EFFECTS OF STUDENT'S ATTITUDE TOWARDS BIOLOGY PRACTICAL WORK ON ACADEMIC PERFORMANCE IN TURBO SUB-COUNTY, KENYA

BY

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DECLARATION

Declaration by the Student

This thesis is my original work and to the best of my knowledge has not been presented to any other university for the award of a degree or a diploma.

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SEDU/CTE/M/012/21

Declaration by the Supervisors

This thesis is submitted for examination with our approval as the University supervisors.

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DEDICATION

I dedicate this work to my family for the support and encouragement they gave me.

ABSTRACT

In the last few years, there has been a concerning decline in the performance of students in biology, leading to concerns about their ability to access courses that require satisfactory grades in the subject. Therefore the current study sought to investigate the relationship between students' attitudes towards biology practical work and their academic performance in biology practical tests. The research was conducted in Turbo sub County in Kenya targeting biology teachers and biology students. A total of 23 biology teachers were purposively sampled and 245 students randomly selected in the schools. The data were collected using mixed method approach integrating both qualitative and quantitative data collection. The data collection tools were questionnaires, interview and administering biology practical test to students to determine their performance. The data were subjected to various statistical test including one way Analysis of Variance (ANOVA), t test and Chi-square test. The findings revealed a significant associations between different attitudes towards biology practical work and academic performance ($P<0.05$). In terms of relationship between gender and attitudes towards biology practical work, female students demonstrated a higher inclination towards expressing positive attitudes compared to male students. Notably, school categories based on gender, ownership and administrative/academic characteristic demonstrated distinct attitudes and performance patterns. Femaless' schools had higher academic performance compared to boys' schools in the biology practical test, as well as in the overall Kenya Certificate of Secondary Education (KCSE) results for the year 2022. Private schools had higher percentages of students feeling encouraged and challenged to improve their performance but reported higher levels of test anxiety and technicality compared to public schools. Practical test performance varied significantly across the school categories based on administrative/academic characteristic, with Extra-county schools showing the highest mean performance (9.23 ± 1.2), followed by County schools (6.88 ± 0.9), and Sub-county schools with the lowest mean performance (4.32 ± 0.6). These findings emphasize the need for targeted strategies to address attitudes and foster a conducive learning environment, ultimately improving overall academic performance in biology. Policymakers and educators can utilize these insights to implement effective interventions and support students in their biology education journey, paving the way for better educational outcomes.

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ABBREVIATIONS

CATS	Continuous Assessment Tests
CBC	Competence Based Curriculum
CDE	County Director of Education
K.I.C.D	Kenya Institute of curriculum Development
K.C.S.E	Kenya Certificate of Secondary Education.
KIE	Kenya Institute of Education
KNEC	Kenya National Examination Council
MDG:	Millennium Development Goals.
MoEST:	Ministry of Education, Science and Technology.
SDG:	Sustainable Development Goals
SPSS	Statistical Package for the Social Sciences
STEM	Science technology Engineering and Mathematics
UN:	United Nations
TLR	Teaching Learning Resources
STR	Students' Teacher Ratio

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CHAPTER ONE

INTRODUCTION

1.0 Introduction to Chapter one

The chapter provides a comprehensive background of the study, emphasizing the necessity for the current research. It sets the stage by presenting the statement of the problem, followed by the study's objectives, research questions, justification, and significance of the study. Additionally, it outlines the research hypotheses, assumptions, and scope and limitations of the study. To provide a conceptual understanding, the chapter also introduces the conceptual framework and theoretical framework. Finally, the chapter concludes by offering clear operational definitions of key terms used throughout the study. By organizing the information in this manner, the chapter ensures a smooth and coherent flow of ideas.

1.1 Background information to the study

Globally, scientific and technological growth is advancing rapidly. However, there is a growing concern about the declining interest of students in science courses and careers. In response to this concern, efforts to reform science education on a worldwide scale have been initiated. The impact of students' attitudes toward science is crucial, considering the increasing integration of technology into all sectors of the economy. Research studies in the United States have focused on strategies to enhance the quantity and quality of science education (Sakariyu *et al*., 2016). Science education's significance in the development of any nation is evident through the success of science and technology in developed countries, exemplified by the Russians launching Sputnik in 1957, which was made possible by their strong emphasis on physics education (Ndonga, 2019). As a result, science education in the

United States emphasizes real-world observation, manipulation, and experimentation (Hussaini, 2016).

This study specifically centres on biology, a subject that consistently demonstrates poor performance globally, despite its importance for numerous careers in fields like Medicine, Zoology, Botany, and many more. The issue of poor performance in Biology is not limited to a specific region but is a global concern, as evidenced by research from the United States, Canada, Portugal, Jamaica, and various countries in Africa (Valverde & Schmidt, 2017; Landry, 2018; Fonseca & Conboy, 2016; Blair-Walters & Soyibo, 2004; Majo, 2016). Additionally, the performance of Biology among secondary school students in East Africa, Africa, and globally has been on the decline (Majo, 2016). The consistent poor performance has raised significant concerns among educators and stakeholders in the global education sector.

In Africa, the attitude of students has been identified as a significant factor negatively affecting their proficiency in biology practical. Biology holds a crucial position as one of the core subjects in secondary school curricula across the continent and is mandatory for admission to quality tertiary institutions. However, despite its importance, poor grades are often observed in this subject, with students' attitudes playing a key role in their overall performance. For instance, a study conducted in Botswana assessed students' attitudes toward practical work and found that their attitude toward practical activities influenced their achievement in biology, while their attitude toward the interest and difficulty of practical work did not have a significant impact (Hinneh, 2017). Similarly, in Namibia, biology teachers encounter various challenges in ensuring students excel in the subject, including a lack of apparatus for conducting practical activities (Kambaila *et al*., 2019).

Furthermore, a study conducted in Ogun State, Nigeria, explored students' attitudes toward science and found that a higher proportion of students displayed a positive attitude toward science, with no significant difference between the attitudes of male and female students (Sakariyu *et al*., 2016). The study also revealed that students in private schools exhibited a more positive attitude toward biology compared to their counterparts in public schools. Several factors contribute to this discrepancy, including inadequate preparation at lower educational levels, weak mathematical backgrounds, limited job opportunities outside the teaching profession, inadequate teacher qualifications, and below-standard pedagogical content knowledge (Akinmade, 2018). Addressing these attitudes and challenges is crucial for improving biology education in Africa and fostering a generation of students who excel in this vital subject.

In Kenya, the performance of students in Biology, as measured by the KCSE mean scores, has been consistently low across the country (Kiilu *et al*., 2022). This has led to public outcry and debates over the massive failure, particularly in science subjects like biology (Michira, 2017). One possible cause of this poor performance is attributed to the change in the question format, which has shifted from focusing on students' ability to an analytical approach. However, the preparation among candidates has not adapted to this change, as students are expected to apply their acquired knowledge rather than merely memorizing information. Feedback from teachers suggests a deliberate shift that may undermine the country's education system through unfair grading of candidates. Other potential causes for the poor performance include teaching skills in preparation for examinations, a disconnect between student abilities and the questions set, strict marking, and inconsistent grading. A study conducted in Nakuru County found that poor biology performance within Nakuru

East Sub County was influenced by low teacher qualifications, which subsequently affected student attitudes (Orina *et al*., 2022). As a result, the study recommended that teacher qualifications be improved and that positive attitudes be fostered in order to improve student performance in biology.

The goal of national education policies is to provide learners with basic practical skills for self-reliance and employment. To that end, the Kenyan government has begun a transition in the education system from the 8-4-4 system to a competency-based curriculum (CBC) designed by the Kenya Institute of Curriculum Development (KICD). The CBC places a greater emphasis on hands-on learning, recognising the importance of hands-on activities in science teaching and learning in secondary schools. Students gain first-hand experience and a deeper understanding of scientific concepts through practical activities (Akinmade, 2018).

Several initiatives have been launched in Kenya to address the challenges of poor performance in biology education. The Strengthening of Mathematics and Sciences in Secondary Education (SMASSE) project was initiated by the Ministry of Education (SMASSE baseline report, 1998). The programme has spent the last two decades focusing on in-service capacity building for math and science teachers. However, biological results show that performance has not improved as expected. This persistently poor performance raises concerns about the impact of students' attitudes towards the subject. The overall low performance in science, and particularly in biology, among the four finalists (KCSE), continues to be a major source of concern for stakeholders, especially in an era of urbanisation and globalisation, where modern biology faces a variety of socioeconomic and environmental challenges. The current study aims to bridge this gap by investigating learners' attitudes towards practical

lessons and examining the effects on their performance in biology in Turbo Sub-County, Kenya.

1.2 Statement of the problem

In the last half a decade, the Kenya National Examination for Secondary Education (KCSE) results have consistently revealed poor performance in biology (KNEC, 2018-2022). The poor performance can be attributed to a number of factors, including ineffective science teachers, overcrowded classrooms, a lack of science equipment, and negative student attitudes towards biology and practical science (Ngakhala, 2021). Practical biology work is necessary for gaining practical experience and developing scientific skills. There is growing concern, however, about the impact of students' attitudes towards practical work on academic performance. While there is evidence that pupil interest in science is declining (Bennett 2005; Doherty & Dawe 1988; Abrahams, 2009) found that nearly half of attitudinal claims about practical work were simply statements of relative preference. A study that examines how attitudes change throughout compulsory secondary science education is yet to be conducted. While research suggests that teachers believe practical work has a positive impact on students' attitudes (Holstermann *et al*., 2009), students have rarely been asked to express their thoughts on practical work in isolation from science lessons in general. As a result, the current study sought to fill a research gap (by encouraging students to express their opinions) by investigating the relationship between students' attitudes and academic performance in Turbo Sub-County, Kenya. Understanding the impact of attitudes is critical for improving regional science education. Negative attitudes can stifle engagement and interest, resulting in poor academic performance. Investigating attitudes-influencing factors like perceived relevance and enjoyment of

practical work will provide valuable insights into how attitudes shape learning outcomes.

1.3 Broad objective

The aim of this study was to examine the learners' attitude towards practical lessons in biology and its impact on their performance in Turbo Sub-County, Uasin Gishu County, Kenya. The ultimate goal was to promote practical learning and cultivate a positive attitude among students towards biology lessons, thereby enhancing their overall performance in the subject.

1.4 Specific objectives

(i) To investigate the effect of students' attitudes towards practical work and their academic performance in biology.

(ii) To find out the student's attitudes towards biology practical work per school category and their academic performance in biology.

(iii) To investigate gender attitudes towards biology practical and the influence on academic performance in biology subject.

1.5 Research Hypothesis

The study was guided by the following research hypothesis;

$H0_1$. There is no significant relationship in student's attitude towards biology practical work and academic performance.

$H0_2$. There is no relationship between school category attitude and academic performance in biology.

$H0_3$. Gender attitude towards biology practical work does not influence the academic performance in biology.

1.6 Rationale of the study

The Kenyan education system has been a subject of frequent criticism due to its failure to adequately prepare students for the job market, resulting in many graduates being ill-equipped to meet employment demands. Consequently, a significant number of students find themselves unemployed and struggling, particularly in rural areas. Moreover, the current education system has been accused of promoting rote learning, disregarding learners' aptitudes and abilities for higher education and vocational training. In light of this, biology, as a science subject encompassing the study of life and its applications in medicine, agriculture, food security and modern biotechnology. However, it is essential to recognize that learners bear the ultimate responsibility for their own learning, as they determine the level of attention they dedicate to tasks, construct their interpretations of meaning, and evaluate their understanding accordingly (Driver & Bell, 2016).

Individual attitudes towards a subject or object have a significant impact on how they perceive its value. Attitudes shape judgements, determining whether something is good or bad, harmful or beneficial, pleasant or unpleasant, and important or unimportant. Given the impact of attitudes on the learning process, it stands to reason that students' attitudes towards biology can have a significant impact on their academic performance. Existing research on students' attitudes towards biology, on the other hand, has not adequately linked these attitudes to their performance in practical work. Despite the identification of various attitudes, the relationship between these attitudes and academic performance is largely unknown.

While research on secondary school students' attitudes towards sciences, particularly in Kenya, has shown that attitudes have a significant influence on academic performance, there is a critical gap in understanding how students' attitudes

specifically affect their performance in biology practical work. While biology is widely recognised as an important subject with numerous applications in fields such as medicine and industry, it is required in many secondary schools across Kenya. Surprisingly, little research has been conducted into the relationship between students' attitudes towards biology and their practical performance in this subject.

As a result, the study sought to investigate the specific attitudes that students hold towards practical biology, as well as how these attitudes influence their engagement, learning outcomes, and overall performance. By conducting a comprehensive study on this topic, educators and policymakers can gain valuable insights into the factors that influence students' practical work performance in biology. This knowledge can then be utilized to develop targeted interventions and teaching strategies, enhancing students' interest, motivation, and understanding in biology practical's, ultimately contributing to improved academic achievement and better-prepared graduates for the demands of the job market.

1.7 Significance of the study

The academic atmosphere in Kenyan schools is often disrupted by a range of challenges, including psychological problems such as anxiety, phobia, mental health issues, poor academic performance, examination irregularities, and moral decadence. These issues not only impact syllabus coverage but also have a psychological effect on students, potentially leading to decreased academic achievement. Therefore, this study holds significant value for various stakeholders in education, including educationists, psychologists, teachers, school management, the Ministry of Education, Kenya National Examination Council (KNEC), students', and researchers who recognize the influence of students' attitude on education.

The findings of this study can be utilized by the Ministry of Education and policy makers to make informed decisions regarding the evaluation process within the ongoing competence-based curriculum (CBC) implemented in the Kenyan education system, with a specific focus on the practical aspect. Policymakers can develop policies that incorporate the motivational beliefs of both teachers and students in the education system. Additionally, the study may inspire the creation of programs aimed at addressing and reversing the negative attitude towards biology as a subject. Lastly, the study's results can be documented for future reference, particularly by researchers conducting studies in similar areas. Furthermore, the information can be valuable for the Ministry of Education and education stakeholders as they strive to review and implement significant changes in the education system, specifically within the competence-based curriculum (CBC).

Educators can benefit from understanding the factors contributing to positive or negative attitudes, guiding instructional strategies to promote positive attitudes and engagement. Policymakers can use the findings to inform science education policies, curriculum development, and resource allocation in Turbo Sub-County, Kenya. The study also aims to identify challenges students face in engaging with biology practical work, like limited resources or inadequate teacher training, enabling the design of practical activities that cater to specific needs. Ultimately, the study's results will contribute to enhancing biology education in Turbo Sub-County, creating an engaging and effective learning environment to promote students' success in biology.

1.8 Scope of the study

This study conducted a targeted examination of secondary schools in Turbo Sub County, with a particular emphasis on key stakeholders, including director of studies, biology teachers, and form four biology students. Both public and private secondary

schools were included in the research. The study primarily sought the perspectives of biology teachers and students engaged in biology as an elective subject, excluding input from other parties, such as parents. Moreover, it was confined to both single-sex and coeducational secondary schools located within Turbo Sub-County, Kenya. It's important to note that the study specifically focused on the context of the 8.4.4 education system.

