pdf?sequence=1&

Vanderwolf, C. H. (2005). *semanticscholar*. Retrieved from semanticscholar.org: https://www.semanticscholar.org/paper/TEACHING-SCIENCE-IN-THE-21-ST-CENTURY-An-Of-Science-Vanderwolf-Cook/28327bb3d31c04ee7cba3b0eeaa8c49b7c57bb0e

Vidija, M. D. (2015). *erepository.uonbi.ac.ke*. Retrieved from ac.ke: http://erepository.uonbi.ac.ke/bitstream/handle/11295/93480/Malongo,%20David_Impact%20of%20school%20based%20practical%20assessment%20on%20learner%20achievement%20in%20biology%20in%20secondary%20schools%20in%20Kakamega%20county,%20Kenya.pdf?sequence=3

VIDIJA, M. D. (2015). *erepository.uonbi.ac.ke*. Retrieved from ac.ke: http://erepository.uonbi.ac.ke/bitstream/handle/11295/93480/Malongo,%20David_Impact%20of%20school%20based%20practical%20assessment%20on%20learner%20achievement%20in%20biology%20in%20secondary%20schools%20in%20Kakamega%20county,%20Kenya.pdf?sequence=3

Wamukota, D. N. (2017, December). *oarklibrary*. Retrieved from app.oarklibrary.com: https://app.oarklibrary.com/file/2/7d07c7af-bb43-44ee-84af-93c93472cb6f/07acd417-12db-4b1c-8237-a490fc771810.pdf

Wanjala, M. (n.d.). *ResearchGate*. Retrieved from researchgate.net: https://www.researchgate.net/figure/National-Mean-Scores-of-Biology-and-Chemistry-from-2011-to-2015_tbl1_343767310

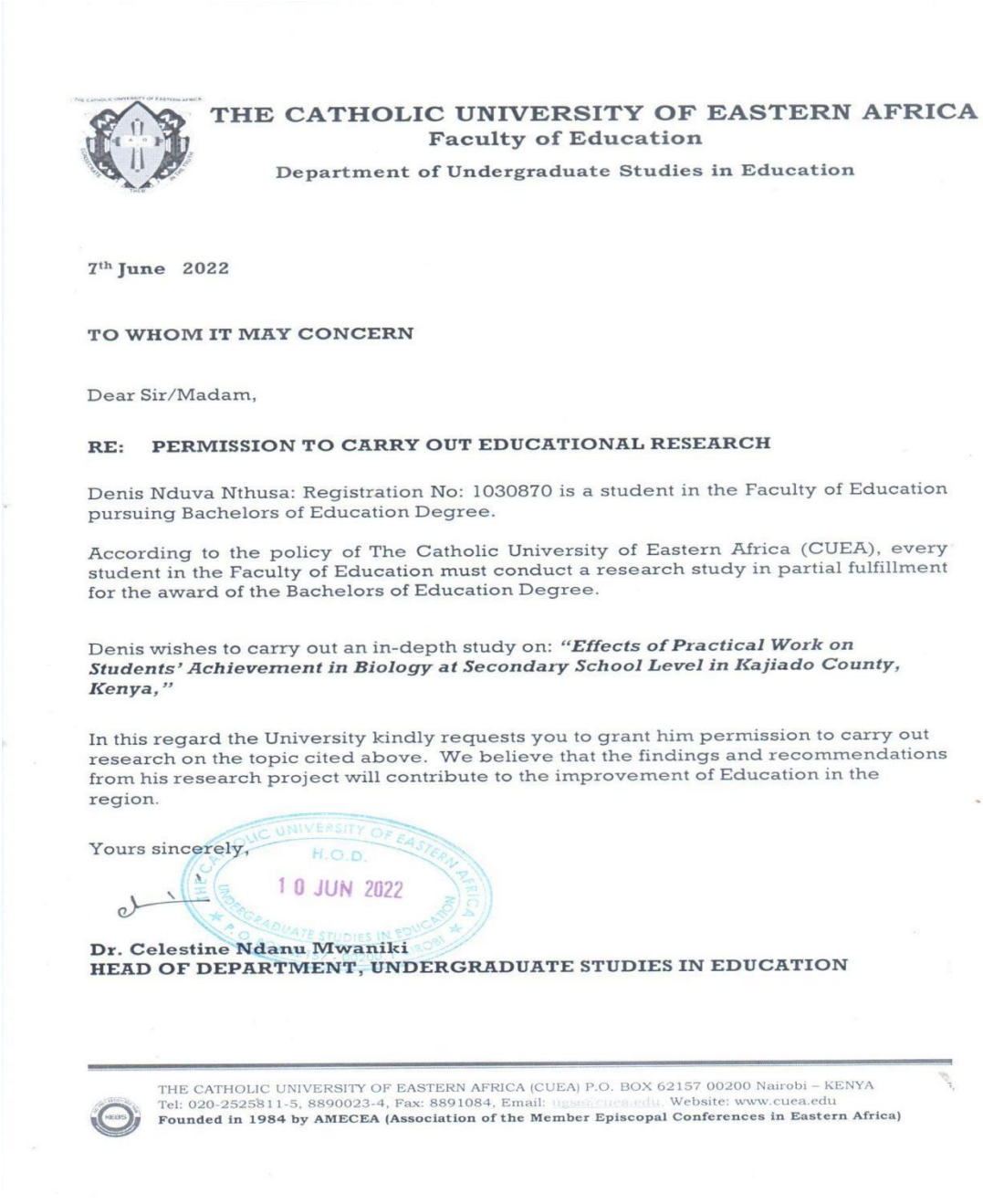
wikipedia, K. A. (2022, 2018). *wikipedia, oapub*. Retrieved from wikipedia.org, oapub.org: https://en.wikipedia.org/wiki/Lecture, https://oapub.org/edu/index.php/ejes/article/download/1605/4236

