INTEGRATION OF INQUIRY-BASED APPROACH IN TEACHING AND ITS IMPACT ON STUDENTS' ATTITUDE TOWARDS LEARNING BIOLOGY IN SECONDARY SCHOOLS, KIAMBU COUNTY, KENYA

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DECLARATION

This thesis has not been submitted for certification to any other University or institution; it is entirely my own work. All sources are referenced using APA 7th edition system and anti-plagiarism standards.

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DEDICATION

To God Almighty, who has faithfully guided me along this path, do I dedicate this thesis. I am grateful.

I commit this thesis to my dear wife, Beatrice K. Doboyou and my son, David W. Doboyou for their love, inspiration, prayers, commitment, dedication, faithfulness and encouragement during my two years of stay in Kenya.

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ABBREVIATIONS AND ACRONYMS

CBC	Competency-Based Curriculum
CEMASTEA	Centre of Mathematics, Science and Technology Education in Africa
SCEO	Sub-County Education Officer
ERG	Educational Reform of Ghana
IBA	Inquiry-Based Approach
INSET	In-Service Education and Training
JICA	Japan International Cooperation Agency
KICD	Kenya Institute of Curriculum Development
KNEC	Kenya National Examinations Council
KNBS	Kenya National Bureau of Statistics
KCSE	Kenya Certificate of Secondary Education
NACOSTI	National Commission for Science, Technology and Innovation
MOE	Ministry of Education
SCQAO	Sub-County Quality Assurance Officers
SPSS	Statistical Package for Social Sciences
SPS	Science Process Skill
SMASSE	Strengthening of Mathematics and Science in Secondary Education
TPDP	Teacher Professional Development Programme

ABSTRACT

The study looked into the integration of Inquiry-Based Approach (IBA) in teaching and its impact on students' attitude towards learning Biology. The objectives were to: determine the extent to which teachers of Biology use IBA; determine teacher's ability levels to integrate inquiry-based approach in teaching Biology; establish the impact of IBA on the attitude of students towards learning Biology; and determine students' attitude towards learning Biology. The study was anchored on the experiential learning theory proposed by David Kolb (1984) and the constructivism theory by Jerome Bruner (1960). In this study, a descriptive survey design was used. A population of 1,194 students from Form three and 29 teachers of Biology from 33 secondary public schools were targeted. Eleven schools were chosen using stratified random sampling technique. Also, a purposive sampling technique was employed to pick 14 teachers while 344 students in Form three were selected for the study using simple random sampling technique. For data collection, the study used questionnaires, interview, and classroom observation guide. Two (2) schools participated in a pilot study to determine the validity and reliability of the research instruments. The data was analysed employing Statistical Package for Social Sciences (SPSS). Findings from the study revealed that majority of the teachers do not often adopt inquiry-based approach. Also, it was found that most of the teachers have the ability to implement inquiry-based approach. Teachers of Biology emphasized on confirmatory inquiry than Guided, Structured and Open inquiry. It was concluded that integration of IBA impacts students' attitude towards learning Biology. Also, it was demonstrated that majority of the students have positive attitude about learning Biology. The study recommends that teachers should use other levels of inquiry and should be continuously trained in using the approach. It is important to also allow students to design experiments individually. The findings of the study are vital in the educational institutions in encouraging Biology teachers to fully integrate IBA, since there is a transition from expository to the CBC methodologies among teachers in Kenya.

CHAPTER ONE

INTRODUCTION

This section contains the background of the study, statement of the problem, the purpose, objectives, and research questions. It also addresses the importance of the study, its scope, limitations and delimitations, the assumptions, the theoretical and conceptual frameworks, and the operational definitions of terminology.

1.1 Background to the Study

Inquiry-based approach (IBA) enables students to construct their knowledge and comprehension by investigating and researching topics based on prior knowledge (Shanmugavelu et al., 2020). The integration of IBA places the questions of students central in learning and emphasises on research, knowledge and understanding of Biology. According to Shanmugavelu et al., teaching and learning through inquiry-based approach helps students develop their knowledge and attitude in the subject and improves performance.

In Indonesia, Andrini (2016), found that the interest and creativity of science students to learn is influenced by selecting appropriate teaching approaches, such as IBA. Teachers become facilitators and mediators in the process of employing this approach. They facilitate learning by using their skills to explain the concepts to the students. According to the study, integration of inquiry-based approach engages students to investigate, actively observe, guess, make inferences and communicate results. Integration of IBA improves students' performance as well as their attitude towards learning Biology (Briones et al., 2021; Chemiat, 2020; Islam & Tasnim, 2021; Olufemioladebinu et al., 2018).

In the Philippines, Lopez (2021), established that the performance of students and the development of their attitude was influenced by teachers' professional development, education level, and the way they integrate inquiry-based approach. A study done in Turkey by Can and Boz (2012), revealed that there were positive changes in terms of enjoyment and importance of Chemistry among grade nine (9) and grade 10 students. It was also revealed that the attitude of individuals towards learning about Science subjects correlate to their feelings about science lessons. If Science teachers use effective teaching approaches, such as inquiry-based approach, to make sure that students have positive experiences and feelings from the beginning of learning, then, students will perform better. This will also have impact in developing positive attitude towards the subject (Bicer & Lee, 2019).

The integration of IBA incorporates student-centred approaches, hands-on-activities and practical activities. In Ghana, Tordzro et al. (2021), acknowledged that the best method for teaching and learning Biology is through hands-on activities that can be completed in the field, laboratory, or in the classroom. The Educational Reform of Ghana (ERG), highlighted that Biology instruction should be centred on practical activities, because they inspire students' interest. It also improves knowledge acquisition and transfer.

A study conducted by Hattie (2003), in New Zealand, revealed that teachers play major roles in developing students' interest towards learning Biology to improve their performance. According to Blanchard et al. (2010), teachers contribute 30% of students' achievement in Science, while the school environment in terms of being conducive or uncomfortable, parental influence on the students and peers all contribute a total of 20% towards students' performance.

In Ghana, Annan et al. (2019), found that students become motivated and perform well in Biology if they develop positive attitude. The study recommended that teaching should be done

through the implementation of IBA. According to the study, inquiry-based approach requires building a scientific environment similar to that of scientists which requires asking questions, observing, experimenting and communicating results. Students receive guidance during the learning process (Gathage et al., 2021). Also, they can experience the process of creating and defending knowledge by following the procedures taken by Scientists. In order to grow a technological country, the study's findings recommended the integration of IBA during teaching since it influences students' attitude and performance. Since attitude influences performance, understanding the integration of IBA, its impact on the attitude of students is important. In Nigeria, Falemu and Akinwumi (2021), found that integration of inquiry-based approach improves students' learning preferences particularly, Biology practical activities.

In Tanzania, Ndayambaje (2021), revealed that due to poor performance, few high-performing students are chosen to study Biology at colleges and universities. It was found that improving performance is the need for using effective teaching strategies since it is the core of educating students.

In Kenya, Wamukota and Masibo (2017), revealed that there are a range of variables that influence students' performance, some of which are: students' interest in the subject, motivation to study, students' career choice, and teaching methods (Ogutu et al. 2014). According to the study, IBA can be utilized to involve the students in the process of learning, resulting in improved learning and development of positive attitude towards the subject.

In Nyakach, Thika West District, Kenya, it was found that an individual with a positive attitude will perform better, compared to an individual with a negative one (Owino et al., 2015; Muthoni, 2012). According to the study, the inability of students to grasp the concepts of Biology lessons, is due to poor presentation of the contents; which most often results to dismal

performance. Similar concern of students' inability to conceptualize Biology knowledge was raised in the analysis of KCSE Biology performance report in Kenya which resulted to poor performance of the candidates in 2020. It has been established that an effective teaching approach encourages students to put in more effort in their studies by fostering a positive attitude towards learning.