1.9. Limitation of the study

The majority of respondents attended mixed-gender schools, with a smaller subset attending single-sex schools. This demographic distribution has the potential to bias the final research findings. Financial constraints influenced the study, resulting in a single administration of the practical test rather than multiple administrations. The study was conducted from August to December 2022, time which, students were preparing for exams, which limited the time available for some students to fully participate in the research. The study's primary goal was to investigate the impact of attitudes, gender, and school category on students' academic performance. It should be noted, however, that we relied on KCSE general results, which may not accurately reflect students' performance in KCSE practical assessments.

1.10. Assumptions of the study

The study was grounded on several foundational assumptions, providing a solid framework for the research. These assumptions serve as guiding principles and shape the direction of the investigation. By recognizing these assumptions, the study establishes a strong foundation for its findings and interpretations.

(i) In all the selected schools, there was a functional laboratory facility equipped with the necessary equipment to conduct practical work in biology hence no variation in terms of access to laboratory equipment.

(ii) The teachers responsible for administering the treatment were qualified in biology education, ensuring their expertise in the subject matter.

(iii) The students across the different schools had covered the topic in which the biology practical test was administered.

(iv) The practical assessments were well-designed, moderated, and properly administered to ensure fairness and accuracy.

1.11 Theoretical framework

1.11.1 Observational Learning and Modelling

Social Cognitive Theory posits that individuals acquire knowledge and behaviour not only through direct experience but also through observational learning or modelling (Bandura, 1997). In our research context, this implies that students within Turbo Sub-County may observe their peers, instructors, or influential role models engaging in biology practical work. Through these observations, students may form impressions and attitudes towards practical work based on the outcomes and experiences they witness. Positive modelling of practical work may lead to more favourable attitudes and motivation to engage actively in similar activities.

1.11.2 Self-Efficacy Beliefs

A central tenet of Social Cognitive Theory is the concept of self-efficacy, which pertains to an individual's belief in their capacity to successfully execute a particular task or behaviour (Bandura, 1997). In the context of this research, students' attitudes towards biology practical work can be closely connected to their self-efficacy beliefs

(Schunk, 2012). A positive attitude towards practical work may be indicative of higher self-efficacy, signifying that students believe in their ability to excel in these tasks. Such heightened self-efficacy can, in turn, positively influence their academic performance.

1.11.3 Reciprocal Determinism

The theory posits that personal factors, behaviours, and environmental factors interact reciprocally and dynamically. In our study, we acknowledge the interplay between students' attitudes, their experiences with biology practical work, and the surrounding educational environment. This reciprocal determinism suggests that attitudes can both influence and be influenced by the experiences and feedback students receive, further emphasizing the significance of assessing this relationship.

1.11.4 Outcome Expectations

Social Cognitive Theory also underscores the importance of outcome expectations, which involve individuals' assessments of the potential consequences of their actions (Schunk & Usher, 2019). Within our research scope, students' attitudes are examined in light of their expectations regarding the outcomes of engaging in biology practical work. If students perceive that participation in practical work can lead to improved academic performance, they may be more likely to develop positive attitudes towards these activities.

1.12 Application in Research

In the present research, Social Cognitive Theory served as a guiding framework through which we analysed the intricate relationship between students' attitudes towards biology practical work and their academic performance. Specifically, it aids in the design of our data collection methods, allowing us to assess factors such as observational learning, self-efficacy beliefs, and outcome expectations among

students in Turbo Sub-County. This theoretical framework facilitates a deeper understanding of the cognitive and behavioural processes underlying the connection between student attitudes, practical work engagement, and academic outcomes. Moreover, it provides a structured approach to explore the role of role models, feedback mechanisms, and interventions in influencing students' attitudes and, subsequently, their academic performance in the context of biology practical work. In general, the incorporation of Social Cognitive Theory into our research framework enhances the rigor and depth of our investigation, allowing us to delve into the complex interplay of cognitive, behavioural, and environmental factors within the educational landscape of Turbo Sub-County, Kenya.

1.13 Conceptual framework

This study aims to examine the relationship between attitudes towards practical work in biology (the independent variable) and students' academic achievement in biology (the dependent variable). These variables are illustrated in (Figure 1.1), indicating their interconnection. The independent variables in this study include gender, learners' attitude, and school category. On the other hand, the dependent variables are biology performances and practical. There exists a correlation between the independent and dependent variables within this study.

The findings of the study reveal that student attitudes, regardless of their school category (private or public), significantly impact their performance in biology experiments and overall achievement in this critical subject. Additionally, gender is another independent variable of interest, as attitudes towards biological practical’s differ based on whether the student is male or female. This difference in attitude also affects their performance in biological practical’s. Furthermore, the study identifies two intervening variables: teachers' qualifications and the availability of laboratory

apparatus in schools. These variables are considered as intervening because they have a substantial influence on whether students develop a positive or negative attitude towards biological practical's, as well as improve their performance in the Kenya Certificate of Secondary Education (KCSE).

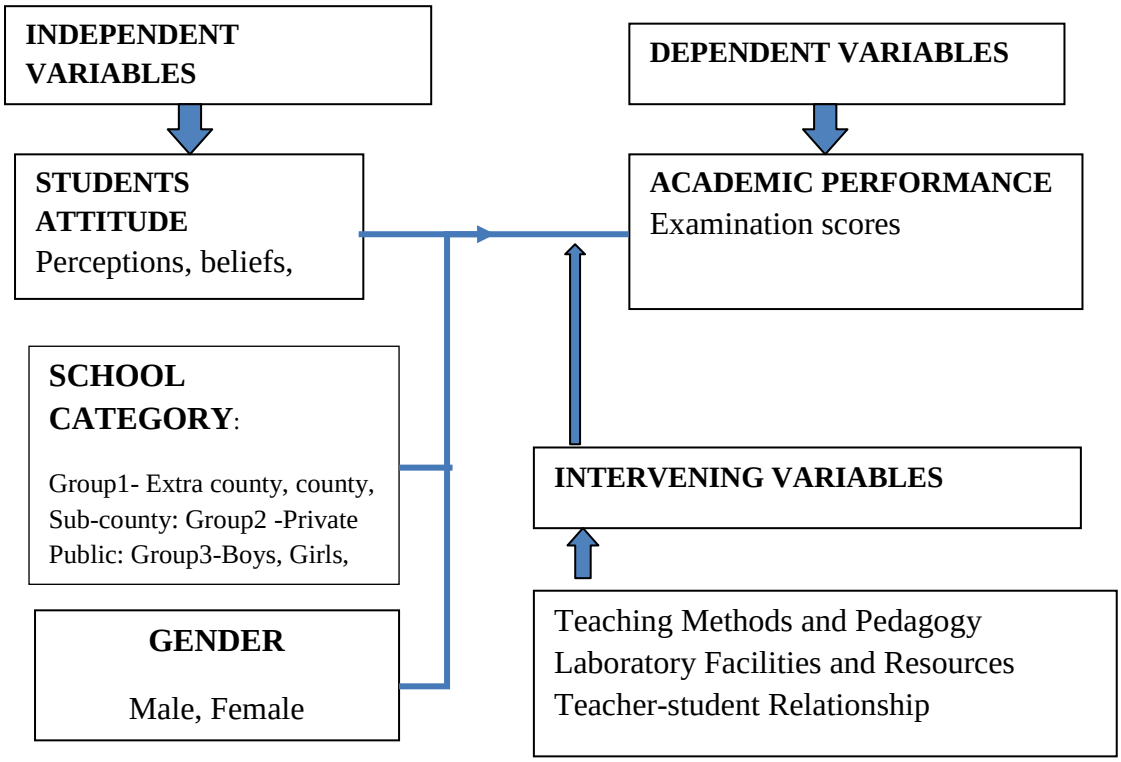

Figure 1. 1: Conceptual framework of the study

1.14 Operational definitions terms

In order to ensure clarity and consistency throughout this study, it is essential to define the key terms and their corresponding meanings. By providing explicit definitions for these terms, the study establishes a common understanding and avoids potential misinterpretations.

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

Biology achievement: - This refers to the knowledge of biology, facts, conceptions, skills and principles as measured by biology evaluation tests. In this study form four results obtained from the Kenya National Examination Council were used. They were compared with the scores obtained from the attitude scale scored by the same students to establish their correlations.

Academic performance: - Academic performance refers to a student's level of achievement, typically measured through practical test assessments and main examinations i.e. KCSE.

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

School category: - This refers to the grouping of schools based on the rank nationwide.

In this study, there were three categories of schools i.e. Extra-County, County and Sub-County schools: School categories based ownership -private, public: Based on gender-girls, boys and mixed schools.

Scientific attitude: - is linked to the way of thinking or scientific method, which covers the skills and is related to the undertaking of practical work.

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

Type of school: - This refers to a class of schools based on the kind of sex of students present. In the study, schools are of three type's namely single girl schools, single boy schools and mixed school (with both male and female students).

1.15 Chapter summary

This chapter serves as the foundation for the study, providing a comprehensive background and context. It outlines the main purpose, objectives, and research hypotheses, setting the stage for the research. Furthermore, it delves into the significance and justification of the study, while also addressing the assumptions and limitations that underpin the research. The chapter elucidates the theory on which the study is anchored, offering a theoretical framework to guide the investigation. Additionally, it includes the operational definition of key terms to ensure clarity and consistency in their usage. Lastly, the chapter presents the conceptualization of the study's variables, establishing a clear understanding of the constructs under investigation.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction to the literature

Mugenda and Mugenda (2003) emphasize the importance of conducting a systematic review of related literature. This process involves identifying and analysing documents that contain pertinent data and information relevant to the research topic being investigated.

The purpose of this literature review is to investigate and analyse various objectives concerning the impact of gender attitudes and school category-related attitudes on biology performance, particularly in the context of practical work. Understanding the dynamics of gender attitudes towards practical biology work is critical because it allows us to investigate the potential impact of social constructs on students' engagement and performance in science education. By contrasting students' attitudes in single-sex and mixed secondary schools, we can learn how the presence of a specific gender environment influences biology performance as well as students' overall interest and participation in practical laboratory work. Furthermore, the impact of school category-related attitudes towards practical lessons on biology performance is an important factor to consider. Different schools may take different approaches to practical work, and understanding how these attitudes affect students' learning outcomes can help improve science education strategies. Investigating the relationship between school-category-related attitudes and performance in biology can provide valuable insights into the effectiveness of various teaching methods and environments.

Lastly, examining students' attitudes towards biology practical work and their impact on performance is crucial for understanding the role of individual perspectives in the learning process. By determining the influence of students' attitudes towards practical work, educators and policymakers can identify potential barriers or facilitators to effective learning experiences. This knowledge can then be used to develop targeted interventions or instructional approaches that foster positive attitudes towards practical work, ultimately enhancing students' overall performance in biology and finally the summary of the literature reviewed.

2.2. Empirical studies

2.2.1. Impact of student attitude on biology practical performance and academic achievement

The concept of attitude is a complex and unique one, encompassing the cognitive, affective, and psychometric aspects of learning. Hinneh (2017) defines attitude as a state of readiness or predisposition to respond in a certain way when confronted with stimuli. While Fareo (2019) defines attitude as a mental and neutral state of readiness influenced by experience that influences an individual's response to objects and situations. According to Driver and Bell (2016), a learner's attitude is their state of mind, which influences their personal actions. In general, attitude refers to a person's proclivity to think, feel, or prefer something based on their beliefs about it. In the context of this study, promoting practical skills, using appropriate teaching methods, and having skilled and innovative science teachers may all contribute to secondary school students having a positive attitude towards biology practicals (Iliyasu, Lee, & Yahya, 2015). This, in turn, could lead to better academic performance in this subject. Furthermore, the inclusion of general science in Kenyan secondary schools allows students who struggle with specific science subjects to select alternative subjects with

more manageable content coverage. A positive attitude activates an individual's thinking, feeling, and reacting components, which improves student performance. A negative attitude, on the other hand, contributes to a lack of motivation and hinders academic performance in students due to limiting beliefs and negative thinking.

According to Oluwatelure (2015), negative attitudes are self-defeating and cause a variety of problems in life. As a result, students' understanding and academic performance can suffer as a result of a negative attitude towards biology, causing them to lose interest in classroom activities and become susceptible to distractions (Owino, Osman, & Yungungu, 2014). For the past 30-40 years, science education researchers have been investigating students' attitudes towards studying science (Osborne, 2003). Musasia, Abacha, and Biyoyo (2012) conducted a study in Kenya with two groups of girls from three medium-performing schools to investigate this relationship. In their second year of secondary school, the experimental and control groups were given pre- and post-tests to compare their achievements, attitude development towards biology, science process skills learned, and desire to pursue the subject further. The experimental group outperformed the control group across all research objectives, according to the researchers. The use of a homogeneous group of female students from only three schools, on the other hand, did not account for differences in ability. Because attitudes can be influenced by factors not explicitly targeted in the study, the intervention, which covered only two topics from each term, was insufficient to draw definitive conclusions. Given that it was an academic intervention, it would have been more conclusive if a diverse group had been included and all practical topics in the syllabus had been covered. Sharpe (2012), on the other hand, conducted a study to investigate the role of practical work in determining students' attitudes towards school science and science outside the classroom. The

study used data from three English secondary schools and included field trips with students in grades 9 and 10. Sharpe discovered that practical work influenced students' positive attitudes, particularly in the cognitive and affective domains. Throughout the research, it became clear that while many students enjoyed practical work and recognised its importance, they rarely considered it as a career option. Jenkins and Nelson, (2005) conducted a similar study and found that while students acknowledged the importance of science; they were not attracted to it as a career worth pursuing. However, Mordi, (2019) discovered that, in general, practical work enhanced students' attitudes toward learning science. Sharpe (2012) found that students enjoy doing practical work and that laboratory experiences foster positive attitudes and increased interest in science. Nonetheless, a clear relationship between students' attitudes and practical work remains elusive, despite these studies. According to Morris (2000) and Hussain & Akhtar (2013), the primary goal of science education is to instill a sense of delight and commitment in students, encouraging them to pursue science studies beyond secondary school. However, the impact of practical work on students' scientific achievement remains a hotly debated topic within the scientific community and research field. Hussain and Akhtar (2013) compared an experimental group that was taught using practical hands-on activities to a control group that received traditional instruction in their study involving 342 students. They discovered that engaging students in practical, hands-on activities can boost their science achievement. Their study, however, did not determine whether or not there was a significant difference in achievement between the two groups. Furthermore, relying solely on science achievement tests is insufficient for determining student success. Similarly, Kalender and Berberoglu (2009) discovered that student participation in practical activities did not correlate with achievement

measures. These findings agreed with those of Odom, Stoddard, and LaNasa (2007), who studied 611 seventh and eighth grade students. The study found that frequent incorporation of practical activities had the greatest positive impact on students' science achievement. These studies, however, were primarily concerned with immediate observations and did not guarantee that students would pursue science careers beyond secondary school.