Xingcun, L. C. (2004, July to August). *The Role of Biology in Environmental Education*. Retrieved from ERIC. EDUCATION: https://eric.ed.gov/?id=EJ749197

Yusuf, U. (2020, march). *Academia*. Retrieved from academia.edu: https://www.academia.edu/45520209/IMPACT_OF_TWO_TEACHING_METHODS_ON_SECONDARY_SCHOOL_STUDENTS_PERFORMANCE_IN_BIOLOGY

APPENDICES

Appendix 1: Permit Letter



THE CATHOLIC UNIVERSITY OF EASTERN AFRICA
Faculty of Education
Department of Undergraduate Studies in Education

7th June 2022

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: PERMISSION TO CARRY OUT EDUCATIONAL RESEARCH

Denis Nduva Nthusa: Registration No: 1030870 is a student in the Faculty of Education pursuing Bachelors of Education Degree.

According to the policy of The Catholic University of Eastern Africa (CUEA), every student in the Faculty of Education must conduct a research study in partial fulfillment for the award of the Bachelors of Education Degree.

Denis wishes to carry out an in-depth study on: ***"Effects of Practical Work on Students' Achievement in Biology at Secondary School Level in Kajiado County, Kenya,"***

In this regard the University kindly requests you to grant him permission to carry out research on the topic cited above. We believe that the findings and recommendations from his research project will contribute to the improvement of Education in the region.

Yours sincerely,

H.O.D.
10 JUN 2022

Dr. Celestine Ndanu Mwaniki
HEAD OF DEPARTMENT, UNDERGRADUATE STUDIES IN EDUCATION

THE CATHOLIC UNIVERSITY OF EASTERN AFRICA (CUEA) P.O. BOX 62157 00200 Nairobi – KENYA
Tel: 020-2525811-5, 8890023-4, Fax: 8891084, Email: ugse@cuea.edu. Website: www.cuea.edu
Founded in 1984 by AMECEA (Association of the Member Episcopal Conferences in Eastern Africa)

Figure 11 Research Permit

Appendix 2: Principal's Questionnaires

Instructions

Please check the boxes or enter your replies in the areas provided. Please be as **Truthful** as possible in your responses.