The transition from a Content-based Curriculum to a Competency-based Curriculum (CBC), according to Isaboke et al. (2021), demands a change in the teaching approach. Implementation of inquiry-based approach will enable teachers of Biology to maintain and extend the implementation of CBC. The rationale for making the decision to implement IBA is that CBC learners will relate easily with IBA and the integration of IBA will enhance achievement of the goals of CBC. According to M'mboga (2021), CBC has the ability to promote the acquisition of skills. According to Sifuna and Obonyo (2019), CBC, like the IBA, places emphasis on the improvement of skills and use of information in practical life situations. It aims at developing the skills of students to use appropriate knowledge that will enable them complete a project (Atieno & Kanake, 2021; Amunga et al., 2020; Ngwacho, 2019). The integration of IBA correlates and fulfils CBC's objectives as it motivates and engages students into extracurricular activities, thereby developing their attitude (Waseka & Simatwa, 2016). It is very crucial to investigate the integration of IBA and the impact it has on students' attitude towards learning Biology.

According to Ogutu et al. (2014), students' interest and attitude towards a subject encourages them to put in more time to study and this enhances performance. In Kenya, according to Muriithi (2022), concerns have been raised by educators and medical practitioners, regarding the decrease in the quantity of students receiving diplomas in Nursing programs as a result of low performance in Biology at KCSE. It was reported that a grade of C^+ (plus) in Biology is

required for a candidate to achieve a diploma in Nursing. According to Ochungo et al. (2021), students' Biology results draws a national concerns because, those who score low grades, that is, grade below C^+ (plus), are not permitted to study courses such as medicine, engineering, law and pharmacy (Waseka & Simatwa, 2016).

By adopting the CBC curriculum, the Kenyan Government chose to move away from primarily expository teaching and learning approaches towards heuristic approach which implies more of student-centered methodologies such as the IBA. This approach is necessary because it improves the ability of students to do well in Biology lessons and develops their attitude (Kiige & Atina, 2016). The Kenya Government, together with the Japan International Cooperation Agency, (JICA), in 1998, initiated the Strengthening of Mathematics and Science in Secondary Education (SMASSE) with the aim of raising students' academic performance in Science subjects and Mathematics. Since 2003, Biology teachers have participated in professional development programs sponsored by the Centre of Mathematics, Science and Technology Education in Africa (CEMASTEA).

To improve students' attitude and performance in Biology, the Kenya National Examinations Council (KNEC) (2020), recommends the implementation of learner-centered approaches, one of which is inquiry-based approach. The integration of this approach and its impact on students' attitude towards learning Biology are not sufficiently covered in the literature in the study locale. Investigating the integration of IBA and its' impact on the attitude of students, was the purpose of this study.

1.2 Statement of the Problem

According to research, integration of IBA requires students to actively engage in critical thinking as opposed to just listening to lectures and taking notes. Unlike the traditional learning methods, the integration of IBA develops and improves the attitude of Biology students to learn. Research evidence shows that an individual with a positive attitude towards learning Biology performs better. In describing better performance in Biology, a mean score of C^+ (plus) is considered to study in higher institutions of learning in Kenya. This becomes a challenge for a majority of students since they do not attain a C^+ (plus) in Biology.

In order to enhance students' attitude and performance, the Kenya National Examinations Council recommends the integration of inquiry-based approach among Biology teachers for conceptual understanding. The integration of IBA will enhance positive attitude development and improvement of academic performance in Biology, thus enabling more students to pursue careers in Biology. This will increase scientists specifically, professional medical practitioners in the nation. Consequently, it is imperative to raise the proportion of students that excel in Biology at KCSE. The conceptualization of the study in Githunguri sub-County on the integration of IBA in teaching and its impact on students' attitude towards Biology is to bridge the gap.

1.3 Purpose of the Study

The aim of the study was to investigate integration of IBA in teaching and its impact on students' attitude towards learning Biology in Secondary Schools, Kiambu County, Kenya.

1.4 Objectives of the Study

The study was conducted based on the following objectives:

a) To determine the extent of adoption of IBA by teachers of Biology.

b) To determine the ability levels of teachers to implement IBA in teaching Biology.

c) To establish impact of IBA on the attitude of students towards learning Biology.

d) To determine students' attitude towards learning Biology.

1.5 Research Questions

The study was guided by the following these questions:

a) To what extent do teachers of Biology adopt IBA in teaching?

b) What are the ability levels of teachers to use IBA in teaching Biology?

c) What is the impact of IBA on the attitude of students towards learning Biology?

d) What is the attitude of students towards Biology?

1.6 Significance of the Study

The findings will be a benefit to the Ministry of Education by enabling the development of relevant policies for integration of IBA in education. It will also be of importance to the administrators of schools and the Ministry of Education to appreciate the importance of enhancing the ability and capacity of Biology teachers to use IBA in teaching Biology. The findings will confirm to teachers already implementing IBA that it is the best way to teach Biology. Teachers of Biology and the Ministry of Education will understand how students' attitudes towards learning Biology are impacted by adopting IBA.

1.7 The Scope, Limitations and Delimitations of the Study

This section explored the scope, limitations and delimitations of the study.

1.7.1 Scope the study

The study, which was conducted in Githunguri Sub-County, aimed to find out how IBA integration impacts the attitude of students towards Biology and how it is integrated in teaching.

1.7.2 Limitation of the Study

Insufficient time and resources resulted in limitations to this study. This limitation was addressed by adopting the methodology that matched with the time and available resources such as the utilization of questionnaires, interviews including observational methods to gather data that takes less time to fill in and also consumes less resources. Teachers and students who participated in the study were likewise limited in terms of availability because of class schedules. This limitation was addressed by utilizing the time when they were on break to respond to the instruments. The filling in of the questionnaires was allocated adequate time so as not to interfere with learning.

1.7.2 Delimitation

The study was limited to Biology teachers and students in Form three (3) at 11 public secondary schools in Kiambu County. It also focused on the integration of IBA; its impact on students' attitude towards learning Biology.

1.8 Assumptions of the Study

It was anticipated that the participants might give valid and sincere answers that could be trusted to make inferences. The study also assumed that the items in the instruments addressed the study variables adequately. Further, the study assumed that there was a relationship between the variables.

1.9 Theoretical and Conceptual Framework

The theoretical and conceptual frameworks are discussed in this section.

1.9.1 Theoretical Framework

The research was anchored on two theoretical frameworks; the Constructivism theory by Jerome Bruner (1960) and the Experiential Learning Theory (ELT) by David Kolb (1984). The constructivism theory emphasises that students are the owners of their learning experience. With an emphasis on problem-based learning, they acquire knowledge by doing. This theory applies scientific concepts to actual life situations. It relates facts and concepts for better understanding of a concept in order to investigate problems. It ensures the retention of knowledge acquired, and enables a person to understand the subject under discussion. Inquiry-based-approach is learner-centred and places emphasis on learning through discovery.

According to the principle of experiential learning, knowledge is acquired through experience. It is built on four steps: concrete experience, careful observation, conceptualisation of abstract objects, and practical experience. For instance, an individual with a real-life experience, observes it, then thinks back on it, learns effectively. Through this process, generalizations and abstract concepts are generated which are then used to test theories in in actual life situations. While learners can start the learning cycle at any level, Kolb argues that the stages must be completed in the correct order. The integration of IBA and its impact on students' attitude towards learning Biology are supported by these theories, respectively.