2.2.2 The impact of school category on academic performance in biology

Secondary school students' attitudes towards biology performance are critical to their academic achievements and future career paths. Multiple factors, including the type of school they attend, can influence their attitudes. Many educational systems divide schools into tiers based on their location, resources, and academic standards. The purpose of this literature review is to investigate the effects of school categories, specifically extra-county, county, and sub-county schools, on attitudes towards performance in biology among secondary school students. Extra-county schools are distinguished by higher academic standards, cutting-edge infrastructure, well-equipped laboratories, and qualified teachers. Several studies have looked into the effects of extra-county schools on students' attitudes towards biology performance. According to research, students who attend extra-county schools have more positive attitudes towards biology than their counterparts in other school categories. Extra-county schools provide a stimulating learning environment by providing state-of-the-art laboratory facilities, resources, and experienced biology teachers. This environment encourages students' curiosity, enthusiasm, and motivation, resulting in more positive attitudes towards the subject. According to DFID (2007), three critical components of teaching and learning resources (TLR) are physical facilities, human resources, and material resources.

TLR adequacy refers to the sufficiency of material resources, physical facilities, and human resources in terms of both quality and quantity. The accessibility and adequacy of instructional materials, particularly textbooks, have a significant impact on students' performance in a given subject (Padmanabham, 2001). Inadequate TLR can cause instructors to treat science subjects like biology as abstract and uninteresting, which has a negative impact on student engagement. Proper personnel, physical facilities, and instructional materials planning and allocation are critical to supporting educational efforts. TLR scarcity, such as textbooks, libraries, computer laboratories, and science laboratories, can impede the education system's ability to respond effectively to emerging demands (Coombs, 1970). Better learning materials, physical facilities, and human resources are required to improve the quality and efficiency of education, particularly in county and sub-county schools where resource constraints are more prevalent. Recent research has looked into the sufficiency and distribution of TLR, as well as their effects on students' attitudes and performance in exams like the KCSE.

These studies have revealed the scarcity of TLR in schools, particularly in sub-county schools, posing a challenge to educators and students' attitudes towards subjects. Momoh (2010) discovered that TLR has a significant impact on students' performance and attitude in examinations in her study on the impact of instructional resources on education. TLR was made available due to students' positive attitudes and concrete understanding of science concepts, which discouraged rote learning. TLR inadequacy jeopardises the educational process, resulting in negative attitudes and lower performance among students. Adeogum (2001) discovered a strong positive relationship between academic performance and teaching resources. When compared to schools with insufficient TLR, schools with more resources tend to perform better.

Textbooks, charts, audio-visual materials, and electronic resources are examples of material resources in biology. Similar research by Babayomi (1999) and Mwiria (1985) supports the idea that the quality and quantity of TLR have a significant influence on students' attitudes and performance.

Schools that have adequate facilities, such as textbooks, outperform their less well-equipped counterparts in examinations. Poor academic performance and negative attitudes are linked to inadequate equipment and learning materials. The adequacy of teaching and learning resources determines whether an education system succeeds or fails. The students-to-teacher ratio (STR), which indicates the number of students assigned to each teacher, is one method of determining teacher adequacy. STR can assist in determining whether available resources are being underutilised or overutilized (Afolabi, 2005). Human resources include both teachers and non-teaching personnel. A sufficient number of human resources, particularly teachers, should be employed to ensure successful performance in biology practicals, particularly in sub-county schools.

2.2.3. Link between gender and performance in biology: Assessing practical and academic achievement

The development of knowledge and skills in science is increasingly necessary for all students, as these skills are vital for individuals and nations to compete in the global market. Oluwatelure, (2015) discovered gender differences in attitudes towards science, evident in variations in course enrolment. Separating boys and girls in the classroom according to many supporters of single-sex education, boosts pupils' academic achievement and engagement. It should be mentioned that other supporters believe that single-sex education should be a choice for families that are interested,

regardless of the consequences. However, in this instance, accurate evidence on whether single-sex programs produce better results than mixed gender education programs is required for parents and school districts making the decision. Because single-sex education is expensive and difficult to implement in public schools (Datnow, Hubbard & Woody, 2001; Pahlke *et al*, 2012), the question of whether it enhances student results is still crucial.

The most popular perspectives are (a) beliefs that gender differences in psychological characteristics relevant to learning are significant and/or biological in nature; (b) social psychological and "girl power" approaches that highlight the detrimental effects of sexism in coeducational classes and (c) views that single-sex schooling increases students' achievement and interests. As mentioned above, some proponents of single-sex education make the biological difference argument that boys and girls perform better when they receive instruction that is tailored to the significant biological differences they believe exist between boys and girls (Gurian *et al*., 2001; Sax, 2005). According to this viewpoint, thousands of teachers have participated in training sessions offered by the National Association for Public Single-Sex Education and the Gurian Institute to learn how to instruct to the supposedly distinct learning styles of boys and girls (Gurian, Stevens & Daniels, 2009). Other proponents of single-sex education embrace what we refer to as the "girl power" perspective, which justifies segregating boys and girls from coeducational classrooms due to the issue of domineering boys.

Boys typically seek out and get the majority of the attention from teachers in mixed gender classrooms, especially in math and science (Lee, Marks & Byrd, 1994). Additionally, educators are concerned that males' sexist attitudes and actions would

discourage girls from pursuing traditionally male-dominated STEM disciplines (Lee *et al*., 1994; Sadker & Sadker, 1994; Sadker, & Zittleman, 2009). Shapka & Keating, (2003) asserts that, male-free classrooms, are more conducive to girls' academic success in counter-stereotypical subjects. According to this logic, single-gender classes empower females (hence the term "girl power") by allowing girls to gain self-confidence in math and science. Social setting and social interaction, according to social psychologists, play a critical role in influencing students' behaviour (Rudman & Glick, 2008).

Hopkins (1997), a third group of proponents of single-sex education, focuses on the alleged benefits for low-income American boys of African American and Hispanic descent. This approach combines theoretical perspectives that emphasise social consequences and inherent differences. According to supporters, discipline issues have decreased and academic emphasis has increased in many low-income, predominantly minority all-boys schools (Riordan, 1994). From a social psychology standpoint, supporters point to negative stereotypes, low standards, and a lack of student and adult role models in coeducational schools (McCIus Key, 1993; Riordan, 1994; Singh, Vaught & Mitchell, 1998). These educators are hoping that schools for minority and low-income boys will address these concerns.

Lower achievement scores, according to Kibirige and Tsamago (2013), result in fewer female students pursuing science-related careers; additionally, fewer female students enrol in elective science classes. Several studies have looked into the differences in perception, attitude, and achievement in science between boys and girls. Science process skills, which are necessary for the workforce, are systematically developed (Twoli, 2006). Abstract ideas can be concretized through practical biology, which

motivates students to learn physics (Osborne, 2003). Students excel in activity-based courses that allow them to manipulate equipment, allowing them to gain a deeper understanding of the material. Millar (2004) proposes using practical work to engage biology students in critical thinking and to validate the scientific worldview. Developing critical thinking skills early in biology places students at the centre of learning, allowing for active participation and cultivating a desire to learn more about the subject.

The attitude of a student towards a school subject has a significant impact on the learning process (Ndonga, 2019). Students' attitudes towards biology have intrinsic educational value and influence their chemistry achievement. Njuguna (2008) investigated the link between Form 4 students' attitudes towards science and academic achievement. In the physical sciences, a positive and significant relationship was discovered among the study group, leading to the recommendation that teachers promote positive attitudes in students. Banu (1985) discovered that 69% of secondary school students in Nigeria preferred science courses, with 70% expressing interest in science-related subjects in a separate study on secondary school students. The findings also revealed that male students had a more positive attitude towards science than female students.

Physical science, according to Kibirige and Tsamago (2013), is frequently perceived as challenging, difficult, and analytical, reinforcing the notion that science is more masculine. This perception is reflected in the levels of participation of both teachers and students. Ndonga (2019) investigated the impact of student attitudes towards science on 450 eighth-grade students at a New York Junior High School. The majority of students had positive attitudes, with boys showing more interest in science than

girls. Lee and Lockheed (1990) studied perceived ability and gender differences in science achievement with 1012 students from single-sex and mixed-sex secondary schools in Nigeria's Ten Southern States. Their findings revealed that perceived ability was positively related to higher achievement, especially among male students. One's attitude towards a subject appears to be a significant predictor of success in that field. A girl's prior positive attitude, the development of a positive attitude by teachers, or a strong positive attitude towards science all play important roles in determining whether she will pursue a scientific career (Mordi, 2019).

The above presumptions have been explained to instructors in manuals and teacher-training programs (Gurian *et al*., 2001). These presumptions would probably affect the outcomes of single-sex schooling, especially if they are communicated to instructors, students, and parents. For instance, teachers, students, and parents are frequently reminded openly that a goal of the school is to enhance girls' participation in STEM fields and to combat gender bias at all-girls schools with a "girl power" perspective. Schools that adopt a biological approach, in contrast, may promote gender-essentialist thinking through parent and teacher workshops, as well as student-led discussions about the alleged distinctions between the preferences and learning styles of boys and girls.

2.3 Gaps in literature

Despite a substantial amount of literature focusing on the various factors contributing to failure and non-performance in biology subjects among secondary school students, there has been a noticeable lack of research on the students' attitudes towards biology practical’s and how these attitudes influence their performance in the subject. As a result, the objective of this study was to examine the attitudes of learners towards

practical lessons and explore their impact on biology performance in Turbo Sub-County, Kenya.

2.4 Summary of literature reviewed

In the rapidly changing global landscape, scientific knowledge and skills are essential for individual and societal success (Abrahams & Millar, 2008). Notably, gender differences in attitudes towards science have been observed, leading to variations in course enrolment. This literature review explores the attitudes of students towards biology practical work in both single-sex and mixed secondary schools and the potential impacts on academic achievement. One widely debated approach in education is single-sex schooling, with proponents arguing that it enhances academic achievement and engagement (Rudman & Glick, 2008). Some supporters believe that instruction tailored to perceive biological differences between boys and girls can lead to better outcomes (Gurian *et al*., 2001; Sax, 2005). In contrast, others adopt a "girl power" perspective, advocating for single-sex classrooms to combat gender bias and improve girls' academic success in STEM disciplines. Additionally, some proponents focus on the alleged advantages for low-income boys of African American and Hispanic descent in single-sex schools, combining social impact and intrinsic difference theories (Hopkins, 1997).

Boys and girls differ in their perception, attitude, and achievement in practical biology, according to research. Biology practical work has been recognised as a means to engage learners in critical thinking, foster scientific interest, and encourage active participation (Twoli, 2006). Positive attitudes towards practical biology have a significant impact on students' academic performance in this subject. Girls, in particular, have lower interest and achievement in science-related careers, which can

be attributed to societal perceptions of science as a male-dominated field (Ndonga, 2019). Students' attitudes towards performance in biology practicals are influenced by the categorization of schools into extra-county, county, and sub-county schools. Extra-county schools, which are known for having higher academic standards and more resources, provide a stimulating learning environment that fosters positive attitudes towards the subject. County and sub-county schools, on the other hand, frequently face resource constraints, which affect student attitudes and performance in biology practicals (Momoh, 2010).

Teaching and learning resources (TLR), including physical facilities, human resources, and material resources, play a critical role in shaping students' attitudes and performance in biology (DFID, 2007). Schools with sufficient TLR outperform those with limited resources in terms of exam performance. The students-to-teacher ratio (STR) is an important indicator of teacher adequacy because it influences students' practical learning experiences and overall attitudes towards biology (Padmanabham, 2001). Attitude is a multifaceted concept that encompasses cognitive, affective, and psychometric aspects of learning. Positive attitudes towards practical biology work can lead to higher academic achievement, whereas negative attitudes can impede comprehension and motivation. Although practical biology work has been shown to foster positive attitudes and interest in science among students, its long-term impact on career choices is still being debated.

This literature review investigates the intricate relationship between gender attitudes, school categories, and practical work in biology. The study aims to encourage interest and excellence in biology practical for all students, regardless of gender or school category, by emphasizing the importance of establishing a positive and inclusive learning environment. More research is needed to gain a better understanding of the

factors that influence attitudes towards practical biology and their potential impact on long-term career choices in the scientific field. This study focuses on how students' attitudes towards practical work in biology affect their academic performance in Kenya's Turbo Sub-County. We can work towards more effective strategies that promote equitable participation and achievement in biology education by addressing these issues.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The primary objective of this chapter is to outline and explain the key components of the research methodology employed in the study. It provides a comprehensive overview of the research design, study area, target population, sample size, sampling techniques, research instruments, data collection procedures, methods to ensure reliability and validity, pilot study details, data analysis techniques, and ethical considerations. By presenting these essential elements, this chapter offers a clear and coherent understanding of how the research was planned and conducted, ensuring the credibility and integrity of the study's findings.

3.1 Research Methodology

This study adopted a mixed-method research design, integrating both quantitative and qualitative approaches to gather and analyse data (Creswell *et al*., 2014). The convergent parallel design was utilized, allowing simultaneous collection of qualitative and quantitative data, leading to comprehensive and detailed results (Alex *et al*., 2017). Quantitative data was collected through a cross-sectional survey research design, which is effective in understanding the current status of the study subject and addressing specific research questions. This combination of methods facilitated a holistic investigation, providing valuable insights from diverse viewpoints. The integration of quantitative and qualitative data enriched the study's findings and enhanced the overall understanding of the research topic.

3.2 Research Design

Kombo and Tromp (2006) aptly described research design as the "glue" that binds all the elements of a research study together. It serves as a well-structured outline or plan for generating answers to the research problems at hand. The research design establishes the framework for data collection and analysis, with the goal of ensuring that it is relevant to the research objectives. In this study, a descriptive survey was employed, enabling the researcher to provide an accurate depiction of the prevailing conditions and present the research findings (Kombo & Tromp, 2009). As Kothari (2009) emphasizes, this design is particularly effective in collecting descriptive data about population characteristics and justifying existing conditions and practises.

Researchers used both primary and secondary data sources to collect the information. Primary data collection entailed using well-structured questionnaires, administering tests, and scheduling interviews with study participants to obtain information directly from them. These methods enabled researchers to collect responses in a systematic manner from a diverse set of respondents, ensuring comprehensive data coverage. In addition to primary data collection, secondary data sources were used in the study. Researchers gathered quantitative data from pre-existing sources such as government databases, official reports, and previous studies.

The researchers were able to efficiently gather relevant information to address the research questions and draw informed conclusions based on the findings by using both primary and secondary data acquisition approaches. The use of primary and secondary data sources enriched the qualitative and quantitative data in the study, resulting in a more comprehensive and holistic understanding of the research topic. This methodological approach contributed to the study's credibility and rigour,

reinforcing the importance of a well-designed research design in producing meaningful results.

3.3 Study Area

The study was conducted in Turbo Sub-County, situated between longitudes $34^{0}50'$ east and $35^{0}37'$ west. This sub-county comprises four educational zones: Kapyemit, Sugoi, Kiplombe, and Turbo. It shares its borders with Lugari Constituency to the West, Nandi County to the South, and Kakamega County to the Western (refer to Appendix VI). The area's elevation stands at approximately 1500 meters above sea level, covering a total land area of 324 km². Turbo Sub-County experiences high population density attributed to rapid urbanization (GOK, 2003). Agriculture is a predominant livelihood, with substantial commercial farming, including large-scale maize and wheat cultivation, alongside smaller-scale crop farming. The sub-county houses a total of 46 secondary schools. The choice of Turbo Sub-County as the study area was influenced by its historical underperformance in the Biology KCSE examination.