Section A: Background

1. **Name of School ……**
2. **Principal's Name ……**
3. **Date ……**

Section B: Demographic Information

1	**Gender (Sex)**	**Male**	**Female**			
2	Age Category	Below 40 years	41-50 years	51-60 years		
3	Professional Qualification	PhD	Med	Bed	DipEd	
4	For how long you have been a principal	Below 1 year	2-5 years ☐	6-10 years	11-15 years	16 years and above
5	How long have you served as a principal in this school	Below 1 year	1-5 years	6-10 years	11 years and above	

Section C: Factors Influencing Performance of Biology

In the table below you are required to answer by ticking your best choice among the following options as stated besides every question given.

Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), and Strongly Disagree (SD)

A Frequent Biology Practical Lessons

1	Students who participate in a significant amount of practical work perform better in Biology Exams than those who do not.	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

- In your own opinion do you believe that more practical will improve overall performance in Biology?.....

  ……

  ……

2	Do you agree students should be left alone to investigate practical issues?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

- If Strongly Agreed, do you believe they are eligible to perform under no supervisions.

  YES ( ) NO ( )

B	**Laboratory and Inter-Activities**					
1	There is a Positive Impact towards Students Attitude and achievement, due to Lab presence and Practical	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

C	Student-Teacher Relationship					
1	Do you Agree that a good relationship between teachers and students encourages high performance between them?	SA ☐	A ☐	N ☐	D ☐	SD ☐

D	Intervening Variable i.e. The School Administration					
1	School Administration's provision of Appropriate Lab Resources leads to meaningful Lab Practical	SA ☐	A ☐	N ☐	D ☐	SD ☐
2	Intervention by School Administration leads to proper Utilisation of Biology laboratory.	SA ☐	A ☐	N ☐	D ☐	SD ☐
3	Are the Lab Resources in Abundance and availability?	SA ☐	A ☐	N ☐	D ☐	SD ☐

E	Teachers Qualifications					
1	High Qualified teachers flexibly use different modes of teaching to encourage students' high performance	SA ☐	A ☐	N ☐	D ☐	SD ☐
2	High qualified teachers create conducive classroom for learners than lowly qualified teachers?	SA ☐	A ☐	N ☐	D ☐	SD ☐
3	High qualified teachers have enough content mastery to give students than lowly qualified teachers?	SA ☐	A ☐	N ☐	D ☐	SD ☐

F	Lab Technicians Qualifications					
1	High qualified Lab Technicians work more effortlessly and efficiently	SA ☐	A ☐	N ☐	D ☐	SD ☐
2	A good relationship between High qualified Lab Technicians, teachers and students encourages fluidity of communication, hence efficiency	SA ☐	A ☐	N ☐	D ☐	SD ☐

G	Parents involvement and level of education					
1	Highly educated parents' involvement in their children education, improves the student's attitude and therefore better grades	SA ☐	A ☐	N ☐	D ☐	SD ☐
2	Parents with higher level of education can set conducive learning environment at home than those with or without lower level of education	SA ☐	A ☐	N ☐	D ☐	SD ☐

Table 19 Principals Questionnaire 1

Appendix 3: Principal's Interview Schedules

Instructions

Please enter your replies in the areas provided. Please be as **Truthful** as possible in your responses.

Section A: Background

1. **Name of School ……**
2. **Principal's Name ……**
3. **Date ……**

Section B: Evaluation

How many Trained teachers do you have on your staff? ……

How many Trained Lab Technicians do you have on your staff? ……

How many form-2 students do you have in the school currently? ……

How many form-2 biology students do you have in the school currently? ……

How many Biology lessons allocated per week in form-2?.....

What is the trend of Biology Enrolment in your School for the last 4-years?

On Increase ( ) Constant ( ) On the Decline ( )

Are there many Maintenance and utilisation faults or errors in Laboratories? If Yes, please explain……

……

…….

When you call parents for a school meeting, who often turn up?

Father ( ) Mother ( ) Other Guardians ( )

What is the **Main** source of income of **most** parents in this school?

Wages and Salaries ( )

Self-employment income ( )

Government Transfer Payments ( )

Investment income ( )

Other income (specify if any) ……

……

……

How is the relationship between students and teachers in this school?