1.9.2 Conceptual Framework

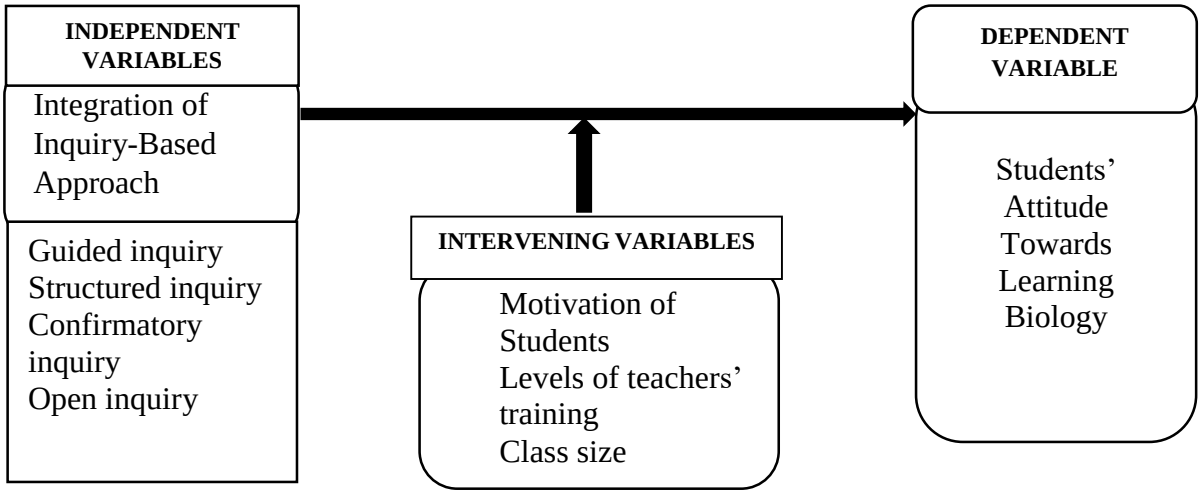

Figure 1.1: Conceptual Framework

As seen in Figure 1.1, how integration of IBA impacts on the attitude of students towards learning Biology is displayed. Integration of IBA was the independent variable, while the attitude of students towards learning Biology was the dependent variable. Further, motivation of students, training of teachers including class size, were the independent variables.

1.10 Operational Definition of Terms

The terminologies mentioned below are those that are utilized in this research.

Attitude means the behaviour of an individual and teachers toward the usage of an inquiry-based approach is referred to as their attitude.

Competence is the ability level of a person to successfully carry out his or her teaching activities in the classroom.

Confirmatory Inquiry in this thesis refers to a method in which students are given a practical task and taught to follow the provided processes to ensure that he or she obtains a similar answer.

Guided Inquiry refers to the process in which students learn to solve problems while the teacher provides help during the learning activities.

Extent of adoption of Inquiry-based approach is referred to the range, or level to which integration of IBA has reached.

Impact of inquiry-based approach is referred to as the influence or effect of IBA on students in an inquiry-based classroom such as actively participating and engaging in the lesson.

In-service refers to programmes of training given to teachers who are already teaching in schools.

Open Inquiry is a learning process where the students create their own problem to solve.

Structured Inquiry refers to a planned learning activity by the teachers for the students to follow to solve a problem.

Teacher's ability level to adopt IBA is the level of skills teachers have that enable them to adopt IBA.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

An overview of relevant literature is given in this section. The literature is organized and reviewed in line with the objectives of the study: the extent to which teachers of Biology adopted IBA in teaching Biology; the ability levels of teachers to adopt IBA; the impact of IBA on students' attitude towards learning Biology; and students' attitude towards learning Biology.

2.2 Extent to which Inquiry-based Approach is Adopted by Teachers of Biology

According to the Mariam Webster Dictionary, extent refers to the frequency, or how often something is done or the limit to which it spreads. The extent to which IBA is adopted in the classroom is influenced by curriculum, students' assessments, and the teachers' educational background (Correia & Harrison, 2020). A study was conducted in Cyprus by Silm et al. (2017) on the readiness of teachers to adopt inquiry-based approach. A sample size of 497 teachers from ten (10) different nations were considered. According to the findings of the study, it was found that IBA was not frequently implemented in the classrooms due to inadequate teachers' training.

In the Philippines, Lopez (2021), investigated the use of IBA in Science and the extent to which it is implemented among secondary schools. A sampled of 102 secondary Science teachers and 400 secondary students were used. The study employed inferential and descriptive statistics for data analysis. The results showed that secondary school Science teachers implemented inquiry-based approach frequently during discussion in the Science classroom. It was discovered that most of the teachers were good at asking questions that could allow students to think critically.

Another study by Kang and Keinonen (2016), revealed that, the size of the class, the use of appropriate resources, and the education levels of teachers affected how often inquiry-based approach was adopted in Finland and South Korea. However, it was found that, teachers did not frequently implement inquiry-based approach because of low confidence levels in teaching Science subjects. The frequent adoption of IBA in Science classes according to Fitzgerald et al. (2019), is greatly facilitated by programmes in teachers professional development. Literature on how often IBA is used is uncertain in Githunguri sub-County. Hence, this study was conducted to bridge the gap.

A research conducted in Zagreb City by Letina (2019) sampled 275 teachers from Grade One (1) to Grade Four (4). The study findings revealed that teachers did not frequently implement IBA in practice. Teachers who more frequently integrated IBA were those who experienced the use of IBA during their formal education. In order for teachers to adopt IBA effectively and confidently in their teaching practice, it was recommended that teacher training programs must include IBA learning activities.

In Canada, Chichekian et al. (2016), demonstrated that teachers who are inexperienced were considerably less likely to use inquiry-based approach. According to the study, the frequency of engaging students in inquiry-based activities reduced over time. Also, Kaya et al. (2021), asserted that American teachers adopted learner-centred approach to a low extent due to their inability. Teachers' beliefs, content knowledge of Biology and past experiences, tend to hinder the adoption of IBA. According to Tang et al. (2020), results from a study from the Czech Republic revealed that the interactions among teachers and the views they have about inquiry-based approach influence the extent to which it is used in their lessons. These studies looked into the beliefs and the views teachers hold towards implementation of IBA and the extent of

implementation. This study aimed at determining how often IBA is adopted in Githunguri Sub-County.

In Germany, Schmid and Bogner (2015), revealed that, since it is challenging to fully adopt IBA in teaching due to insufficient time, teachers should employ it by concentrating on specific components of the topic as deemed necessary. In Ghana, a study conducted by Mohammed et al. (2020), revealed a infrequent use of inquiry-based approach in some schools of Ghana. It was observed that junior high school students attending urban public schools engaged in less inquiry-based activities compared to their counterparts attending rural public schools. In order to effectively adopt IBA, the study recommended investing more learning resources for improving Science education in Ghanaian and African schools.

The Education Ministry along with the Science and Technology in Malawi, redesigned the Elementary School and Teacher Education Curricula in 2008 from expository to heuristic approach in an attempt to raise the standard of Primary Education. Instead of being passive listeners, students must now actively engage in the learning process. In Malawi, Chiphiko and Shawa (2014), conducted a study to investigate how elementary school teachers implemented the heuristic approaches in the District of Kasungu. John Dewey's progressivism learning theory was employed. It was revealed that elementary teachers did not use the heuristic approach at lesson planning level. They failed to engage students in critical thinking and problem-solving activities throughout classroom instruction. In order to determine how often IBA was implemented in Githunguri, a descriptive survey design using a sample of 14 Biology teachers and 344 Form three students was employed.

In Ghana, Mohammed et al. (2020), sought to investigate the extent to which IBA was adopted in Ghanaian junior high schools. In the Central Region of Ghana, a sample size of 503 science students, 18 science teachers, and 23 school administrators from the villages and cities of four (4) districts and municipalities, were selected. Concurrent triangulation mixed methods design was employed. The findings revealed that inquiry-based approach was rarely implemented in the selected Ghanaian junior high schools.

A study done by Nzomo (2023) in Meru sub-County, Kenya, used a mixed method research design. Public and private schools were targeted with a sample size of 42 Form three (3) Chemistry teachers and 357 students. It was found that once a week, teachers employed IBA. According to Ndirangu (2017), IBA was partially implemented in Kenyan Secondary Schools. According to the study, 75% representing 110 of the 147 Science teachers, were not full implementers of IBA as compared to 5% who were fully adopting IBA. Otara et al. (2019), revealed that if teachers are not properly trained, they will not adopt the learner-centred approach. According to Atieno (2013), practical activities should be the basis for teaching Science in Kenan schools. However, the extent of implementation has been low.