3.4 Study Population

The target population in this study refers to the entire group of individuals sharing common attributes or characteristics, from which samples are drawn for measurement purposes (Mugenda & Mugenda, 2003). Respondents were selected from three school categories present within Turbo Sub-County, including Extra-County (4), County (5), and Sub-county (37) schools. These schools were further categorized as either private (7) or public (39) secondary institutions. Additionally, they were classified as single-sex or mixed-gender schools, with the distribution as follows: Girls (4), Boys (3), and Mixed (39).

The investigation aimed to encompass all secondary schools within the Sub-County, which totals 46 schools. As a result, the target population of this study encompassed all 46 Directors of Studies, 76 Biology teachers within these schools, and Form Four students across these institutions (as detailed in Table 3.1).

3.5 Sampling Procedure

Sampling is defined as the selection of some part of an aggregate or totality on the basis of which a judgment or inference about aggregate or totality is made. It is the process of obtaining information about an entire population by examining only a part of it (Kothari, 2009). The researcher used probability sampling methods. The probability techniques was used in this study were stratified and simple random sampling. Stratified random sampling was used to select the schools because they are heterogeneous (Kothari, 2009). The strata consisted of schools based on the school category. From the sampled schools, purposive sampling was then used to select teachers teaching biology and students taking biology in form four.

3.6 Sample size determination

Fisher's formula was used to determine the sample for biology students. However, researchers give a range of 10-25% (Borah, 2013). The study therefore computed the student sample size using the average figure of 20 percent following Fisher's formula;

$$\text{Sample size} = \frac{z1-\frac{a}{22p}(1-p)}{d^2}$$

$Z_{1-a/2}$ = standard normal variation (at 5% type 1 error ($p< 0.05$) which is 1.96.

p= expected proportion in population based on survey/ pilot studies. d= absolute error or precision decided by the researcher. Therefore, the student sample size was computed as:

Sample size= $\frac{1.962 \times 0.20(1-0.20)}{0.05^2}$ =245.3624 = 245

Hence the total sample size of the learners was 245 (125 females, 120 males). This study adopted a 30 percent sample size for the schools, class teachers and directors of studies. On this basis the sample size comprised of 14 principals, 23 biology teachers, 14 directors of studies, and 245 students. The summary of the sample size is as shown in Table 3.1.

Table 3. 1: The sample size (n) of respondents included in the study conducted in Turbo-sub County.

Strata	Target population	Sample size
Director of studies	46	14
Students	4320	245
Teachers of Biology	76	23
Total	4442	282

3.7 Data Collection Instruments

Quantitative data was collected using questionnaires and document analysis whereas qualitative data involved the use of interview schedule.

3.7.1 Questionnaire

Questionnaires was one of the data collection tool. It several advantages in research, the most important of which is their ability to reduce interview bias because respondents provide answers in their own words (Kothari, 2009). Furthermore, questionnaires allow respondents plenty of time to craft thoughtful responses. Furthermore, they are a quick way to collect data from a large sample (see Appendix II). The choice of a questionnaire as the research instrument was influenced by its

ability to eliminate interviewer bias and provide respondents with enough time to respond thoughtfully. This method was deemed appropriate for a cohort of literate, educated, and cooperative study participants who all met these criteria. The research questionnaire was distributed to biology students from various secondary schools in Turbo Sub-County.

3.7.2 Document analysis guide

Using the document analysis guide, the study focused on the practical test administered to form four students (2022 cohort) and the KCSE biology performance (2022 cohort) attained by the students. The KCSE results were obtained with the help of the Director of Studies in order to make an opinion based on the trends and relate to the variables.

3.7.3 Interview Schedule

According to Orodho (2009), people prefer to express themselves verbally rather than in writing, which leads to a greater willingness to provide comprehensive data during oral communication versus completing a questionnaire. The researcher was able to engage with and delve deeply into the perspectives of the subjects by conducting structured interviews (refer to Appendix III). Structured interviews were conducted with the directors of studies, principals, and biology teachers in Turbo Sub-County secondary schools for this study. The goal was to collect qualitative data on the impact of students' attitudes on practical work and their impact on academic performance in biology within Turbo Sub-County.

3.7.4 Test administration

The selected students across 46 secondary schools were subjected to practical test during biology practical lessons. The test was marked out of 40 (Appendix IV)

3.8 Pilot Study

A pilot study is about running a trial of the main study. This is a small investigation with an aim to test the feasibility and validity of procedures and to gather information prior to the main study Chinedu, (2015). It is a small study to test research protocol, data collection instruments, sample recruitment strategies and other research techniques in preparation for a larger study. It is conducted to identify research problem areas and deficiencies in research instruments and protocol prior to implementation during the final study. The researcher collected data from four schools from Kapseret Sub-County who had students taking biology. Sample sizes of 30 students were randomly sampled to take part in the study. The schools chosen from the neighbouring sub county for the pilot study were considered to have similar characteristics as those in Turbo Sub County and they were not included in the study. The feedback received during the pilot study was valuable in refining the questionnaire. Based on participant responses, some questions were clarified, and minor adjustments were made to enhance the questionnaire's clarity and comprehensibility. These improvements were crucial in minimizing potential measurement errors and ensuring that the instrument effectively captured the intended information.

3.9 Validity and Reliability

3.9.1 Validity

Data validity refers to how well a test measures what it is supposed to measure (Porter, 2010). According to Mugenda and Mugenda (2008), validity is the degree to which research findings based on data analysis accurately represent the phenomenon under investigation. The Kaiser-Meyer-Olkin (KMO) measure was used to assess the

suitability of the sampling data as normally distributed, and a KMO value greater than 0.5 indicated an adequate sample size.

Bartlett's test of sphericity was used to test the null hypothesis that the item-to-item correlation matrix formed an identity matrix based on responses from respondents for all relevant variables. Following the guidelines of Copper and Schindler (2003), the questionnaire was carefully constructed, and pretesting was performed to identify and modify any ambiguous, awkward, or offensive questions. To evaluate the questionnaire structure, expert opinions were also sought.

Table 3.2 shows that the study's guiding factors, including academic performance in biology (0.871), student attitude in practical work (0.958), gender attitude towards biology practical work (0.932), and school category (0.99), were all above the acceptable threshold of 0.7. The validity test confirmed that all questionnaire questions were aligned with the study's objectives and could effectively address the research objectives.

Table 3. 2: Test for validity of the data collected in the study conducted in Turbo-sub County

Factor	KMO	Barlett's test of Sphericity		
	Test	$\chi 2$	DF	P
Academic performance in biology	0.87	221.45	3	>0.001
Students' attitude in practical work	0.95	176.65	3	>0.001
Gender attitude towards biology practical	0.93	167.34	3	>0.001
Category of schools	0.99	188.72	3	>0.001

Extraction Method: Principal Component Analysis

3.9.2 Reliability of research instrument

The reliability of an instrument refers to its ability to consistently measure the intended construct. In a nutshell, it evaluates the instrument's ability to produce consistent and stable results across multiple administrations, assuming that the

underlying construct being measured remains constant. In this research study, a questionnaire was utilized as the primary data collection instrument. The questionnaire consisted of carefully designed and structured questions aimed at gathering data related to the research objectives. It provided a systematic and standardized approach to collect information from the study participants, allowing for efficient data analysis and interpretation.

To ensure the reliability of the questionnaire, assessment of internal constancy was conducted, which focused on evaluating the coherence and consistency of the questionnaire items in measuring the targeted construct. A questionnaire is considered reliable if the correlation coefficient is greater than 0.70 as shown in Table 3.3. The analysis revealed a high Pearson correlation coefficient values, indicating strong internal consistency among the questionnaire items ($r>0.8$, $P < 0.05$). The variables of study were academic performance in biology (R=0.82), gender attitude towards biology practical work (R=0.88), and category of school (R=0.99), students' attitude towards biology practical (R=0.99).

Table 3. 3: Reliability test of data collection tool using Pearson correlation test

Variable	Coefficient
Academic performance in biology	0.82
Students attitude towards biology practical	0.99
Gender attitude towards	0.88
Category of schools	0.99

3.10 Data Collection Procedures

The researcher sought permission from NACOSTI, the National Research Council of science Technology and innovation in the Ministry of Higher Education, through the Directorate of Postgraduate Studies (D.P.S), University of Eldoret. Letters of notification were then sent to the County Director of Education and the principals of

the selected schools. The researcher then went to the sampled schools to collect data. Following consent and briefing, the researcher began the exercise before administering the instrument. When schools were in session, 268 students were given questionnaires. The researcher also conducted a 30-minute interview with the principals, director of studies, and biology teachers who were chosen to participate in the study.

3.11 Data Analysis

Data analysis is a critical process that aims to structure, order, and interpret the vast amount of information gathered during the research. The method of analysis chosen is determined by a number of factors, including the type of research, objectives, and hypotheses being tested. The current study aimed to investigate the effects of student attitudes towards practical biology on their performance.

The information was gathered, entered, organised, and saved in Microsoft Excel 2013. The data was then coded and analysed using the Statistical Package for Social Sciences (SPSS V. 26), a widely used statistical analysis tool. Data organisation entailed organising the collected data in a systematic manner so that it could be handled effectively during the analysis process. Following that, data coding was used to assign labels or categories to various responses or variables, making it easier to manipulate and analyse specific aspects of the data. Quantitative data (numbers) were analysed using both inferential (ANOVA, t-test, and Chi-square) and descriptive statistics (frequency, means, maximums, and minimums). The data were summarised using this method by identifying central tendencies, patterns, and variability within the dataset and then drawing conclusions about the data based on the research questions. Frequencies and percentages: descriptive methods were used to effectively

present these summaries. On the other hand, descriptive statistics, primarily frequencies and percentages, were used to analyse qualitative data, which consisted of non-numerical information. The findings were presented in tables, pie charts, and graphs, allowing for a visual representation of the quantitative data analysis results. These visual aids aided readers in better understanding the key patterns and trends in the data

3. 12 Ethical Consideration

The study adhered to ethical protocols by obtaining necessary permissions from relevant authorities, including NACOSTI and the University of Eldoret, and seeking consent from principals, teachers, and students before data collection. To maintain originality and prevent plagiarism, proper citation and acknowledgment of authors in various citations within the study were ensured. During data collection, participants were briefed about the study's objectives and procedures, and confidentiality was strictly upheld. The rights and preferences of respondents to participate were respected based on the guidelines of Kombo & Tromp (2009). Furthermore, the research followed the University of Eldoret's postgraduate research rules and regulations, ensuring compliance with institutional guidelines and ethical standards.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, INTERPRETATION AND DISCUSSION OF THE RESEARCH FINDINGS

4.0 Introduction

The chapter presents the research findings and discussions of the study. Data analysis was done based on the following objectives: to determine the effect of attitudes towards school category and on biology practical and overall academic performance in biology, to investigate gender attitudes towards biology practical and the influence on academic performance in biology subject, and to investigate the effect of students' attitudes towards practical work and overall academic performance in biology. Both descriptive and inferential statistics results are presented in tables and figures in this chapter. The chapter was organised into the following sub-themes:

4.1.1 Response Rate

In this study, the response rate derived from the study participants were as follows; form four student respondents had a response rate of 98% (n=240) as shown in table 4.1. The biology teachers had a response rate of 78% (n=18), the interview schedules with the principals and director of studies had a response rate of 71% (n=10) and 85% (n=12) respectively. The average questionnaires return rate was well above 70% which according to Mugenda and Mugenda, (2003) is an acceptable proportion and is termed adequate for analysis. This is in agreement with Lasoi *et al.,* (2017) research whose response rate of 95.4% for Board of Management members and response rate of 87.5% for Principals were very good for the study in Kajiado County.

Table 4. 1: Student Questionnaire Return Rate

Status	Frequency	Percent
Returned	240	98
Not Returned	5	2
Total	245	100

4.1.2 School Category

The schools sampled were categorized as males' schools, females' schools, and mixed. The boys and females schools were categorized as single sex schools. From the findings, majority (84.8%) of the respondents were in mixed schools, while 15.2% were in single sex schools.

Table 4. 2: School Category based on gender

Variable	Frequency	Percentage (%)
Males schools	3	6.5
Females schools	4	8.7
Mixed Schools	39	84.8
Total	46	100

4.1.3 Highest Level of Education of teachers

The highest levels of education attained by the Biology teachers were categorized in the following categories; Diploma, Undergraduate, Masters or PhD (Table 4.2). Among the surveyed teachers, 14.2% had a Diploma as their highest level of education. The largest proportion, comprising 80.1% of the teachers, held an Undergraduate degree as their highest qualification. Additionally, a smaller percentage of teachers, specifically 5.7%, possessed advanced degrees such as a Masters or PhD.

This data indicates that the majority of teachers in the study had completed their Undergraduate education, which is essential for becoming qualified educators. A

smaller portion had pursued higher levels of academic attainment, such as a Masters or PhD, which suggests a presence of well-qualified and potentially specialized educators among the participants. Wekesa, (2022) reported a similar result of high number of qualified teachers to teach in secondary schools in western Kenya Counties. Such diverse educational backgrounds could contribute to a varied and comprehensive teaching approach, catering to the unique needs of students at different levels of learning. The study's findings align with Nzoka and Aluko, (2014) research, which established that all schools had a human resource pool with acceptable and relevant academic qualifications. Similarly, in Thailand, Puangjakta and Vinitwatanakhun, (2014) discovered that a majority of respondents held a Bachelor's degree, representing 65.2% of the sample. These results clearly indicate that teachers in upgraded National Schools are well-qualified for their roles. Overall, the findings underscore the significance of teachers' educational qualifications in shaping the quality of education they provide in their respective roles.