……

……

How often does the school administration give mandatory inspections on the adequacy and maintenance of Lab resources? Please Specify?……

……

……

……

In your own opinion do you agree that Flexible high qualified Lab technicians work best in constantly changing and new environments? Please specify? ……

……

……

……

Appendix 4: Teacher's Questionnaires

Instructions

Please check the boxes or enter your replies in the areas provided. Please be as **Truthful** as possible in your responses.

Section A: Background

1. **Name of School ……**
2. **Teacher's Name ……**
3. **Date ……**

Section B: Demographic Information

1	**Gender (Sex)**	**Male**	**Female**			
2	Age Category	Below 40 years	41-50 years	51-60 years		
3	Professional Qualification	PhD	Med	Bed	DipEd	
4	For how long you have been a teacher	Below 1 year	2-5 years ☐	6-10 years	11-15 years	16 years and above
5	How long have you served as a teacher in this school	Below 1 year	1-5 years	6-10 years	11 years and above	

Section C: Factors Influencing Performance of Biology

In the table below you are required to answer by ticking your best choice among the following options as stated besides every question given.

Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), and Strongly Disagree (SD)

A FREQUENT BIOLOGY PRACTICAL LESSONS

1	Students who participate in a significant amount of practical work perform better in Biology Exams than those who do not.	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
	• In your own opinion do you believe that more practical will improve overall performance in Biology?..... …… ……					
2	Do you agree students should be left alone to investigate practical issues?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
	• If Strongly Agreed, do you believe they are eligible to perform under no supervisions. **YES ( ) NO ( )**					
B	**Teachers Qualifications**					
1	High Qualified teachers flexibly use different modes of teaching to encourage students' high performance	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
2	High qualified teachers create conducive classroom for learners than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

3	High qualified teachers have enough content mastery to give students than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
4	High qualified teachers possess actual Biology process skills in the Laboratory work than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
C	**Student-Teacher Relationship**					
1	Do you Agree that a good relationship between teachers and students encourages high performance and **Attitude** between them?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
D	**Intervening Variables i.e., I.T infrastructure**					
1	Incorporation of Computer Based Instructions as a supplement (such as ICT tools and projectors) to content delivery, will highly improve students' **performance** and attitude.	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
2	School projects (i.e., Competitions) in form of Practical will highly improve students' performance and **enrolment**	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

E	**Laboratory and Inter-Activities**					
1	There is a Positive Impact towards Students Attitude and achievement, due to Lab presence and Practical	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
2	A good relationship between High qualified Lab Technicians, teachers and students encourages fluidity of communication, hence efficiency	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
3	High qualified Lab Technicians work more effortlessly and efficiently	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
4	High qualified Lab technicians create conducive Lab for learners and teachers than lowly qualified Lab technicians?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
F	**Parents involvement and level of education**					
1	Highly educated parents' involvement in their children education, improves the student's attitude and therefore better grades	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
2	Parents with higher level of education can set conducive learning environment at home than those with or without lower level of education	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

Table 20 Teachers Questionnaires

Appendix 5: Teacher's Interview Schedules

Instructions

Please enter your replies in the areas provided. Please be as **Truthful** as possible in your responses.

Section A: Background

1. **Name of School ……**
2. **Teacher's Name ……**
3. **Date ……**

Section B: Evaluation

How many Trained biology teachers are in your staff? ……

How many Trained Lab Technicians are in your staff? ……

How many form-2 biology students do you have in the school currently? ……

How many form-2 biology students are in your class?.....

How many Biology lessons allocated per week in form-2?.....

How many Biology practical lessons are allocated per week?.....

What is the trend of Biology Enrolment in your School for the last 4-years?

On Increase ( ) Constant ( ) On the Decline ( )

Please explain how the KNEC in partnership with the SMASSE projects, have taken the initiative to changing approach in designing more practical lessons? Have you received any training from them, elaborate?.....

…….

……

Which teaching strategy do you think is best suitable? If both, please elaborate?

Lecture method, teacher oriented ( )

Lecture method, student oriented and Practical method ( )

……

……..

What are the main challenges when incorporating different teaching methods?

……

……

When you call parents for a **Teacher-Student** School meeting, who often turn up?

Father ( ) Mother ( ) Other Guardians ( )

What is the **Main** source of income of **most** parents in this school?