In Meru South Sub-County, Njagi (2016) conducted a study to establish the frequency of adoption of IBA in Science in Early Childhood Development Education (ECDE). A sampled size of18 teachers, using Phenomenological interview and Science lesson observation for data collection. The study established the extent of implementation of inquiry-based approach in other parts of Kenya using mixed research design. The finding also showed limited adoption of IBA in Science classes in other parts of Kenya. It has been discovered that there is insufficient literature utilising a descriptive survey design on how often IBA is implementation in Githunguri Sub-County.

2.2 Ability Levels of Teachers to Implement Inquiry-Based Approach in Teaching Biology

Teacher's ability level to implement inquiry-based approach during teaching, according to Ceran and Ates (2020), is referred to their ability to prepare and present inquiry activities, possess pedagogical content knowledge, engage students in critical thinking and questioning skills, understand teaching inquiry using the levels of inquiry effectively, and providing guidance for students during inquiry activities (Eltanahy & Forawi, 2019). According to DiBiase and Mcdonald (2015), the inability levels of the teachers to use IBA is rooted in their feeling of being unprepared. Teachers claimed that they lack basic understanding necessary to integrate inquiry-based approach.

In Canada, Chichekian et al. (2016), discovered that, due to changes in the ability levels of students, their attitude in the subject, and engagement in the lesson, the ability levels of first-year teachers to implement inquiry-based approach in their lessons decreased.

In the United States of America (USA), teachers' inability to adopt IBA in the classroom was a concern (DiBiase & Mcdonald, 2015). The study revealed that 179, representing 65% of the 275 Science teachers, expressed concern about their ability to implement IBA, and 173 representing 63%, argued that IBA required sufficient basic understanding to be implemented fully. In addition, 209 representing 76% of the teachers, claimed that it was challenging to implement inquiry-based approach due to the difficulties it presents to attain instructional objectives. The ability levels of teachers to plan lessons that incorporate inquiry-based activities, is key in implementing the approach. It was concluded that teachers need background knowledge which include; content knowledge, pedagogical knowledge and experience to facilitate teachers' ability levels to implement IBA. According to Kaya et al. (2021), the knowledge teachers have in the content and their experiences are abilities that can improve the

capacity of the teachers to design meaningful research questions and give direction to students during inquiry activities (Ramnarain, 2016). There is no sufficient literature on the teachers' ability levels to adopt inquiry-based approach in Githunguri sub-County, which was the purpose for this study.

A study done by Eltanahy and Forawi (2019), in Dubai revealed that teachers have good understanding in using IBA to teach Science subjects. Despite these abilities, they have misconceptions about IBA and lack the ability to differentiate between the various types of IBA which include; confirmatory, structured, guided and open inquiry. Although it was recommended that teachers integrate structured and guided inquiry in their science lessons, challenges such as insufficient time, inadequate learning resources and limited background knowledge, reduced their ability levels to frequently implement inquiry-based approach.

In Nigeria, Gimba et al. (2018), demonstrated that the weak foundation of students in science and technology was caused by Teachers' inability to teach the subject adequately. This led to the unwillingness of students to learn. In Liberia, Hackman et al. (2021), also revealed that many teachers in Liberia have insufficient understanding and lack the ability to teach Science subjects. Teachers of Biology's ability levels to implement IBA in teaching in Githunguri sub-County is unknown. This study was conducted to determine teacher's ability levels to implement inquiry-based approach.

In Migori County, Kenya, Khavugwi and Amolloh (2017), established that teachers who are trained in inquiry-based teaching effectively implemented inquiry-based approach. When teachers are well trained, they will be able to implement the syllabus. It was found that pre-primary school teachers were undertrained and those who received training lacked sufficient

knowledge and abilities to handle variety of subjects intended to be covered in the curriculum which calls for more training opportunities (Isaboke et al., 2021).

According to Kiige and Atina (2016), despite the challenges the integration of IBA presents, SMASSE, which is one of Kenya's teacher training programmes, has the capacity to affect the teachers' ability levels to implement IBA. It was found that the understanding teachers received in the subject matter, the teaching approach and the belief about inquiry-based approach, influenced how well-equipped teachers were to use IBA. It is established that the training teachers received enabled them to effectively teach the curriculum using IBA. It is unknown as to what training teachers have received in Githunguri sub-County and their ability levels to integrate IBA. Thus, the purpose of this research study.

2.4. Impact of IBA on the Attitude of Students Towards Learning Biology

Integration of IBA impacts students' attitude towards learning Biology. According to Chu et al. (2017), the integration of IBA influences the attitude, performance, reading skills, and presentation skills of students. It enhances the creation of knowledge, engages students into deep thinking and reasoning, and promotes their ability to apply knowledge. Inquiry-based approach involves asking questions, seeking and testing explanations, and producing knowledge by using Science Process Skills (SPS). Inquiry- Based Approach facilitates students to gain knowledge and develop extensive understanding of concepts taught.

An experimental study conducted by Abdi (2014) in Iran, demonstrated that the adoption of inquiry-based activities significantly impacted the performance of students. It was emphasized by Bezen and Bilgisi (2020), that inquiry-based approach positively changed students' attitude as they develop more interest in the lesson. According to the study, inquiry-based approach

enables students to understand the concepts of Biology and develops process skills in Science **(**Şimşek & Kabapinar, 2010). It was concluded that students' attitude towards Biology was influenced by the implementation of IBA. Nevertheless, there is a scarcity of literature on the impact of IBA on students in Githunguri sub-County, Kenya. Thus, the purpose for this study.

In Australia, Attard et al. (2021), demonstrated that, students' continual interactions with their teachers, classmates and active engagement into learning was influenced as IBA was implemented. As the teachers supported the learning process, it significantly influenced students' active engagement in the inquiry-based classroom. Continual interaction among students resulted to independence giving them ownership of their learning process. According to Jensen et al. (2012), collaborative learning helps to shape individuals' insight as they listen and learn from others. This often results in the comprehension of the concepts taught. The study aimed at establishing how implementation of IBA impacts students' attitude towards learning Biology in Githunguri sub-County, Kenya.

Irwanto et al. (2019), established that implementation of IBA enables students thinking skills and integrate knowledge to practical life situations, thereby promoting their ability to learn. It was also demonstrated by Gormally et al. (2009), that inquiry-based teaching enhances students' reading proficiency, acquisition of communication, teamwork, thinking critically and problem-solving skills, ability to research, and self-confidence in learning. The analysis of the findings established that students interact, engage in the lesson, and collaborate during learning in an inquiry-based class. It is not certain about the activity students in Githunguri sub-County are engaged with in an inquiry-based classroom and the impact these activities have on their attitude towards learning Biology.

In Hong Kong, Chan et al. (2012), reported that students can collaborate in groups to generate collective knowledge, develop their ability to ask questions, and perform better when teaching and learning is done through the implementation of IBA. Students, according to Andrini (2016), will be able to connect newly taught material with previously known information, resulting in meaningful learning. Also, teachers need to be able to facilitate the learning process during IBA implementation, so that the students understand how to apply their expertise to gain information.

A study conducted by Enebechi (2021) in Nigeria, indicated that inquiry-based approach promotes students' ability to retain concepts learned in Biology and fosters a more thorough understanding of contents. Teachers of Biology were encouraged to integrate inquiry-based teaching in order to develop students' ability to retain information learned.