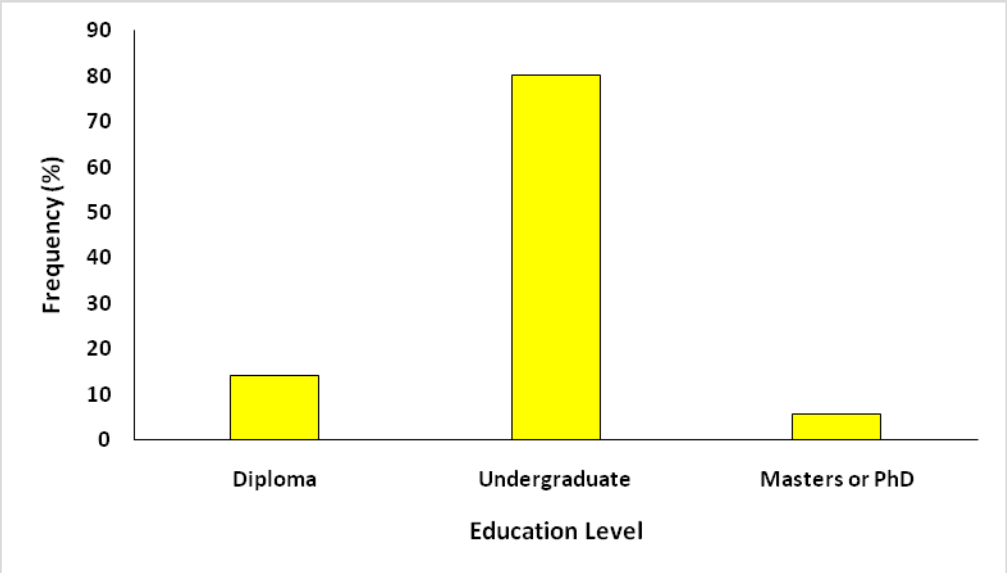

Figure 4. 2: Level of education of the respondents

4.1.4 Teachers experience

The study examined the years of experience among Biology teachers, providing valuable insights into their proficiency and familiarity with the subject matter. The data revealed that out of a total of 23 teachers, the majority (43.5%) had taught Biology for a period of two to four years (Table 4.3). This significant percentage indicated that a substantial portion of the teachers possessed considerable experience in handling Biology as a subject. It is noteworthy that four teachers (17.4%) had less than two years of experience, while six teachers (26.1%) had been teaching Biology for four to six years. Furthermore, a small yet experienced group of three teachers (13.0%) had dedicated over six years to teaching Biology. These findings highlighted the diverse levels of expertise among the educators, with the largest segment of teachers having acquired substantial knowledge and practical skills in their two to four years of teaching Biology. Such experienced educators are likely to play a pivotal role in shaping the understanding and academic growth of their students in the field of Biology.

Table 4. 3: Teachers experience

Years	Frequency	Percentage (%)
Less than two years	4	17.4
Two – Four years	10	43.5
Four – Six Years	6	26.1
Over six years	3	13.0
Total	**23**	**100**

4.1.5 Time spent in the current station

The study captured the duration of time that Biology teachers had served in their current teaching stations, as depicted in Table 4.3. The data revealed the frequency

and percentage of teachers falling into distinct categories based on their tenure in their current positions. The findings revealed that a substantial portion of Biology teachers (39.1%) had spent between three to six years in their current stations, representing the largest segment. This particular group of educators had likely accumulated a significant amount of experience and familiarity with their teaching environment during this period, which could positively impact their instructional effectiveness and rapport with students. This substantial experience implied that they possess the necessary knowledge of planning dynamics and academic performance. Moreover, their teaching experience in their current stations demonstrates their familiarity with the challenges and opportunities that arose due to their institutions being upgraded to national status (Wekesa, 2022).

Table 4. 4: Time spent in the current station

Years	Frequency	Percentage (%)
Less than three years	8	34.8
Three – Six years	9	39.1
Over six years	6	26.1
Total	**23**	**100**

Moreover, the data indicated that 34.8% of the teachers had served for less than three years in their current stations. This observation could suggest a relatively higher turnover rate among Biology teachers, possibly due to factors such as career advancement, transfers, or other personal reasons. Interestingly, a noteworthy minority of teachers (26.1%) had remained in their current stations for over six years, signifying a more enduring commitment to their roles. Such teachers may have developed deep connections within the school community and exhibited a strong dedication to their profession.

The distribution of time spent in the current station among Biology teachers presents valuable insights into their stability and experience levels. Educators with longer tenures might bring a sense of continuity and institutional knowledge, fostering a conducive learning environment (Puangjakta & Vinitwatanakhun, 2014). Meanwhile, the presence of both new and experienced teachers may contribute to a dynamic teaching landscape, offering fresh perspectives and potential innovations in pedagogy. Understanding these patterns can aid educational institutions in providing adequate support and professional development opportunities tailored to the varying needs of their teaching staff.

4.2 Relationship between the students' attitude towards practical work and their academic performance in Biology.

4.2.1. Students' attitude towards biology practical work

The students were presented with questionnaires with different attitudes towards biology practical and were required to indicate whether they agree or not. The results revealed diverse opinions among the participants (Table 4.5).

The values in parentheses are percentages representing the proportion of students agreeing, disagreeing, or undecided on each attitude. Values outside parentheses indicate the actual number of students corresponding to the percentage.

Table 4. 5: Student attitude towards biology practical.

Items	Agree	Disagree	Undecided
Biology practical inspire me to read ahead of the teacher	154(64)	58(24)	29(12)
Biology practical encourages me to excel in Biology	46(19)	175(73)	19(8)
Biology practical make me work hard towards attaining quality grades	36(15)	166(69)	38(16)
Biology practical challenges me to improve performance in biology subject	65(27)	156(65)	19(8)
I feel anxious and fearful during biology practical examination	118(49)	108(45)	14(6)
I have adequate learning resources	96(40)	127(53)	17(7)
Biology practical work are technical to learn	125(52)	108(45)	7(3)

A significant portion of the students, approximately 64%, expressed that biology practical inspire them to read ahead of the teacher, indicating a positive impact on their learning motivation. The findings are consistent with other studies Musasia *et al.,* (2012) who found that biology practical has a significant influence on students' learning and fosters a positive attitude towards biology. Similarly, when it comes to encouraging students to excel in Biology, only 19 % of the respondents agreed that the practical have such an effect, while a much larger proportion, around 73%, disagreed. This indicates that the majority of students might not perceive biology practical as strong catalysts for excelling in the subject. This observations on this particular attitude contradicts the findings of Sharpe, (2012), who reported that practical work is perceived as an essential component by many students, leading to positive attitudes and improved understanding of biology.

Interestingly, a considerable number of students (69%) expressed a lack of belief in the biology practical ability to make them work hard towards attaining quality grades,

while only 15% agreed with this statement. This suggests that there might be disconnect between the perceived values of biology practical in relation to academic achievement.

While some students (27%) found the biology practical challenging and motivating to improve their performance in the subject, a slightly larger portion (65%) disagreed with this sentiment. This discrepancy suggests that the practical may not equally impact all students in terms of enhancing their understanding and performance in biology.

The survey also highlighted that approximately 45% of the students experience anxiety and fear during biology practical examinations, which could have implications for their overall learning experience. On the other hand, 49% disagreed with this notion, indicating a significant proportion of students who may not experience such negative emotions during practical assessments.

Regarding the availability of learning resources for biology, less than a half of the students (40%) reported having adequate resources, while 53% disagreed with this statement. This indicates that there might be room for improvement in providing sufficient learning materials for biology practical.

Finally, a notable 52 % of students found biology practical work to be technical and challenging to learn, while 45% disagreed. This suggests that a substantial portion of students may perceive practical activities as complex and require additional support to grasp the concepts effectively.

Generally, the results showcased a range of attitudes towards biology practical among students. While some students find them inspiring and motivating, others might not

see the same level of benefit or might encounter challenges during practical assessments. Understanding these attitudes can help educators tailor their teaching approaches and support systems to cater to the diverse needs and preferences of students in the context of biology practical learning.

4.2.2. Teachers' opinion towards biology practical work

The teachers' responses on Biology Practical reveal diverse opinions regarding the impact of practical activities on students' learning and attitudes (Table 4.6).

Table 4. 6: Teachers' responses on Biology Practical

Teachers' responses on Biology Practical	Disagree	Agree	Undecided
Challenge students to use their time well.	83.3 (15)	5.6(1)	11.1(2)
Encourages students to be enthusiastic about learning.	94.4(17)	0(0)	5.6(1)
Make students to look forward to learning and improvement in Biology	83.3(15)	5.6(1)	11.1(2)
Provoke students to seek for knowledge	100(18)	0(0)	0(0)
Help students to assess their ability	83.3(15)	5.6(1)	11.1(2)
Results proves that learning has taken place in a student	94.4(17)	0(0)	5.6(1)
Continuous assessment tests encourage students to study	95.4(15)	5.6(1)	11.1(2)
Frequent examinations inspire students to achieve highly.	83.4(15)	5.6(1)	11.1(2)

The findings revealed that only a small percentage (5.6%) of teachers disagreed that biology practical effectively challenge students to manage their time well. The majority (83%) of teachers agreed with this statement, suggesting that they perceive practical as effective time management tools. A small portion (11%) remained

undecided. Interestingly, all the teachers agreed that biology practical encourage students to be enthusiastic about learning. The vast majority (94%) agreed with this notion, indicating that they find practical to be strong motivators for student enthusiasm. A small percentage (5.6%) remained undecided. Similarly, only a small percentage (5.6%) of teachers agreed that practical make student's look forward to learning and improvement in Biology. The majority (83.3%) agreed, suggesting that teachers perceive practical as particularly inspiring in this regard. A small portion (11.1%) remained undecided. All teachers (100%) agreed with the idea that practical provoke students to seek knowledge, indicating a positive impact in this aspect.

Regarding self-assessment, only a small percentage (5.6%) of teachers disagreed that practical's effectively help students assess their abilities. The majority (83.3%) agreed, indicating that they might consider practical's as valuable self-assessment tools. A small portion (11.1%) remained undecided. When it comes to whether the results of biology practical prove that learning has taken place in a student, vast majority (94.4%) of the teachers agreed, indicating that they find practical as reliable indicators of learning outcomes. A small percentage (5.6%) remained undecided.

In terms of continuous assessment tests, only a small percentage (5.6%) of teachers disagreed that they encourage students to study. The majority (95.4%) agreed, suggesting that teachers perceive practical assessments as strong motivators for student study habits. A small portion (11.1%) remained undecided. Similarly, only a small percentage (5.6%) of teachers disagreed that frequent examinations in practical inspire students to achieve highly. The majority (83.4%) agreed, indicating that teachers view practical exams as strong drivers of high achievement. A small portion (11.1%) remained undecided.

Generally, the teachers' responses reflect a range of perspectives on the effectiveness of biology practical in various aspects of student learning, motivation, and achievement. While majority of teachers see potential benefits, a few appears to have reservations or are undecided about the impact of practical activities on students' attitudes and outcomes.

4.2.3. Influence of attitude towards biology practical work on academic performance of student

The study investigated the association between students' attitudes towards biology practical and student performance in biology practical test. The data was analyzed using the Chi-square test (χ^2), which assesses the significance of the relationship between categorical variables. The results revealed several significant associations between attitudes and academic performance (Table 4.7).

Table 4. 7: Percentage of students who passed and failed in test, and agreed with statement on attitude towards biology practical, and Chi-square test depicting the association between attitudes towards biology practical and students' academic performance

	Agree (%)		Test	
Attitude towards biology practical	**Pass**	**Fail**	χ^2	**P (sig)**
Inspire me to read ahead of the teacher	45.7	38.2	8.8	<0.01
Encourages me to excel in Biology	41.2	37.1	5.4	0.02
Make me work hard towards attaining quality grades	56.3	38.5	3.1	0.08
Challenges me to improve performance in biology subject	34.8	37.9	4.2	0.04
I feel anxious and fearful during biology practical examination	55.6	28.4	10.8	<0.01
Biology practical work are technical to learn	44.8	38.5	15.1	<0.01

Students who exhibited feelings of inspiration to read ahead of the teacher (Pass=45.7%, Fail= 38.2%) and encouraged to excel in Biology (Pass= 41.2%, Fail= 37.1%) demonstrated significantly better performance in the subject (χ^2 = 8.8, P <

0.01; χ^2 = 5.4, P = 0.02, respectively). Interestingly, the presence of learning resources did not show a significant relation with student performance (χ^2 = 0.6, P = 0.43). This suggests that while having adequate learning resources is important, it may not be the sole determinant of academic success in biology.

Conversely, students who experienced anxiety and fear during biology practical examinations or found the practical work technically challenging tended to exhibit lower academic performance (χ^2 = 10.8, P < 0.01; χ^2 = 15.1, P < 0.01, respectively). Similarly, students who felt challenged to improve their performance in biology also demonstrated lower academic outcomes (χ^2 = 9.2, P < 0.01). Overall, the findings indicate an association between students' attitudes and their academic performance. Positive attitudes appear to activate students' cognitive, emotional, and behavioral components, positively influencing their performance. Conversely, negative attitudes contribute to a lack of motivation and hinder students from performing well. Cultivating positive attitudes among students may enhance their ambitions and motivation to excel, leading to improved academic performance.

4.3 Relationship between the categories of school and students' academic performance

4.3.1. Association between attitude towards biology practical and school category (Females, Males and Mixed)

Table 4.8 presents the association between different types of schools based on gender (mixed schools, males' schools, and females' schools) and students' attitudes towards biology practical work.

Table 4. 8: Comparison of student attitude towards biology practical in females, boys and mixed schools (% of students who agreed to statements per school category)

	School category (%)			Test	
Attitude towards biology practical	**Female**	**Males**	**Mixed**	**χ^2**	**P**
It inspire me to read ahead of the teacher	86	65	63	9.21	0.01
It encourages me to excel in Biology	77	58	66	5.63	0.06
It make me work hard towards attaining quality grades	68.6	55.2	66.8	5.05	0.08
It challenges me to improve performance in biology subject	69.8	80.5	69.2	6.44	0.04
I feel anxious and fearful during biology practical examination	82.3	66.7	72.3	7.82	0.02
It work are technical to learn	55	63	72	13.82	0.001

The study investigated how the school environment influenced various aspects of students' attitudes, including inspiration, encouragement, perceived challenges, anxiety, and technicality of the subject. To determine the statistical significance of the associations, chi-square test was employed. The results of the study revealed several noteworthy findings concerning the relationship between the type of school and students' attitudes towards biology practical work. There were significant associations between the school category and students' inspiration to read ahead of the teacher during Biology practical ($\chi^2 = 9.21$, $p = 0.01$), as well as students feeling encouraged to excel in Biology through practical work ($\chi^2 = 5.63$, $p = 0.06$). In females' schools, a higher percentage of students felt inspired (86%) compared to their peers in males' schools and mixed schools (65% and 63% respectively), and a larger percentage (77%) also felt encouraged compared to lower percentages in mixed schools and males' schools (66% and 58% respectively). Based on these two attitudes (students feeling encouraged to excel in Biology through practical work, and students'

inspiration to read ahead of the teacher during Biology practical), the findings suggests that females-only schools might provide a supportive and empowering environment for female students, fostering their interest and engagement in traditionally male-dominated subjects like science. Conversely, mixed schools and males' schools may need to focus on strategies to better inspire and encourage their students in biology practical work (Wire, 2015).

Additionally, the study identified a significant association in students' perception of biology practical work as technically challenging to learn (χ^2 = 13.82, p = 0.001). Students in mixed schools were more likely (72%) to view the practical work as technically challenging compared to their peers in males' schools and females' schools (63% and 55% respectively). This could be attributed to various factors, such as the teaching approach, classroom dynamics, and teacher-student interactions (DFID, 2007). Similar findings have been reported in previous research, emphasizing the role of school environment in shaping students' perceptions of the difficulty level of certain subjects (Adeogun, 2001). Schools with more resources tend to register better performance compared to schools with inadequate TLR (Otieno, 2021)

Furthermore, the study revealed significant associations between the school category and students' attitudes regarding challenges to improve performance (χ^2 = 6.44, p = 0.04) and test anxiety during practical examinations (χ^2 = 6.44, p = 0.04). Students in boys' schools were more likely (80.5%) to feel challenged to improve their performance compared to students in mixed schools (69.2%) and girls' schools (69.8%), and also experienced lower levels of test anxiety (66.7%) compared to students in mixed schools (72.3%) and girls' schools (82.3%). These results suggest that boys' schools provide an environment that fosters healthy competition and

motivation among male students. On the other hand, girls' schools might need to address issues related to test anxiety and provide additional support to help female students feel more confident during assessments. These findings resonate with research on gender differences in educational settings, which emphasize the importance of tailoring approaches to accommodate students' specific needs (Amedu, 2015).