Wages and Salaries ( )

Self-employment income ( )

Government Transfer Payments ( )

Investment income ( )

Other income (specify if any) ……

……

……

How is your teacher-student relationship in this school?

……

……

How often does the school administration, intervene in the utilisation and progress of Biology Laboratories?……

……

……

……

In your own opinion do you agree that Flexible high qualified Lab technicians work best in constantly changing and new environments? Please specify? ……

……

……

……

Appendix 6: Student's Questionnaires

Instructions

Please check the boxes or enter your replies in the areas provided. Please be as **Truthful** as possible in your responses.

Section A: Background

1. **Name of School ……**
2. **Student's Name ……**
3. **Date ……**

Section B: Demographic Information

1	**Gender (Sex)**	**Male**		**Female**		
2	Age Category	Below 12 years	13 years	14 years	15 years and Above ☐	

Section C: Factors Influencing Performance of Biology

In the table below you are required to answer by ticking your best choice among the following options as stated besides every question given.

Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), and Strongly Disagree (SD)

A BIOLOGY AND PRACTICAL

1	Students who participate in a significant amount of practical work perform better in Biology Exams than those who do not.	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
	• In your own opinion do you believe that more practical will improve **your** overall performance in Biology?..... …… …….					
2	Do you agree students should be left alone to investigate practical issues?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
	• If Strongly Agreed, do you believe you are eligible to perform under no supervisions? **YES ( ) NO ( )**					
B	**Teachers Qualifications**					
1	High Qualified teachers flexibly use different modes of teaching to encourage students' high performance	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
2	High qualified teachers create conducive classroom for learners than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

3	High qualified teachers have enough content mastery to give students than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
4	High qualified teachers possess actual Biology process skills in the Laboratory work than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
C	**Student-Teacher Relationship**					
1	Do you Agree that a good relationship between teachers and students encourages high performance and **Attitude** between them?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
D	**Laboratory and Inter-Activities**					
1	There is a Positive Impact towards Students Attitude and achievement, due to Lab presence and Practical	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
2	High qualified Lab technicians create conducive Lab for learners and teachers than lowly qualified Lab technicians?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
E	**Parents involvement and level of education**					
1	Highly educated parents' involvement in their children education, improves the student's attitude and therefore better grades	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

2	Parents with higher level of education set conducive learning environment at home than those without or with lower level of education	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

Table 21 Students Questionnaires

Appendix 7: Student's Interview Schedules

Instructions

Please enter your replies in the areas provided. Please be as **Truthful** as possible in your responses.

Section A: Background

1. **Name of School ……**
2. **Student's Name ……**
3. **Date ……**

Section B: Evaluation

Do you consider Biology boring compared to the other sciences?

YES ( ) NOT SURE ( ) NO ( )

Are the following Disciplines from acquiring Biology Knowledge? (**Tick as many as you can**)

Agriculture ( ) Medicine ( ) Biotechnology ( ) Agrochemical ( )

Food Industry ( ) Physicist ( )

How likely are you going to pursue with Biology in your upper levels?

Not Likely Extremely Likely

0	1	2	3	4	5	6	7	8	9	10

How is your confidence level, from the work done in Biology and Basic Lab operations in Form-1?

Not Confident Super Confident

0	1	2	3	4	5	6	7	8	9	10

In your own opinion do you think more positive reinforcements, should be accrued in teaching and understanding of Biology concepts?.....

……..

……

Tick all or if any skills you have acquired from biology practical so far?

Observation ( ) Recording ( ) Measurements ( ) Classification ( )

Communication ( ) Hypothesising ( )

How is your biology performance trend, in the past 2-terms?

Poor Pass Average Good Excellent

0	1	2	3	4	5	6	7	8	9	10

Which teaching method do you prefer? If both, please elaborate?

Lecture method, teacher oriented ( )

Lecture method, student oriented and Practical method ( )

……

……

……..

Rate your teacher's, level of motivation and encouragement in class

Not commendable Pass Average Very Good Super commendable

0	1	2	3	4	5	6	7	8	9	10

When your parents are summoned for a **Teacher-Student** School meeting, who often turn up?

Father ( ) Mother ( ) Other Guardians ( )

What is the **Main** source of income of **your** parents or guardians?