In Wareng sub-County, Kenya, Mukhwana (2016), found that students' performance progressed positively when inquiry-based approach was implemented (Njoroge et al., 2014). It was noted by Kunga et al. (2022)**,** that integration of IBA develops students' Science Process Skills (SPS). SPS was described by Mulyeni et al. (2019), as the ability to observe, classify, investigate, experiment and infer the findings of an investigation. Hassan (2015) and Wabuke et al. (2017), conducted two distinct studies with Form one (1) and Form three (3) in Kenya. In these studies, it was recognised that IBA has influence on the performance of students. According to Mwangi (2014), a learner-centred approach, such as IBA significantly impacts the attitude of Form four (4) students' academic performance in the KCSE. In Kakamega County of Kenya, Waseka and Simatwa (2016), revealed that students' performance on the Kenya Certificate of Primary Education (KCPE), possibly influences their performance in KCSE. Students' participation in co-curricular activities, which can be done during IBA

implementation, positively impacts their academic achievement. These studies were done in different sub-Counties in Kenya but not in Githnguri sub-County.

2.5 Students' Attitude Towards Learning Biology

Knowledge that comprises opinions thoughts, and the tendency to like or dislike something is known as attitude. Attitude towards learning Biology was described by Dibiase and Mcdonald (2015), as an inclination for liking or not liking a thing. Attitude, which is strongly linked to motivation in learning Biology, has the propensity to influence academic performance of students (Diaz et al., 2021; Prokop et al., 2007). It was observed by Prokop et al., that, Slovakian students exhibited positive attitudes. Nevertheless, the level of interest in Biology among Slovak girls was higher than among boys, but it waned as the females aged. The desire students had to handle real objects during Biology classes resulted in the development of their positive attitude.

In Czech Republic, Masaryk et al. (2012), raised a concern on the global decline in the number of students pursuing Science courses like Biology. According to research findings, one of the primary contributing factors is the inaccurate and antiquated method of teaching Science in schools. Also, students' learning styles have changed significantly, necessitating the development of innovative teaching strategies. It is imperative to equip students for lifelong learning. It has been recommended that IBA a suitable teaching and learning approach that greatly motivates students. Since there was no literature on the attitude of Form three (3) students in Githunguri, this study was necessary.

In America, 758 students were sampled by Diaz et al. (2021)**,** from 34 grade four (4) students in Ohio and North Carolina, USA. It was discovered by Osborne et al. (2003) that, the views

students hold about their Science teachers, the confidence in themselves, fear of failing Science subjects, importance of Science and how much they enjoy learning about Science subjects, motivate them to pursue Science subjects. Teachers can improve the quality of their Science students' experiences by learning more about how activities in the classroom can enhance the value of tasks. The value of a task, is the extent to which students feel that a particular activity will enable the realisation of their future plans. A task's value can be determined by its relevance to students' future careers and their areas of interest (Diaz et al., 2021; Eccles & Wigfield, 1995). The value students place on learning Biology in Githunguri was a necessity for this study.

In Ogun State of Nigeria, Sakariyau et al. (2016), sampled 200 students from both Government and private schools to investigate their attitude towards Science. It was found that 122 students representing 61.0% of the 200 students had positive attitude towards Science subjects.

In Kenya, Mwanda (2017) investigated students' attitude towards the use of constructivism teaching methodology. Using a cross-sectional survey approach, 477 students were involved in the study. It was discovered that positive attitude towards the constructivist teaching methodology was observed among students. The study's recommended that teachers implement this approach in teaching to enhance the development of students' interest in learning Biology.

Owino et al. (2015), found that, passing the performance test in Kenyan secondary schools qualifies a person to pursue higher education, and this has been the key motivating factors for learning. However, performance in Biology in KCSE has been below the main score of C^{+} (plus) to pursue higher Education in Nursing, Medicine, Law, Pharmacy, and Engineering. This may significantly inhibit the students from pursuing their career dreams (Waseka & Simatwa,

2016; Njue et al., 2018). As a result, nationally, there has been concerns about students' negative attitude about learning Biology. In the same vein, studies conducted in Meru South sub-County by Nzomo (2023), revealed a decline in performance in Chemistry. The study found that students' poor performance was a result of both their negative attitude towards the subject and the teaching approach. Teachers of Biology are encouraged to implement IBA in Chemistry practical lessons since it has the propensity to influence the development of students' attitude. This study determined the attitude of students in Form three (3) who were studying Chemistry in Meru South sub-County. The uncertainty in the attitude of student in Form three (3) in Githunguri sub-County, was the purpose of this study.

In Nyakach District, Kisumu County, Ogutu et al. (2014), revealed that the levels of students' motivation and attitude about Biology will affect how well they perform at KCSE. It was established that since students lacked the motivation to study Biology, participate in class discussion, and perform laboratory activities, their performance became poor in Biology at KCSE. Another study done by Nzomo (2023) in Meru sub-County, established that students' attitude towards learning Chemistry significantly improved as IBA was implemented during teaching.

2.6 Summary of Gaps from the Review of Related Literature

A succinct discussion of the main gaps found in the literatures that were reviewed are addressed in this section. Findings from the literature reveals that teachers in the United States of America (USA), South Korea, Canada, Turkey, and Dubai implemented Inquiry-Based Approach with different challenges and results. The literature also revealed that Ghana, Nigeria and Kenya have similar experiences mentioned above. The fact that adoption of inquiry-based approach influences performance, develops students' interest and attitude, remain the same globally (Artayasa et al., 2021; Af'idayani et al., 2018; Njue et al., 2018; Tordzro et al., 2021; Utami

& Sundari, 2019). It also emphasized that students' interest and development of positive attitude towards Biology and improvement of performance can be achieved by implementing inquiry-based approach (Gholam, 2019; Subba, 2020; Ogutu et al., 2014). Teacher's professional development was emphasized in order to empower them to teach new strategies effectively.

Although researchers recommended the integration of an inquiry-based activities, there is still a concern as it relates to the continual low achievement in Biology at KCSE; which affects their eligibility to pursue higher courses such as Medicine (Muriithi, 2022). This establishes gaps on the local literature reviewed. The situation creates the need to investigate the extent, and ability levels of teachers of Biology in implementing IBA in Githunguri sub-County, Kenya.

Most of the studies conducted on inquiry-based approach were done in non-African Countries, African Countries and within other parts of Kenya. However, there was little or no study found in Kiambu County specifically, Githunguri sub-County, creating geographical gap. The gaps found in the literature reviewed include; use of different research designs such as mixed method longitudinal designs, sequential explanatory mixed method designs, and quasi experimental designs. The literature covered different locale of study other than Githunguri sub-County, Kiambu County, Kenya, creating a gap. This creates a need to conduct a study in Kiambu County, specifically, Githunguri sub-County using descriptive survey design.

There was limited literature found on integration of IBA in learning Biology. Most studies conducted in Kenya emphasized on the implementation of inquiry-based approach using experimental research designs. An investigation on integration of inquiry-based approach is essential, because it will encourage and inform Biology educators to determine the extent IBA

has been integrated. It will also encourage them to implement the approach as it will enhance the improvement of students' attitude, interests and performance in Biology at KCSE.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

In this section, the study design, the method employed, and justification were discussed. The area of the study, sample procedures, target population and sample size are all described. The instruments of the study, piloting, validity, reliability, the methods used to collect data, and data processing, legal and ethical issues, were carefully addressed.

3.2 Research Design

Descriptive survey design was employed in this study. The characteristics of individuals, as well as their opinions and views about people who are of interest to the researcher, can be described descriptively (Aggarwal & Ranganathan, 2019). This research design was used to gather data on respondents' attitude, beliefs, and opinions towards education as emphasized by Mugenda and Mugenda (2019). It involves the collection of data by administering questionnaires, observation of live activities in an open or closed environments and interviewing respondents of the target population. Descriptive methods of analysis were employed in this study. This design was utilized since it was appropriate for gathering primary data on the research objectives.

3.2.1 Variables

A variable, as asserted by Gould (2001), is anything that has the ability to change or vary. The Integration of inquiry-based approach was the independent variable. Both variables interacted to determine whether students have positive or negative attitude toward learning Biology. The intervening variables were motivation of students, levels of teachers' training and class size. The dependent variable was students' attitude towards learning Biology.