4.3.2. Test performance of schools categories: A quantitative analysis based on gender- Males, Females and Mixed school categories.

The students in three different school categories (mixed schools, boys' schools, and girls' schools) were given a biology practical test during the study and the data were collected on how they performed. The overall means scores of the Biology Practical Assessment Test (BPAT) (X/20) for the school types are shown in table 4.9.

Table 4. 9: Students mean performance in biology practical assessment test per school category (The assessment was marked out of 20)

School Category	No. students	Max	Min	Mean
Females school	60	15	2	9.66±0.8
Males school	61	17	3	7.82±1.6
Mixed school	119	18	4	6.47±1.3
Test for statistical significance				
F value	-	-	-	3.32
P value	-	-	-	0.03

The findings provide valuable insights into the students' academic achievements under different categories. There was significant variation in performance among the school categories (F=3.32, P=0.03), with girls' schools displaying the highest mean score of 9.66±0.8, suggesting better performance compared to Boys schools (mean score of 7.82±1.6) and Mixed schools (mean score of 6.47±1.3). The present study

presents contradicting results to the findings of Eddy *et al*. (2014), which indicated that females consistently underperform in practical biology examinations when compared to their male counterparts.

Effective teaching strategies and a supportive learning environment specific to girls' needs may have contributed to their success. In contrast, Boys schools' lower performance could be attributed to various factors, such as inadequate resources or challenges affecting boys' engagement and motivation. The mixed nature of mixed schools, with diverse student backgrounds, may account for the variation in mean scores (Amedu, 2015). The statistically significant results from the ANOVA test ($F_{2, 235}$ =3.32, P = 0.03) highlight significant differences among school categories. Policymakers and educators can use these findings to implement targeted interventions and strategies to enhance academic performance and foster an inclusive learning environment.

Students' attitudes towards Biology practical and science, in general, are influenced by various factors, including prior experiences, perceptions of usefulness and difficulty, and the type of school they attend. For instance, single-sex schools may create a more comfortable environment for students to participate in Biology practical without gender stereotypes, potentially enhancing their engagement. On the other hand, mixed schools may subject students to pressure to conform to gender norms, affecting their willingness to participate in certain biology practical activities (DFID, 2007). Addressing these variations in attitudes across different school categories can significantly contribute to overall academic achievement and promote holistic development in the field of biology and beyond.

4.3.3. Attitude towards biology practical and school categories -private and public

The study examined attitudes towards biology practical among students in private and public schools, revealing significant differences through chi-square tests. While feeling inspired to read ahead during Biology practical work did not significantly differ between private (65%) and public school students (70%) (χ^2 = 3.5, p = 0.06), significant disparities were observed in other attitudes (Table 4.10).

Table 4. 10: Percentage of students in public and private schools categories who agreed with the statements on attitude towards biology practical, and test for association between the school categories and attitudes

	Agree (%)		Test	
	Public	**Private**		**p**
Students attitude			**χ^2**	**(sig)**
Biology practical inspire me to read ahead of the teacher	70.0	65.0	3.5	0.06
Biology practical encourages me to excel in Biology	60.0	76.1	4.2	0.04
Biology practical make me work hard towards attaining quality grades	73.3	70.9	3.8	0.05
Biology practical challenges me to improve performance in biology subject	62.1	75.3	6.6	0.01
I feel anxious and fearful during biology practical examination	56.6	67.3	4.7	0.03
Biology practical work are technical to learn	63.2	78.4	6.6	0.01

Private school students showed significantly higher levels of feeling encouraged to excel in Biology through practical work (76.1% vs. 60% in public schools) (χ^2 = 4.2, p = 0.04) and perceived more challenge in improving performance (75.3% vs. 62.1% in public schools) (χ^2 = 6.6, p = 0.01). However, private school students also reported

higher levels of test anxiety (67.3% vs. 56.6% in public schools) ($\chi^2 = 4.7$, $p = 0.03$) and perceived biology practical work as more technically challenging to learn (78.4% vs. 63.2% in public schools) ($\chi^2 = 6.6$, $p = 0.01$). The findings of this study align with the research conducted by Kashu, (2014), which investigated the academic performance of boys and girls in the Kenya Certificate of Secondary Education (KCSE) over a five-year period (2007-2011). The results revealed that there was no significant difference in the overall performance between boys and girls. These findings underscore the importance of considering school types in understanding and addressing students' attitudes towards biology practical work, necessitating targeted support to optimize their learning experiences.

4.3.4 Practical test performance in school categories: A quantitative analysis based on ownership- private and public school categories.

The study also compared the performance of students in private and public schools on a biology practical test. The data from five schools in each category were analyzed, and the mean performance in the biology practical test was found to be significantly higher for students in private schools (mean score: 8.92±1.4 out of 20) compared to students in public schools (mean score: 5.76+1.1 out of 20, Table 4.11).

Table 4. 11: Students performance in biology practical in private vs public schools

Performance in biology practical				
School Category	**No students**	**Max**	**Min**	**Mean**
Private	107	18	5	8.92±1.4
Public	133	17	2	5.76+1.1
Statistical test				
t- value				4.82
P value				0.02

The t-test results ($t(238) = 4.82$, $p = 0.02$) indicated a statistically significant difference in test performance between the two school categories. The study's results

imply that there was a significant disparity in the performance of students on the biology practical test, with students in private schools achieving higher scores. The observed phenomenon could be attributed to availability of facilities and positive attitude towards biology practical among the students in private school (Kashu, 2014).

4.3.5. Association between attitude and school category: Extra-county, County and Sub county school category

The study examined attitudes towards biology practical among students in schools categorized based on administrative and academic characteristics: Extra-county, County, and Sub-county schools. The findings revealed significant relation between these school categories and specific attitudes through chi-square tests. While feeling inspired to read ahead during Biology practical work did not significantly differ between the three school categories (75.8% in Extra-county, 77% in County, and 54.4% in Sub-county schools) (χ^2 = 0.27, p = 0.6), other attitudes exhibited notable variations. Extra-County schools showed significantly higher levels of feeling encouraged to excel in Biology (77.1%) compared to County (74.3%) and Sub-county schools (72%) (χ^2 = 10.83, p = 0.001, Table 4.12).

Table 4. 12: Percentage of student's per school categories who agreed with statements, and test for association between school categories and attitudes: Extra-county, County and Sub County schools

	Agree (%)			Test	
Students attitude towards biology practical	**Extra**	**County**	**Sub**	χ^2	**p**
It inspire me to read ahead of the teacher	75.8	77	54.4	0.3	0.60
It encourages me to excel in Biology	77.1	74.3	72	10.8	0.00
It make me work hard towards attaining quality grades	78.3	63.8	57.9	6.6	0.01
It challenges me to improve performance in biology subject	89.3	82.1	80.7	4.2	0.04
I feel anxious and fearful during biology practical examination	67.3	56.6	68.7	10.8	0.00
Biology practical work are technical to learn	68.4	66.2	62.3	0.7	0.40

Additionally, Extra-county students reported a higher perception of challenge in improving performance (89.3%) compared to County (82.1%) and Sub-county students (80.7%) (χ^2= 4.22, p = 0.04). However, Sub-county students reported feeling more anxious and fearful during biology practical examinations (68.7%) compared to Extra-county (67.3%) and County students (56.6%) (χ^2 = 10.83, p = 0.001). There was no significant difference in the perception that biology practical work was technically challenging to learn between the three school categories (68.4% in Extra-county, 66.2% in County, and 62.3% in Sub-county schools) (χ^2 = 0.71, p = 0.4). These findings highlight the significance of considering school categories in understanding and addressing students' attitudes towards biology practical work, warranting targeted support to optimize their learning experiences.

4.3.6. Practical test performance in Extra-county, County and Sub county school categories

The descriptive statistics revealed interesting patterns in the biology test performance across the three school categories (Table 4.13). Extra-county schools exhibited the highest mean performance (9.23±1.2), followed by County schools (6.88±0.9), while Sub-county schools had the lowest mean performance (4.32±0.6). On the other hand, inferential statistics using ANOVA test depicted significant variation in mean score in practical test ($F_{2, 235}$ = 6.82, P=0.01), suggesting that school category significantly influences students' biology test performance.

Table 4. 13: Students performance in biology practical test is different school-category

Performance in biology practical test				
Category	No. schools	Max	Min	Mean
Extra-county	4	17	3	9.23±1.2
County	5	17	4	6.88±0.9
Sub-county	37	18	2	4.32±0.6
Test for statistical significance				
F- value	-	-	-	6.82
P value	-	-	-	0.001

Otieno, (2021) also reported a similar results of extra-county schools performing better than their county and sub-county counterparts and attributed their good performance especially in biology practical to the vast amount of resources available/they have accumulated since they began existing, which promotes students positive attitude. The findings of this study support the hypothesis that school category plays a crucial role in shaping students' performance in the biology test. Extra-county schools, known for their higher resource allocation and better facilities, which impacts student’s attitude, showed the highest mean performance. On the other hand, Sub-county schools, with more limited resources, demonstrated lower mean performance.

4.4. Relationship between gender and academic performance

4.4.1 Association between gender and attitudes towards biology practical

The present study also delved into an investigation of attitudes towards biology practical among female and male students, aiming to explore the association between gender and specific attitudes. The findings indicated that certain attitudes towards biology practical were significantly influenced by gender. Specifically, female students demonstrated a higher inclination towards expressing positive attitudes compared to male students, as evidenced by their stronger agreement with statements such as "Biology practical inspires me to read ahead of the teacher" (Females: 65%, Males: 52%, χ^2 = 5.41, p = 0.02), "Biology practical encourages me to excel in Biology" (Females: 73%, Males: 59%, χ^2= 4.71, p = 0.03), and "Biology practical makes me work hard towards attaining quality grades" (Females: 76%, Males: 63%, χ^2= 5.43, p = 0.02, Table 4.14).

Table 4. 14: Percentage of student's per gender who agreed with statements, and test (χ^2) for association between attitude towards biology practical and gender

Attitude	Gender (%)		Test	
	Females	Males	χ^2	p (sig)
Biology practical inspire me to read ahead of the teacher	65	52	5.41	0.02
Biology practical encourages me to excel in Biology	73	59	4.71	0.03
Biology practical make me work hard towards attaining quality grades	76	63	5.41	0.02
Biology practical challenges me to improve performance in biology subject	47	56	4.22	0.04
I feel anxious and fearful during biology practical examination	79	72	3.28	0.07
Biology practical work are technical to learn	65	64	0.15	0.7

These results suggest that female students may find greater motivation and inspiration from the hands-on nature of biology practical, fostering a heightened sense of dedication and enthusiasm for the subject. The results are in agreement with the findings of Hofstein & Mamlok-Naaman, (2011) that biology practical work provoke students' interest and attitudes depending on the manner in which it is conducted. The social constructivist theory of learning emphasizes the importance of tailoring activities and practices to the individual's level, interests, and aspirations in order to facilitate meaningful learning. However, when these considerations are overlooked, it can lead to a lack of interest and an unserious attitude towards learning, ultimately hindering students from reaching their full potential.

On the other hand, male students were more inclined to express the opinion that "Biology practical challenges me to improve performance in the biology subject"

(Males: 56%, Females: 47%, $\chi^2 = 4.22$, $p = 0.04$). This indicates that male students perceive biology practical as valuable opportunities for personal growth and development, driving them to strive for enhanced performance through experiential learning. This may be explained with the common notion that science is hard and is only for males. Indeed biology practical work is generally considered an important components but its manifestation as indicated in this study may not provoke students to wanting to take biology career (Hinneh, 2015).

Interestingly, no significant gender-related disparities were found in regards to feelings of anxiety and fear during biology practical examinations (Females: 79%, Males: 72%, $\chi^2 = 3.28$, $p = 0.07$) or perceptions of practical work as technically challenging (Females: 65%, Males: 64%, $\chi^2 = 0.15$, $p = 0.70$). These results suggest that both male and female students experience comparable levels of apprehension and difficulty in certain aspects of biology practical, implying a shared experience in facing challenges during laboratory work. This can possibly be attributed to the fact that, the central motive of teaching science (using practical work) is to bring students to a point where they delight in being involved in learning science and feel committed to continuing the study of science even beyond secondary school (Hussain & Akhtar, 2013; Morris, 1990).

The study's outcomes underscore the importance of understanding gender-related variations in attitudes towards biology practical. These valuable insights can inform educators about the unique needs and preferences of students, enabling the development of tailored teaching strategies to enhance learning experiences and academic performance in biology. By cultivating positive attitudes towards practical learning, educators can foster a more inclusive and supportive learning environment,

promoting gender equality in science education and empowering all students to maximize their potential in the subject.

4.4.2. Influence of students' gender on academic performance (Practical test)

Gender has been recognized as a significant factor that can influence students' academic performance. It is defined as encompassing a range of physical, biological, mental, and behavioral characteristics that differentiate between the feminine and masculine populations (Filgona & Sababa, 2017). According to Meredith (2014), gender is a socially constructed concept that is instilled in individuals from birth. However, when examining its connection to academic performance, studies in the past have produced mixed results, in contrast to the more consistent findings regarding other learner characteristics (Eddy & Brownell, 2014; Wenderoth & Chukwunyeremunwa, 2013).The current study examined if indeed gender attitude towards biology practical may affect academic performance by comparing the students practical test performance in girls' schools and boys' schools. The average scores on the biology practical test were 8.76±0.23 out of 20 in girls' schools and 6.82±0.51 out of 20 in boys' schools (Table 4.15).

Table 4. 15: Performance of boys' and Girls' school in practical test administered to respondent students in various schools in Turbo Sub county

School Category	No of respondents	Max	Min	Mean
Girls school	120	17	2	8.76±0.23
Boys school	117	16	5	6.82±0.51
t- value	-	-	-	1.89
P value	-	-	-	0.03

The results revealed a statistically significant difference between the two groups, with female students demonstrating higher performance in the biology practical test (t (235) =3.85, P=0.03). The result contradicts the study conducted in Delta State,

Nigeria, by Dania, (2014), which found that gender (male/female) had no significant effect on students' achievement in science studies. These differing outcomes highlight the complexity of the relationship between gender and academic achievement and the potential influence of various contextual factors.

4.4.3. Influence of students' gender on academic performance (KCSE biology results- 2022)

The statistical analysis of KCSE biology results for 2022 was conducted to explore the significant variation in mean scores in the biology subject for males and females. The results revealed no statistically significant difference in the mean scores between males and females performance in biology KCSE results (P = 0.43 for 2022, Table 4.16).