Wages and Salaries ( )

Self-employment income ( )

Government Transfer Payments ( )

Investment income ( )

Other income (specify if any) ……

……

……

How is your overall opinion on student-teacher relationship in this school?

……

……

Appendix 8: Lab Technician's Questionnaires

Instructions

Please check the boxes or enter your replies in the areas provided. Please be as **Truthful** as possible in your responses.

Section A: Background

1. **Name of School ……**
2. **Lab Technician's Name ……**
3. **Date ……**

Section B: Demographic Information

1	**Gender (Sex)**	**Male**	**Female**			
2	Age Category	Below 40 years	41-50 years	51-60 years		
3	Professional Qualification	Mmls	Bmls	Dipmls	Cmls	
4	For how long you have been a Lab technician	Below 1 year	2-5 years ☐	6-10 years	11-15 years	16 years and above
5	How long have you served as a Lab technician in this school	Below 1 year	1-5 years	6-10 years	11 years and above	

Section C: Factors Influencing Performance of Biology

In the table below you are required to answer by ticking your best choice among the following options as stated besides every question given.

Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), and Strongly Disagree (SD)

A FREQUENT BIOLOGY PRACTICAL LESSONS

1	Students who participate in a significant amount of practical work perform better in Biology Exams than those who do not.	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
	• In your own opinion do you believe that more practical will improve overall performance in Biology?..... …… ……					
2	Do you agree students should be left alone to investigate practical issues?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
	• If Strongly Agreed, do you believe they are eligible to perform under no supervisions. **YES ( ) NO ( )**					
B	**Teachers Qualifications**					
1	High Qualified teachers flexibly use different modes of teaching to encourage students' high performance	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
2	High qualified teachers create conducive classroom for learners than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

3	High qualified teachers have enough content mastery to give students than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
4	High qualified teachers possess actual Biology process skills in the Laboratory work than lowly qualified teachers?	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
C	**Laboratory and Inter-Activities**					
1	There is a Positive Impact towards Students Attitude and achievement, due to Lab presence and Practical	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
2	A good relationship between High qualified Lab Technicians, teachers and students encourages fluidity of communication, hence efficiency	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
3	High qualified Lab Technicians work more effortlessly and efficiently	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
4	High qualified Lab technicians create conducive Lab for learners and teachers than lowly qualified Lab technicians	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐
5	High qualified Lab technicians create and teach awareness and safety measures to students than lowly qualified Lab technicians	**SA** ☐	**A** ☐	**N** ☐	**D** ☐	**SD** ☐

Table 22 Lab Tech Questionnaires

Appendix 9: Lab Technician's Interview Schedules

Instructions

Please enter your replies in the areas provided. Please be as **Truthful** as possible in your responses.

Section A: Background

1. **Name of School ……**
2. **Lab technician's Name ……**
3. **Date ……**

Section B: Evaluation

How many Trained Lab technicians are in your staff? ……

How many form-2 biology (practical) students are in each session?.....

How many Biology practical lessons are allocated per week?.....

What is the trend of form-2 Biology Enrolment, as per Practical sessions attendees?

On Increase ( ) Constant ( ) On the Decline ( )

Please explain how the KNEC and Curriculum developers in partnership with the SMASSE projects, have taken the initiative to changing approach in designing more practical lessons? Have you received any training from them, elaborate?.....

…….

……

……..

Which teaching strategy do you think is best suitable for most students in this school? If both, please elaborate?

Lecture method, teacher oriented ( )

Lecture method, student oriented and Practical method ( )

……

……..

What are the main challenges when incorporating different teaching methods?

……

……

In your own opinion and observations, how is the teacher-student relationship in every practical sessions?

……

……

How often does the school administration, intervene in the utilisation and progress of Biology Laboratories?…..……..

……

How is your student-Lab technician-teacher relationship in this school?.....

…….

……..