3.2.2 Research Methodology

The mixed method research design was employed. Shorten and Smith (2017), this design combines the collection of both qualitative data and quantitative data. The method was appropriate since it could be applied to enhance better understanding of the similarities or differences between the two data collected, respectively. It also enables the respondents to freely express themselves during the process of data collection (Shorten & Smith, 2017). It was noted by Mugenda and Mugenda (2019) that, combining these two methods enables those conducting research to develop their expertise in research. Qualitatively, data that are in numbers that is, quantitative data, are explained through narrations (Orodho, Nzabalirwa, et al., 2016). As a result, it was imperative to combine the two methods in order to generate comprehensive conclusions.

3.3 Location of the Study

This research was carried out in Githunguri sub-County, Kiambu County in Kenya. There are 13 sub-Counties in Kiambu; one of which is Githunguri sub-County. It was selected since it is one of the sub-Counties with a high enrolment rate. Moreover, for the past five years, Githunguri sub-County has reported low performance in Biology at KCSE. Githunguri sub-County has 33 public secondary schools. There was limited research on integration of inquiry-based approach in Githunguri sub-County. The data that was collected determined teachers' ability levels, the frequency of integration of IBA and its impact on students' attitude towards learning Biology.

3.4 Target Population

Target population, according to Orodho et al. (2016), a is a collection of items that share similar characteristics of major concern that needs to be investigated (Taherdoost, 2016). The study targeted a population of 1,194 students from Form three (3) and 29 Biology teachers from 33 public secondary schools. A representative sample of thirty percent (30%) of the population was chosen. A total of 358 participants, comprising of 344 students and 14 Biology teachers, were sampled for the study. This research study targeted County and sub-County schools since they were considered least performing. National and Extra-County schools were not sampled because they were considered to be performing better.

3.5 Sampling Techniques and Sample Size

3.5.1 Sampling Technique

Since the target population was not homogenous, the study employed the method of stratified random sampling (Mugenda & Mugenda, 2019). It is used when there are a number of distinct sub-groups (Neilson, 2011). To establish validity, this study included participants from each sub-group. This established the accuracy of the study's findings. Purposive sampling was also employed to sample teachers with similar experiences (Delİce, 2001; Taherdoost, 2016).

3.5.2 Sample Size

In order to make generalisations and repeat the study, Delİce (2001) said, it is important to determine a sample size that can represent the target population for generalization. It was revealed by Taherdoost (2016) and McNaughton and Cowell (2018), that if the sample size is large, there will be lesser biased in the findings. According to Neilson (2011), a sample above 10% can be used to represent the population for the purpose of generalization. Therefore, 30%

of the population was selected as the sample size employing simple random sampling technique from the sampled level of schools, as demonstrated in Table 3.1.

Table 3.1: Sampling Frame

Category	Target population	Sample size	Percent %
Schools in Githunguri	33	11	34.0%
Teachers of Biology	29	14	48.3%
Form 3	1,194	344	30.0%
Total	**1,223**	**358**	**29.3%**

Source: Kiambu County Education (2022)

3.5.1 Sampling of Schools

Data was gathered from County and sub-County schools in Githunguri sub-County. In Githunguri, there are 33 Public Secondary Schools: five (5) County schools and 28 sub-County Schools. The sampled schools were classified into boys' schools, girls' schools and mixed schools, respectively. For the purpose of gathering in-depth information, 30% of the sample, representing 11 schools, was picked utilizing stratified sampling method. The stratified random sampling formulae ($\frac{P_i}{N}$xn,) was applied to get the appropriate sample, where Pi means stratum of each sub-group, the population represents N, while, n represents the sample size (11 schools). In the calculation, the stratum for each category of school (Pi) was divided by the target population (N) and the product was multiplied by the sample size (n). Figure 3.1 illustrates the sampling process for the schools.

Table 3.2: School Levels

Schools Levels	Target population	Sample size
National schools	0	0
Extra County schools	-	-
County schools	5	2
Sub-County schools	**28**	**9**
Total	**33**	**11**

Table 3.2 shows that two (2) schools were randomly selected from the County schools and nine (9) schools were chosen by random sampling from the sub-County schools. The total of eleven (11) schools were sampled.

Table 3.3: Sampling of Participants

Category of schools	Target schools	Schools selected	Participants per school	Total number of participants	Percentages
Mixed schools	22	8	32	256	**74.4%**
Boys	8	2	32	64	**18.6%**
Girls	3	1	24	24	**7%**
Total	33	11	88	344	**100%**

As shown in Table 3.3, the schools and the quantity of students chosen are categorized. In order to ensure the participation of students from each of the category of schools, students who have chosen to study Biology were selected by random sampling technique. The researcher selected 32 students from each school except for the girl schools, where 24 participants were picked.

3.6 Research Instruments

There were three (3) research tools that were utilized for data collection: questionnaire, interview guide and classroom observation guide.

3.6.1 Questionnaire for Teachers

The teachers' questionnaire consisted of five (5) sections: A, B, C, D, and E (Appendix II). Section A measured four (4) items which made up of the background information. Section B had 16 items measuring the extent of adoption of IBA by teachers, while section C had 11 (eleven) items measuring the ability levels of teachers to adopt IBA. Section D was open-ended questions and measured ability levels of teachers, while the impact of IBA on the attitude of students towards Biology was measured under section E. This section consisted of 9 (nine) items. Each of the questions was measured on a 4-point Likert scale with four (4) meaning Strong Agreement, three (3) Agreement, two (2) Disagreement and one (1) Strong Disagreement. The research tools used to measured students' attitude towards Biology was adapted and modified (Dibiase and Mcdonald, 2015).

3.6.2 Questionnaires for Students

The student questionnaire comprised of three (3) sections: A, B and C (Appendix III). Section A consisted of 18 questions and measured students' attitude towards learning Biology, while section B which consisted of 7 (seven) items measured teachers' ability levels to adopt IBA. The impact of IBA on students' attitude which was under section C, consisted of 9 (nine) items. Question 18 was an open-ended question measured students' attitude towards learning Biology. The questions were measured on a 4-point Likert scale with four (4) meaning Strong Agreement, three (3) Agreement, two (2) Disagreement and one (1) Strong Disagreement. The research tool for measuring the attitude of students towards Biology was adapted from existing literature of Prokop et al. (2007) and modified.

3.6.3. Interview Guide for Teachers of Biology

A semi-structured interview method was employed for the collection of first-hand information on the extent of integrating IBA and students' attitude towards learning Biology. The interview

guide had two sections: A and B. The extent of adoption of inquiry-based approach was measured in section A and consisted of three (3) questions, while section B has two (2) questions and measured students' attitude towards learning Biology. Interviews aided in obtaining thorough information to confirm the data gathered from the questionnaires. Fourteen teachers of Biology were interviewed within the period of one (1) week. The interviewees were asked to answer questions that were asked while the researcher took down points and recorded the voices to ensure that the researcher captured all essential information. The written and recorded information were transcribed, coded and interpreted.

3.6.4 Classroom Observation Guide

A classroom lesson observation guide was used to observe and record teaching activities of teachers of Biology and learning activities of the students. Use of observation enabled the determination of the ability levels of teachers of Biology and the extent of implementation of IBA. During the classroom observation process, the researcher observed the ability levels of teachers in teaching Biology and the extent of implementation of IBA. The observation guide was made up of two (2) sections. Section A measured teachers' ability levels to implement IBA and it had seven (7) statements while section B had eight (8) statements measuring the extent of adoption of IBA by Biology teachers. The researcher observed as the live classes were ongoing and tick the activities and methods teachers used as indicated on in the observation guide. Any additional activities related to IBA that were performed by the teachers which were not covered in the guide, were recorded under the comment section.