Table 4. 16: Comparison of Biology Subject Performance between Girls and Boys School Categories in Turbo Sub County, Kenya: Analysis of Kenya National Examination (KCSE) Results for 2022

Year	Category	Mean	t- test	P- value
2022	Males	3.67.55±0.97	1.32	0.43
	Females	4.51±0.66		

Generally, the findings demonstrate that there was no significant difference in the mean scores of the biology subject between the females and males in 2022 biology KCSE results. The finding agrees with the observation by Iliyasu *et al.* (2015) who indicated that gender has no significant impact on academic achievement and study habits of students. Similarly, Kashu (2014) conducted a study comparing the academic performance of males and females in the KCSE over a five-year period (2007-2011) and found no significant difference in overall performance between boys and girls. However, our findings contradicts Akinmade, (2018) who examined

academic achievement and study habits of students at the secondary level and found out that female students had significantly higher achievement scores as compared to male students. These parallel findings emphasize the need to consider various factors and contexts when exploring the relationship between gender and academic achievement.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter, study conclusions and recommendations was done based on the results.

5.2 Conclusions

In conclusion, the study provides valuable insights into the influence of students' attitudes towards biology practical work on their academic performance. The findings revealed significant associations between specific attitudes and student performance in the biology practical test. Students who displayed feelings of inspiration and motivation towards practical work achieved significantly better results, while those experiencing anxiety, finding the work technically challenging, or feeling challenged to improve their performance tended to have lower academic outcomes. The presence of learning resources did not show a significant relationship with performance, suggesting that positive attitudes play a more pivotal role in driving academic success in biology.

Additionally, the study revealed a significant association between gender and attitudes towards biology practical work, with female students demonstrating higher positive attitudes compared to males. Through biology practical work, female students felt more inspired, encouraged to excel, and committed to achieving high grades. Male students, on the other hand, saw practical work as challenging and an opportunity for personal growth and improvement. Female students outperformed male students in the biology practical assessment, according to the results of the practical tests.

However, no significant difference in mean scores between males and females in the biology subject was observed in the KCSE results of 2022. These findings highlight the importance of developing tailored teaching strategies to improve practical learning experiences and promote gender equality in science education, ensuring that all students excel in biology. Furthermore, the study found a link between school categories and students' attitudes towards biology practical work, as well as their subsequent performance. In comparison to boys' and mixed schools, female schools stood out as inspiring and encouraging environments, with higher percentages of students feeling motivated and excelling in biology through practical tests. Furthermore, private school students were more enthusiastic about improving their performance and perceived more challenges, resulting in higher test scores than their public school counterparts. Further, school categories based on administration and academic characteristics influenced the students' performance with Extra-county schools displaying superior mean performance in the biology practical test compared to County and Sub-county schools. These findings emphasize the crucial role of school characteristics in shaping students' attitudes and achievements in Biology practical work, providing valuable insights for educational strategies and interventions.

5.3 Recommendations

Based on the findings of this study:

1. Foster Positive Attitudes: Educators should prioritize cultivating positive attitudes towards biology practical work among students. Providing engaging and hands-on practical activities, encouraging open discussions, and emphasizing the relevance of practical work to real-life applications can help

inspire and motivate students. Addressing any anxiety or challenges students may face during practical work through supportive and encouraging learning environments can also boost their confidence and performance.

2. Promote Gender Equality: The study highlights the differences in attitudes and performance between male and female students in biology practical work. To promote gender equality in science education, schools should actively work towards creating inclusive and supportive learning environments that encourage and empower all students to excel in biology. Providing equal access to resources, opportunities, and support can help bridge the gender gap in academic achievement and enable students to reach their full potential in the subject.

3. Tailor Teaching Strategies: Given the significant association between school categories and students' attitudes and achievements in biology practical work, educators should tailor teaching strategies based on school characteristics. Schools should identify their unique strengths and weaknesses in biology education and implement targeted interventions to enhance student engagement and success. For instance, boys' schools and mixed schools could learn from the positive outcomes observed in females' schools and adopt similar practices that foster inspiration and motivation in practical learning.

REFERENCES

Abrahams, I. & Millar, R. (2008). Does practical work really work? A study of the effectiveness of practical work as a teaching and learning method in school science. *International Journal of Science Education*, *30*(14), 1945-1969

Adeogun, A. A. (2001). The principal and the financial management of public secondary schools in Osun State. *Journal of educational system and development*, *5*(1), 1-10.

Adeogun, M. J., & Hay, J. N. (2001). Structure control in sol-gel silica synthesis using ionene polymers. 2: evidence from spectroscopic analysis. *Journal of sol-gel science and technology*, *20*, 119-128.

Akinmade, C.T.O (2018). An Investigation of Attitude and Perceptions of Junior High School Students towards Science Courses. *Dissertation Abstract International* Vol. 43, No.2, p.413.

Aluko, R. (2014). From evaluation to reflection-on-action: Lessons learnt from the impact of a distance education programme. *South African Journal of Higher Education*, *28*(5), 1497-1512.

Amedu, O. I. (2015). The Effect of Gender on the Achievement of Students in Biology Using the Jigsaw Method. *Journal of Education and Practice*, *6*(17), 176-179.

Babayomi, A. O. (1999). Comparative study of the teaching and learning resources in private and public secondary schools in Lagos State. *An Unpublished M. Ed. Dissertation). University of Lagos, Lagos*.

Bandura, A. (1997). Self-efficacy: The exercise of control. New York: Freeman

Banu, D. P. (1985). Science Education in Nigeria Secondary Schools. *A reappraisal studies in science education*, *9*(0), 33-46.

Bell, F.H (1980). *Teaching Elementary School Mathematics: Methods and Contents for Grade 1 – 8*. Dubuque, Iowa WMC: Brown Company publisher.

Bennell, P., & Akyeampong, K. (2007). *Teacher motivation in sub-Saharan Africa and south Asia* (Vol. 71). London: DfID.

Burrow, E.D (2008). *The Relationship among Secondary Science Students Locus of Control, Views of the tentativeness of Science, Attitudes, Perceptions of Teaching Strategies and Achievement.* Dissertation Abstract International Vol. 39, No. 7, p.2165.

Bwire, P. M. (2015). *Influence of gender perception on academic performance of female students in Kenya secondary schools; case of Bungoma south sub-county* (Doctoral dissertation, University of Nairobi).

Chukwunyeremunwa, M. A. (2013). Effect of students improvised instructional materials on senior secondary school students' achievement in biology. *Unpublished Master's thesis). University of Nigeria, Nsukka*.

Connor, J. M., Serbin, L. A., Chipman, S. F., Brush, L. R., & Wilson, D. M. (1985). Women and mathematics: Balancing the equation.

Coombs, C. H., Dawes, R. M., & Tversky, A. (1970). Mathematical psychology: An elementary introduction.

Dania, P. O. (2014). Effect of gender on students' academic achievement in secondary school social studies. *Journal of Education and Practice*, *5*(21).

Datnow, A., Hubbard, L., & Woody, E. (2001). Is Single Gender Schooling Viable in the Public Sector? Lessons from Californias Pilot Program. Final Report.

Dovidio, J. F., Glick, P., & Rudman, L. A. (Eds.). (2008). *on the nature of prejudice: Fifty years after Allport*. John Wiley & Sons.

Driver R, Bell B (2016). Students Thinking and Learning of Science: A Constructivist View. *School Science Review*. 67(240):443-456.

Eddy, S. L., Brownell, S. E., & Wenderoth, M. P. (2014). Gender gaps in achievement and participation in multiple introductory biology classrooms. *CBE—Life Sciences Education*, *13*(3), 478-492.

Eddy, S. L., Brownell, S. E., & Wenderoth, M. P. (2014). Gender gaps in achievement and participation in multiple introductory biology classrooms. *CBE—Life Sciences Education*, *13*(3), 478-492.

Faleye, B. A., & Afolabi, E. R. I. (2005). The predictive validity of Osun State junior secondary certificate examination.

Fareo, D.O. (2019). Study attitude and academic achievement in biology at secondary school level in Mubi Metropolis of Adamawa state. *International Journal Scientific and Research Publications, 9*(8), 333-340.

Fennema, E., & Ayer, M. J. (1984). *Women and Education. Equity or Equality?* McCutchan Publishing Corporation, PO Box 774, Berkeley, CA 94704.

Filgona, J., & Sababa, L. K. (2017). Effect of Gender on Senior Secondary School Students' Academic Achievement in Geography in Ganye Educational Zone, Nigeria. *European Journal of Education Studies*.

Gillion, D. Q., Ladd, J. M., & Meredith, M. (2014). Education, party polarization and the origins of the partisan gender gap. *Social Science Research Network SSRN*.

Gurian, E. H. (2001). What is the object of this exercise? A meandering exploration of the many meanings of objects in museums. *Humanities Research*, *8*(1), 25-36.

Gurian, M., Stevens, K., & Daniels, P. (2009). *Successful single-sex classrooms: A practical guide to teaching boys & girls separately*. John Wiley & Sons.

Hinneh, J. T. (2017). Attitude towards practical work and students „achievement in biology: A case of private senior secondary school in Botswana. *IOSR Journal of Mathematics*, 13(4), 6-11.

Hinneh, J. T. (2017). Attitude towards practical work and students' achievement in biology: A case of a private senior secondary school in Gaborone, Botswana. *IOSR Journal of Mathematics*, *13*(4), 6-11.

Hofstein, A., & Mamlok-Naaman, R. (2011). High-school students' attitudes toward and interest in learning chemistry. *Education química*, *22*(2), 90-102.

Hopkins, R. (1997). *Educating Black males: Critical lessons in schooling, community, and power*. State University of New York Press.

Hussain, A., & Abalkhail, A. M. (2013). Determinants of library use, collections and services among the students of engineering: a case study of King Saud University. *Collection Building*, *32*(3), 100-110.

Hussaini, I., & Akhtar, Y. (2013). Attitudes of secondary school students towards biology as a school subject in Birninkebbi Metropolis, Nigeria. *International Journal of Research and Reviews*, 2 (10), 596-600.

Iliyasu H., Lee M.F, Yahya K., (2015) Attitudes of secondary school students towards Biology as a subject in Birnikebbi Metropolis, Nigeria, *International Journal of Research and Society E-ISSN: 2349-9788.*

Kalender, I. & Berberoglu, G. (2009). An Assessment of factors related to science achievement of Turkish students. *International Journal of Science Education*, 31(10), 1379-1394.

Kambaila, C. M., Kasali, G., & Kayamba, F. (2019). Assessing the effects of Biology Practical Activities on Academic Performance of Senior Secondary School Students, Zambia.

Kashu, J. N. (2014). *Survey on gender and academic performance in secondary schools in Kenya* (Doctoral dissertation, University of Nairobi).

Kenya National Examination Council. (2021). the Year 2020 Kenya Certificate of Secondary Examination Candidates Performance Report, Nairobi.

Kibirige, I. and Tsamago, H. (2013) „Learners ‟ Performance in Physical Sciences Using Laboratory Investigations‟‟, *International Journal of Electrochemical Science,* 5(4), pp. 425–423.

Kibirige, I., & Hodi, T. (2013). Learners' performance in Physical Sciences using laboratory investigations. *International Journal of Educational Sciences*, *5*(4), 425-432.

Kiilu, C. N; Mwania, P & Mumo, R. M. (2022). Keywords: Kenya, Makueni, Kiliungu, Performance, Biology, Secondary School Challenges Facing the Performance in Biology in Public Secondary Schools in Kilungu Sub-County, Makueni County, Kenya. Journal of Popular Education in Africa. 6(11), 28 – 40

Klein, S. S., Ortman, P. E., Campbell, P., Greenberg, S., Hollingsworth, S., Jacobs, J., ... & Wiggins, J. (1994). Continuing the journey toward gender equity. *Educational Researcher*, *23*(8), 13-21.

Kombo, D. K., & Tromp D.A., (2009). Proposal and Thesis Writing. Nairobi: Pauline‟s publications African. *Educational Social Science*, Hanezja HP Press, Maseno.

Kothari, C. R., (2009). Research Methodology: Methods and Techniques. (2nd Ed).Age, New Delhi, International publishers.

Lasoi, C. J. (2017). *Boards of Managements' Initiatives Influencing Quality Education in Secondary Schools in Kajiado West Sub–County, Kajiado County* (Doctoral dissertation, University of Nairobi).

Lee, B. N., & Adams, T. H. (1994). Overexpression of fIbA, an early regulator of Aspergillus asexual sporulation, leads to activation of brIA and premature initiation of development. *Molecular microbiology*, *14*(2), 323-334.

Lee, V. E., & Burkam, D. T. (1996). Gender differences in middle grade science achievement: Subject domain, ability level, and course emphasis. *Science Education*, *80*(6), 613-650.

Lee, V. E., Marks, H. M., & Byrd, T. (1994). Sexism in single-sex and coeducational independent secondary school classrooms. *Sociology of education*, 92-120.

Lee, V.E.and Lockheed, M.A (1990). The Effect of Single Sex Schooling on Achievement and Attitudes in Nigeria. *Comparative Education Review*. 34 (2): 209- 231.

Linn, M. C., & Hyde, J. S. (1989). Gender, mathematics, and science. *Educational researcher*, *18*(8), 17-27.

Millar, R. (2004). The role of practical work in the teaching and learning of science. *Commissioned paper-Committee on High School Science Laboratories: Role and Vision. Washington DC: National Academy of Sciences*, *308*.

Mordi, C (2019). Factors Associated with Pupils‟ Attitude Towards Science in Nigeria Primary Schools. *Research in Science and Technological Education.* 9(1): 39-49.

Morris, D., Shaw, B., & Perney, J. (1990). Helping low readers in grades 2 and 3: An after-school volunteer tutoring program. *The Elementary School Journal*, *91*(2), 133-150.

Mugenda, O. M. and Mugenda, A.G. (2009). *Research Methods: Quantitative and qualitative approaches.* Nairobi. Act Press.

Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative & qualitative apporaches* (Vol. 2, No. 2). Nairobi: Acts press.

Mung'ala-Odera, V., White, S., Meehan, R., Otieno, G. O., Njuguna, P., Mturi, N., & Newton, C. R. J. C. (2008). Prevalence, incidence and risk factors of epilepsy in older children in rural Kenya. *Seizure*, *17*(5), 396-404.

Musasia, A. M., Abacha, O. A., & Biyoyo, M. E. (2012). Effect of Practical Work in Physics on Girls' Performance, Attitude change and Skills acquisition in the form two-form three Secondary Schools' transition in Kenya. *International Journal of Humanities and Social Science*, *2*(23), 151-166.

Musasia, A.M., Abacha, O.A., & Memba Emmah Biyoyo, M.E. (2017)**.** Effect of practical work in physics on girls‟ performance, attitude change and skills

acquisition in the form two-form three secondary schools‟ transition in Kenya. *International Journal of Humanities and Social Science* 2 (23).

Mwiria, K. (1985). The harambee School Movement in Kenya.

Ndonga, W (2019). "The relationship Between Attitude and Academic Achievement in Science Amongst Form Four Students in Ukwala Division, Siaya District. Unpublished M.Ed. Thesis. Kenyatta University

Njuguna, S (2008). "The relationship Between Attitude and Academic Achievement in Science among Form four Students in Kigumo Division. Unpublished M.Ed. Thesis. Moi University.

Nyakach, Kenya. *Research Journal of Educational Studies and Review*, 1 (5), 111-117.