In your own opinion do you agree that Flexible high qualified Lab technicians work best in constantly changing and new environments? Please specify? ……

……

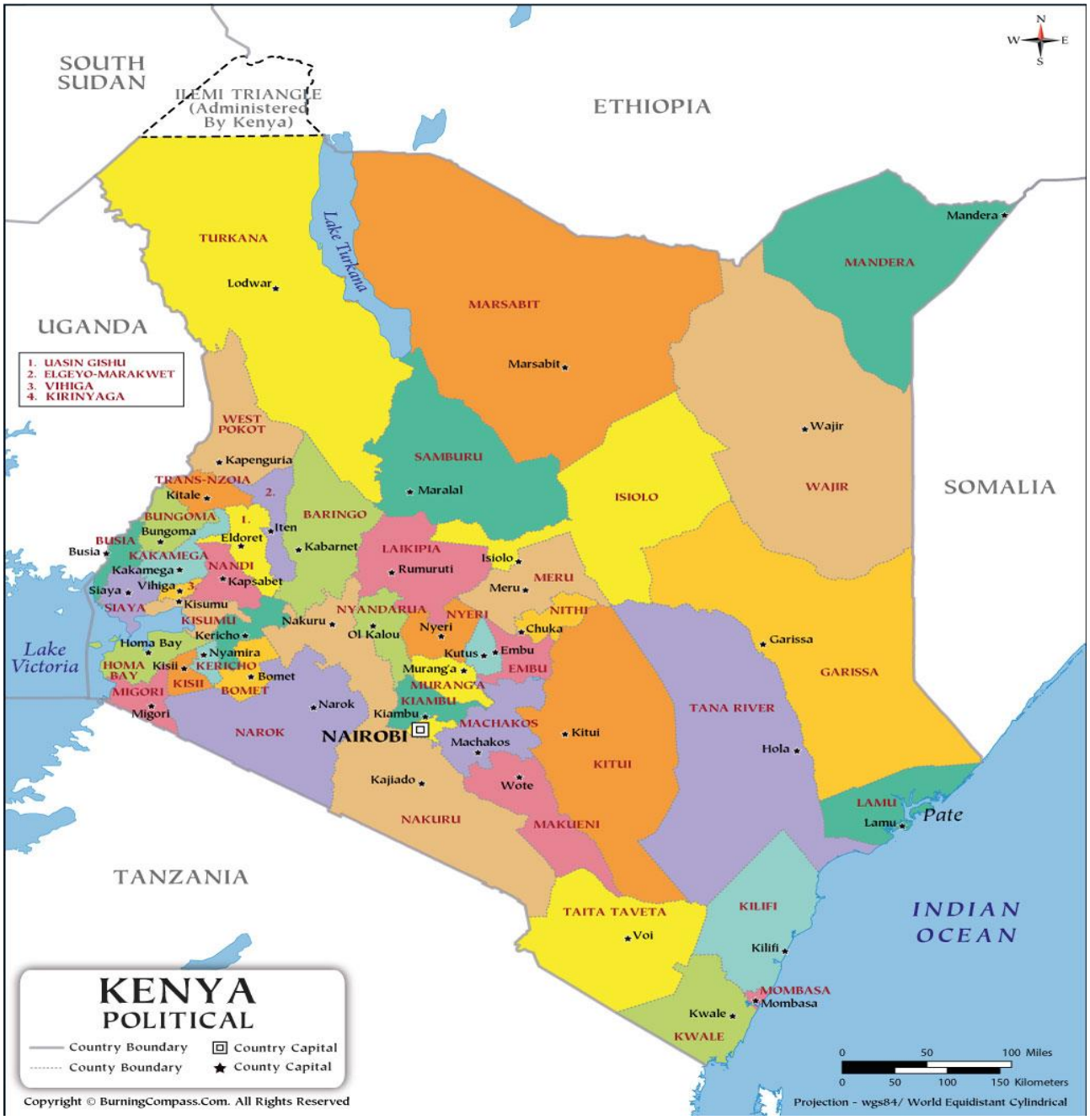
……

……

SECTION: B

Appendix 10: Map of Kenya Showing Counties

Appendix Figure 10.1 Map of Kenya



(BurningCompass, n.d.)

Figure 12 Map of Kenya

Appendix 11: Map of Kajiado County

Appendix Figure 11.1 Map of Kajiado County

(Team e., n.d.)

Figure 13 Map of Kajiado