3.7 Pilot Study

As described by Lowe (2019), a pilot study a mini trial of the methodologies and processes to be utilized on a larger scale in an effort to estimate an adequate sample size and make

improvements to the study design before carrying out the complete research project (Mugenda & Mugenda, 2019). Two (2) schools were piloted in Githunguri sub-County to determine the validity and reliability of the instruments. The selected schools shared the same observable characteristics with the actual sampled schools for the research. During the piloting exercise which was done in two (2) schools within two days, 50 student questionnaire and five (5) teacher questionnaires were distributed. In order familiarised with the observation of classes as well as to determine the validity and reliability, two (2) classes were carefully observed. The result of the piloting activity prompted the modification of the instruments.

3.7.1 Validity of Instruments

The validity of a tool is how often it accurately measures what it is supposed to measure (Mugenda & Mugenda, 2019; Orodho et al., 2016). The researcher solicited assistance from supervisors and subject specialists in order to make sure the research tools face content validity. Results from both instruments, revealed that several items needed to be removed from the scales because they had low factor loadings.

3.7.2 Reliability of the Instruments

It was noted by Orodho et al. (2016), that consistency is a key indicator of the research instruments to be reliable. Since testing the consistency of the tools was very important to the study, the researcher ensured testing them before the actual data collection activities. Testing the research questionnaires, interview questions and classroom observation guide to establish reliability was necessary to show consistency in the results. To assess the consistency of the instruments, the split-half method was utilised. Five (5) teachers of Biology from two (2) schools were chosen for the pilot study, while 50 students were also selected to answer questions from the students' questionnaire.

To evaluate the validity of the research instruments, the Cronbach's alpha correlation (α) was employed (Kimberlin & Winterstein, 2008). The value of alpha ranging from α 0.70 to α 0.95 or zero (0) to one (1), as acknowledged by Tavakol and Dennick (2011), are acceptable. When the coefficient of the reliability value is closer to one (1), it is a reliable test, but when it is closer to the reliability coefficient value of zero (0), it becomes less reliable.

Table 3.4: Reliability Results

Constructs	**No of Items**	**α ≥ 0.7**	**Comment**
Questionnaire (teachers)	5	0.79	Reliable
Questionnaire (students)	50	0.75	Reliable

Source; Research Data (2023)

The reliability coefficient of the questionnaire for teachers, as recorded in Table 3.4, was α 0.79, whereas that of the students was α 0.75. It was emphasized by Mukaka (2012), that to determine the consistency of the instruments, values ranging from α 0.7 and above are regarded as acceptable.

3.8 Data Collection Techniques

To begin, the researcher obtained approval from the National Commission for Science, Technology and Innovation (NACOSTI), the Ministry of Education, Kiambu County Education Office and the sub-County Education Office. The researcher also met with school principals and deputy principals. They provided assistance to meet with the students and teachers who would partake in the study. Those selected consented to take part by signing the consent form. The researcher visited 11 schools for the purpose of observing live classes. The questionnaires were distributed and participants were given a week to provide their views. The following week, Biology teachers were interviewed. This process took the period of two (2) weeks.

3.9 Data Analysis

The research tools included open-ended and closed-ended questionnaires, interviews schedule, and a classroom observation checklist for data collection.

The questionnaires produced quantitative data while the interview guide and the observation checklist provided qualitative data. Descriptive statistics along with the measure of central tendency was employed for the analysis of quantitative data. The qualitative data was transcribed into codes and analysed. The following tools; SPSS version 25, and Microsoft Excel were applied to analyse the data. Frequency tables, charts, graphs and narrative were utilized to present the findings. Also, the data was evaluated utilizing descriptive statistics, which consisted of frequency and percentages. The data analysis methods for each objective are presented in Table 3.5.

Table 3.5: Data Analysis Methods

Objectives	Type of Data	Data Analysis Method
1. To determine the extent to which IBA is adopted by Biology teachers.	Quantitative/Qualitative	Descriptive/Narrative
2. To determine the ability levels of teachers to implement IBA in teaching Biology.	Quantitative	Descriptive
3. To establish impact of IBA on students' attitude towards learning Biology.	Quantitative	Descriptive
4. To determine students' attitude towards learning Biology.	Quantitative/Qualitative	Descriptive/Narrative

3.10 Logistical and Ethical Consideration

The ethical consideration and logistical consideration are discussed in this section.

3.10.1. Logistical Consideration

Before the research process started, the researcher conducted a pre-research task. Pre-research activities such as preparation of proposal to meet Graduate school standards, obtaining an introductory letter from Graduate school, applying for, and obtaining of research permit from NACOSTI were considered. Additionally, letters of authorisation were received from the Ministry of Education and the Education offices in Kiambu County and Githunguri sub-County, respectively. According to Orodho et al. (2016), the field of research is of great value if it gives quality, logical and ethical standards. For the success of the study, all of these steps were carefully observed during the research process.

3.10.2. Ethical Consideration

All ethical considerations regarding voluntary participation and total anonymity of respondents were strictly adhered to during data collection. All participants who went through the research objectives completed an informed consent form. Schools and teachers were not identified directly by name, but rather by pseudonyms and numbers.

CHAPTER FOUR

PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSION

4.1. Introduction

The findings, interpretations, and discussions related to the research objectives are discussed in this chapter. The study's objectives were to: determine the extent of adoption of IBA by teachers of Biology; determine the ability levels of teachers to implement IBA; assess the impact of IBA on the attitude of students; and determine the attitude of students towards learning Biology. Tables of frequency, bar charts, including pie charts were employed to display the data.

4.2 Response Rate

A total of 358 questionnaires were administered, of which 344 were distributed among students in Form three (3) and the remaining 14 were shared among Biology teachers. Every questionnaire was completed and properly returned.

4.3 Background Information

In this section, the background information of teachers is presented.

4.3.1 Background Information of Teachers

The background information of teachers is summarized in this section. The items include gender, teaching experience, subject specialization and professional qualifications. Figure 4.1 shows the teachers' gender.

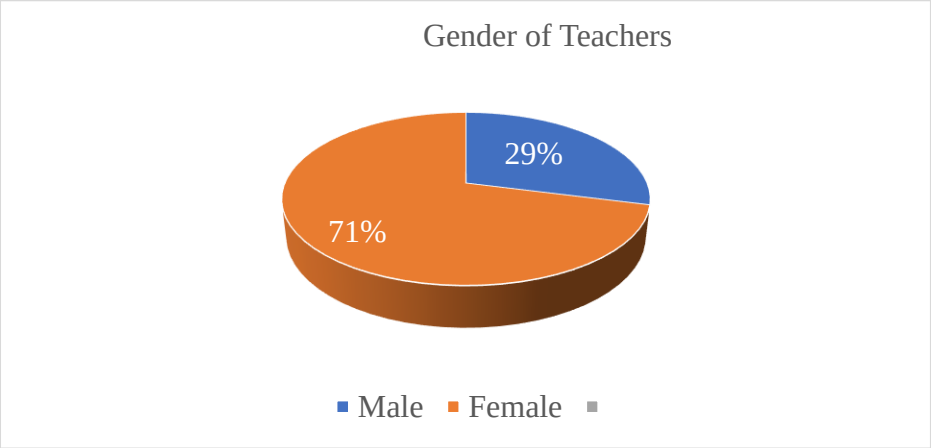

Figure 4.1: Teacher's Gender

This demonstrates that 71% of them were male, compared to 29% who were female. This implies more male teachers than their counterpart. The investigator was also curious in the teachers' experiences in using IBA. Selected individuals that were teaching Biology were asked about their experiences in teaching IBA.