Oakes, J. (1990). Multiplying inequalities: The effects of race, social class, and tracking on opportunities to learn mathematics and science.

Odom, A., Stoddard, E. R., & LaNasa, S. M. (2007). Teachers‟ practices and middle school science achievements. *International Journal of Science Education*, 29(11), 1329-1346.

Oluwatelure, T. A. (2015) Gender difference in achievement and attitude of public secondary school students towards science. *Journal of Education and Practice*, 6 (2), 87-92.

Orodho, A. (2009). *Techniques or Writing Research Proposal and Reports in*

Osborne, J. *(2003).* Attitudes towards science: A review of the literature and its implications. *International Journal Science Education* 25 (9), 1049–1079

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International journal of science education, 25*(9), 1049-1079.

Otieno, V. O. (2021). *Impact of Availability of Teaching and Learning Resources on Students' Performance in KCSE Physics in Public Secondary Schools in*

Ndhiwa Sub-county, Homabay County, Kenya (Doctoral dissertation, University of Nairobi).

Owino O. A., Yungungu A. M., Ahmed, O. & Ogolla B. O. (2015)**.** The relationship between students‟ attitude towards biology and performance in Kenya Certificate of Secondary Education Biology in Selected Secondary Schools in

Padmanabhan, K. A., Vasin, R. A., & Enikeev, F. U. (2001). *Superplastic flow: phenomenology and mechanics* (Vol. 82). Berlin: Springer.

Pahlke, E., Patterson, M. M., & Galligan, K. (2012). Rationales for single-sex schooling: Administrator, teacher, parent, and student perspectives. In *meeting of the American Educational Research Association, Vancouver, British Columbia, Canada*.

Prokop, P., Tuncer, G., & Chuda, J. (2007). Slovakian students‟ attitudes toward biology. *Eurasia Journal of Mathematics, Science & Technology Education*, 3(4), 287-295

Puangjakta, J., & Vinitwatanakhun, W. (2014). A Study of Teachers' Perceptions toward Human Resource Management in an International School in Prawet District, Bangkok, Thailand. *ABAC Journal*, *6*(1).

Republic of Kenya (1964) (GOK, 1964). Kenya Education Commission (Ominde Report). Government Printer: Nairobi.

Riordan, C. (1994). The value of attending a women's college: Education, occupation, and income benefits. *The Journal of Higher Education*, *65*(4), 486-510.

Sadker, D., & Zittleman, K. R. (2009). *Still failing at fairness: How gender bias cheats girls and boys in school and what we can do about it*. Simon and Schuster.

Sakariyu, A. O., Tiawo, M. O. & Ajagbe, O. W. (2016). An investigation on secondary school students‟ attitude towards science in Ogun State. *Journal of Education and Practice*, 7(28), 125-128.

Sax, L. J., Bryant, A. N., & Harper, C. E. (2005). The differential effects of student-faculty interaction on college outcomes for women and men. *Journal of College Student Development*, *46*(6), 642-657.

Schunk, D. H. (2012). Social cognitive theory. In K. R. Harris, S. Graham, & T. Urdan (Eds.), Educational psychology handbook: Vol. 1. Theories, constructs, and critical issues (pp. 101-123). Washington, DC: *American Psychological Association*.

Schunk, D. H., & Usher, E. L. (2019). Social cognitive theory and motivation. In R. M. Ryan (Ed.), The Oxford handbook of human motivation (2nd ed., pp. 11-26). New York: Oxford University Press.

Shapka, J. D., & Keating, D. P. (2003). Effects of a girls-only curriculum during adolescence: Performance, persistence, and engagement in mathematics and science. *American Educational Research Journal*, *40*(4), 929-960.

Sharpe, R. M. (2012). Secondary school students‟ attitudes to practical work in school science. University of York Education. Strengthening of Mathematics and Sciences in Secondary Education (SMASSE) Baseline report (1998).

Sharpe, R. V., & Swinton, O. H. (2012). Beyond anecdotes: A quantitative examination of Black women in academe. *The Review of Black Political Economy*, *39*(3), 341-352.

Warner, R. M. (2012). *Applied statistics: From bivariate through multivariate techniques*. Sage publications.

Wekesa, V., & Kitainge, K. (2022). Academic Performance of Upgraded Extra-County Schools to National Status in Western Kenya Counties. *East African Journal of Education Studies*, *5*(1), 25-36.

Yadav, B., & Mishra, S. K. (2013). A study of the impact of laboratory approach on achievement and process skills in science among is standard students. *International Journal of Scientific and Research Publications*, *3*(1), 1-6.

Yeya, M. S. (2002). *An investigation of the probable causes of poor achievements in Kenya Certificate of Secondary Examination (KCSE) in Matung"a Division; Kwale District Coast Province*. Unpublished Med Thesis Kenyatta University.

Zdenek, K., &Hana, P. (2008). About the Project Education at the Secondary School at Czech Republic .Lat. *Am. J. Phys. Educ., Vol*. 2(3):212-213.

APPENDICES

APPENDIX I: INTRODUCTORY LETTER

Dear Respondent

I am a post graduate student, pursuing a master's degree in science education of University of Eldoret. I am conducting a research entitled effects of students‟ attitude in practical work on academic performance in biology in Turbo sub-county, Kenya The purpose of this letter is to request for your indulgence to allow me collect relevant data from you. The data collected shall be treated with utmost confidentiality and only used for the intended purpose.

Thank you,

Yours Sincerely

Irene Chemutai Sang

APPENDIX II: QUESTIONNAIRE

A: Teacher's questionnaire

Dear Teacher

I Irene Chemutai Sang, doing a research on effects of students‟ attitude in practical work on academic performance in biology in Turbo sub-county, Uasin Gishu County, kindly I request you to fill this questionnaire. Kindly give a genuine response by ticking inside the box and giving further information where need be. The study is purely for academic purposes and the information given herein was kept confidential.

Section 1: Demographic information of the respondents

1. What is your gender? Male [ ] Female [ ]

2. What is your qualification Graduate teacher [ ] Untrained teacher [ ]

Others (specify)……

3. How many years of working experience do you have?

0-5 [ ] 6-10 [ ] 11-15 [ ] 16-20 [ ] 21 and above [ ]

Section 2: Information on Teaching

1. How many lessons do you have per week?

2. For how long have you been in your current station?

Less than 1 year [ ] 1-5 years [ ] 6-10 years [ ]

11-15 years [ ] more than 15 years [ ]

3. How do you like teaching?

Very much [ ] Moderately [ ]

Very little [ ] Not at all [ ]

Section 3: Information about Biology practical's/teachers opinion

1. Do your students give a lot of value in biology practical?

Yes [ ] No [ ]

2. What is your opinion on biology practical as a subject

Dull [ ] Tedious [ ] Interesting [ ] Very Interesting [ ]

3. What are the general attitude of your students towards biology practical Very responsive [ ] Positive [ ] Negative [ ] very negative [ ]

4. What do your students like about biology practical?

Teaching [ ] the teacher [ ] the subject Content [ ]

Any other (specify)

……

The following statements relate to effects of students‟ attitude in practical work on academic performance in biology in turbo sub-county, Uasin Gishu County. Using the rating given below, provide your response in relation to the extent to which you agree to the statement: Strongly agree (SA) 5, Agree (A), 4, Undecided (U) 3 and Disagree (D) 2, and strongly disagree (SD) 1

	SA	**A**	**U**	**D**	**SD**
A biology practical challenges students to use their time well.					
Biology practical encourages students to be enthusiastic about learning.					
Biology practical make students to look forward to learning and improvement in Biology					
Biology practical provoke students to seek for knowledge					
Biology practical help students to assess their ability					
Biology practical results proves that learning has taken place in a student					
Continuous assessment tests encourage students to study					
Frequent examinations inspire students to achieve highly.					

Thank you

B: Questionnaire for Students.

Section I – students bio-data

School category: Extra-county [ ] County [ ] sub-county [ ]

School type: Girls School [ ] Boys school [ ] Mixed school [ ]

Gender: Male [ ] Female [ ]

Section II

1. Which of the following problems affects you during biology practical work

(a) Lack of interest [ ]

(b) Inadequate learning resources [ ]

(c) Language used by the teacher [ ]

(d) Lack of confidence [ ]

(e) Any other (specify)……

The following statements relate to research on effects of students‟ attitude in practical work on academic performance in biology in Turbo sub-county, Uasin Gishu County. Using the rating below, provide your response in relation to the extent to which you agree to the statements. Strongly agree (SA) 5 points Agree (A) 4 points Undecided (U) 3 points Disagree (D) 2 points and Strongly Disagree (SD) 1 point

Questionnaire on Motivation	**SA**	**A**	**U**	**D**	**SD**
Biology practical inspire me to read ahead of the teacher					
Biology practical encourages me to excel in Biology					
Biology practical make me work hard towards attaining quality grades					
Biology practical challenges me to improve performance in biology subject					
Frequent biology practical help me to refine what I have not mastered in biology					
Failure in biology practical provoke me to work harder					
Biology practical are not interesting					
Biology practical are useful in life					
I feel anxious and fearful during biology practical examination					
I have adequate learning resources					
My gender interferes with my learning biology practical					
Biology practical work are technical to learn					

Thank You

APPENDIX III: INTERVIEW SCHEDULE

1. What is the name of your school?

   .....

2. For how long have you been a teacher?

   .....

3. What do you think are the students‟ attitude of the biology practical work on their biology performance?

   .....

   .....

4. Is there any relationship between the students‟ attitude in practical work and their academic performance in Biology?

   .....

   .....

5. Is there any correlation between the gender attitude towards biology practical work from single sex and mixed secondary schools?

   .....

   .....

6. What is the relationship between the category of school and students attitude towards Biology practical work?

   .....

   .....

APPENDIX IV: RESEARCH PERMIT

University of Eldoret
Flame of knowledge and innovation

P.O. Box 1125-30100, ELDORET, Kenya
Tel: 053-2063111/8 Ext.2032
Fax No. 20-2141257
Email: soe@uoeld.co.ke
www.uoeld.ac.ke

UNIVERSITY OF ELDORET

SCHOOL OF EDUCATION
CENTRE FOR TEACHER EDUCATION

Ref: UOE/B/CTE/REF/034 **Date:** 6th September, 2022

To
The Executive Secretary,
National Council for Science and Technology,
P.O. Box 30623-00100,
NAIROBI.

Dear Sir/Madam,

SUBJECT: **RESEARCH PERMIT FOR: IRENE CHEMUTAI SANG**
REG. NO.: SEDU/CTE/M /012/21

This is to confirm that the above named Post Graduate Student has completed Course Work and has successfully defended her thesis proposal.

She is currently preparing for a Field Research Work on her thesis entitled: *Effects of students attitude in practical work on academic performance in Biology in Turbo Sub- county, Kenya.*

Any assistance accorded to her to facilitate successful conduct of the research will be highly appreciated.

Yours Faithfully,

HEAD
Centre for Teacher Education
UNIVERSITY OF ELDORET

DR. R. M. AMIN'GA
HEAD, CENTRE FOR TEACHER EDUCATION

APPENDIX V: RESEARCH LICENCE

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 469310

Date of Issue: 23/December/2022

RESEARCH LICENSE

This is to Certify that Miss.. Irine chemutai Sang of University of Eldoret, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Uasin-Gishu on the topic: EFFECTS OF STUDENTS' ATTITUDE IN PRACTICAL WORK ON ACADEMIC PERFORMANCE IN BIOLOGY IN TURBO SUB-COUNTY, UASIN GISHU COUNTY for the period ending : 23/December/2023.

License No: NACOSTI/P/22/22874

469310

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions

APPENDIX VI: BIOLOGY PRACTICAL

REQUIREMENTS

1. Test tubes in a rack 6
2. 0.1% sodium chloride
3. 1.4% sodium chloride
4. 3 droppers
5. White tile
6. Iodine solution
7. Benedict’s solution
8. Amylase / diastase enzyme labelled solution A
9. Water bath
10. Four labels
11. Starch solution labelled solution C
12. Thermometer
13. Measuring cylinder
14. A freshly picked hibiscus twig with a regular flower (should have flower and a leaf or two) labelled M
15. Hand lens
16. Scalpel

NAME: ……..…….…..……..……..

SCHOOL: …….....……

INDEX NO: ……..……..…..……..

DATE: ……

231/3

BIOLOGY

PAPER 3 (PRACTICAL)

TIME: 1:30 Hour

INSTRUCTIONS TO CANDIDATES

- *Write your **name, index no** and name of your school in the spaces provided above*
- *Write the **date** of examination in the spaces provided.*
- *This paper consists of two questions*
- *Answer **all** the questions in the spaces provided.*
- ***You are required to spend the first 10 minutes of the 1 Hour allowed for this paper reading through all the questions before commencing your work**.*
- ***Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing.***

For Examiners Use Only

Question	Maximum score	Candidate's score
1	13	
2	7	
Total Score	20	

1. You are provided with 6 test tubes, solution C, droppers, a white tile, iodine solution,

0.1% sodium chloride, 1.4% sodium chloride, Benedict's solution, solution A, water bath and labels.

a) Label three tests S, T and U. Into each test-tube, place 3ml of solution C.

b) Put a drop of solution C on a white tile and add a drop of iodine solution.

Record your observation. **(1mk)**

.....

C) Add 3 drops of 0.1% sodium chloride solution and 2ml of solution A to test tube T. To test-tube U add three drops of 1.4% sodium chloride solution and 2ml of solution A. Sodium chloride is a source of sodium ions. Place the test tube S, T and U in a water bath

Maintained at 37^{o}C for 30 minutes. Using a drop of the solution from each test-tube repeat the procedure in (a) above and spare the rest for the next question. Record your observation in the. Table below **(3mks).**

Test-tube	Observation at the end of experiment
S	
T	
U	

c) i) Put $2cm^3$ of solution from test-tube S in a clean test-tube and add $2cm^3$ of Benedict solution, shake then heat the mixture to boil. Record your final observations in the table

Below. Repeat the procedure for solution T and U. **(4mks)**

Test-tube	Observation at the end of experiment
S	
T	
U	

ii) Account for your results in test-tube T and U. **(1mks)**

.....

d) Why was the test-tube S included in the experiment? **(2mk)**

.....

e) Suggest the identity of solution A. **(1mk)**

.....

f) Why was the water bath maintained at $37^{o}C$ **(1mk).**

…….

2. You are provided with specimen labelled M.

a) Using floral parts and the leaves, classify the plant from which part M was obtained into class and give reasons.

Class**.....**

Reasons **(1mks)**

....

b) Suggest the pollinating agent for the specimen M and give reasons. Pollinating agent **……. (1mk)**

Reasons - **(1mks)**

.....

c) Dissect the flower longitudinally into two equal parts and examine one of the parts using a hand lens.

Describe the following parts **(2mks)**

i) Androecium **(1mks)**

.....

ii) Gynoecium **(1mks)**

.....

d) Use the hand lens to observe the pistil closely, draw the pistil only and label the parts.**(2mks)**

Describe the following parts

i) Androecium **(1mks)**

.....

ii) Gynoecium **(1mks)**

.....

.....

APPENDIX VII: SIMILARITY REPORT

University of Eldoret

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