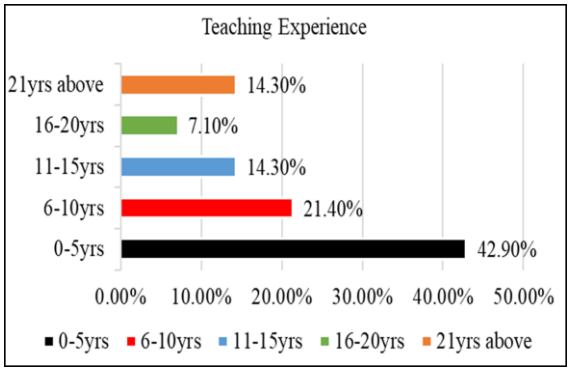

Figure 4.2: Teaching Experience Using IBA

As shown in Figure 4.2, 42.90% of the teachers have 0-5 years of experience in teaching using IBA, while 21.40% of the Teachers of Biology have 6-10 years of experience. The data also shows that 14.30% of the teachers have between 11 and 21 years of experience. This shows that teachers are knowledgeable about integration of IBA. The training a teacher acquires will determine his or her effective teaching and learning ability (Ogutu et al., 2014).

The researcher also sought to determine teachers' subject specialization.

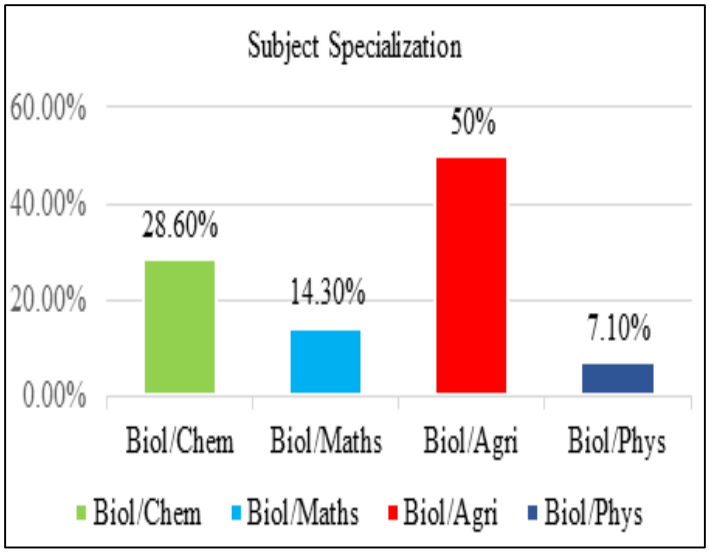

Figure 4.3: Subject Specialization

as revealed in Figure 4.3, 50% are specialized in Biology and Agriculture, 28.6% are specialized in Biology and Chemistry, 14.3% are specialized in Biology and Mathematics and 7.1% are specialized in Biology and Physics. This implies that most teachers are qualified to teach Biology with good professional qualifications. According to Correia and Harrison (2020), the education level of teachers impacts on the extent to which IBA is integrated. The researcher also sought to determine teachers' professional qualifications.

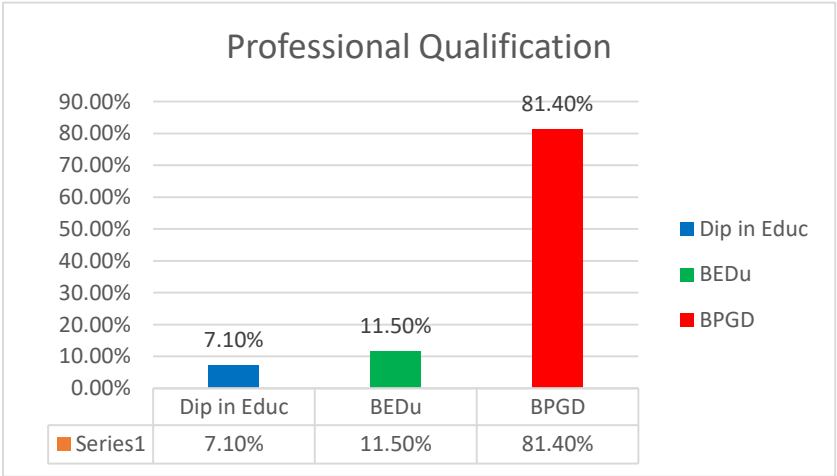

Figure 4.4: Professional Qualification

In Figure 4.4, it is demonstrated that 81.40% of the teachers hold bachelor's degree in addition to a post-graduate Diploma. The data also shows that 11.50% of teachers of Biology have Bachelor's degree in Education and 7.10% have Diploma in Education.

4.3.2 Background Information of Students

This section contains data on background information on students.

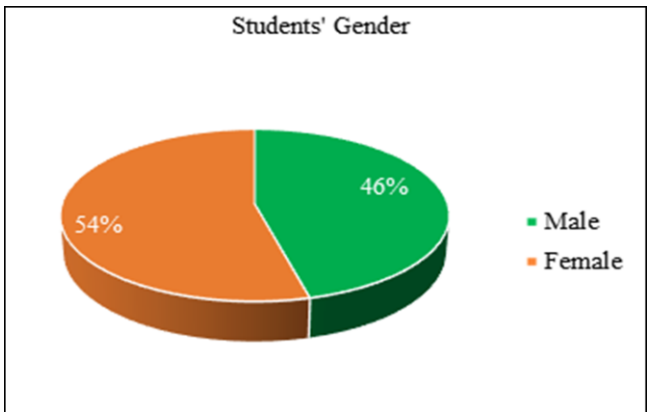

Figure 4.5: Gender of Students

It is demonstrated that 54% are females while 46% are male.

4.4 Extent to which Inquiry-Based Approach is Adopted by Teachers of Biology

4.4.1 Findings on extent of teachers' adoption of IBA

Teachers of Biology were asked to respond to each of 18 statements presented on a four point-Likert scale. Table 4.1 through Table 4.18 display the responses to the the18 statements.

Table 4.1 Teachers of Biology' response to "I often use inquiry-based approach to teach Biology."

Response	Frequency	% of Frequency
Strongly Agree	5	35.7
Agree	1	7.1
Disagree	6	42.9
Strongly Disagree	2	14.3
Total	**14**	**100.0**

Table 4.1 indicates that 42.8% of the teachers often use IBA as compared to 57.2% who did not.

Table 4.2 Teachers of Biology responses to "I choose the procedure to be used in investigating a given problem."

Response	Frequency	% of Frequency
Strongly Agree	4	28.6
Agree	9	64.3
Disagree	1	7.1
Strongly Disagree	0	0.0
Total	**14**	**100.0**

Table 4.2 demonstrates that while 92.9% of teachers selected the procedure, only 7.1% did not.

Table 4.3 Teachers of Biology responses to "Students select the procedure to solve a problem chosen by themselves."

Response	Frequency	% of Frequency
Strongly Agree	3	21.4%
Agree	2	14.3%
Disagree	7	50.0%
Strongly Disagree	2	14.2%
Total	**14**	**100.0**

Table 4.3 reveals that, while 64.2% of the teachers of Biology did not give permission for students to select the procedure, 35.7% allowed their students to do so.

Table 4.4 Teachers of Biology responses to "I encourage the students to find the right answer to the investigated problem."

Response	Frequency	% of Frequency
Strongly Agree	8	57.1%
Agree	6	42.9%
Disagree	0	0.0%
Strongly Disagree	0	0.0%
Total	14	100.0

It revealed that 100% encouraged students to find the right answer to the problem being investigated.

Table 4.5 Teachers of Biology responses to "I facilitate students to get to the solution(s) of the problem during practical activities."

Response	Frequency	% of Frequency
Strongly Agree	9	64.3
Agree	5	35.7
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	14	100.0

Table 4.5 reveals that100% facilitated students to get to the solution.

Table 4.6 Teachers of Biology responses to "I encourage students to plan their own experiment and provide answers to their own questions."

Response	Frequency	% of Frequency
Strongly Agree	0	0.0
Agree	1	7.1%
Disagree	9	64.3%
Strongly Disagree	4	28.6%
Total	14	100.0

According to Table 4.6, 7.1% of teachers encouraged students to plan their own experiment as compared to 92.9% of the teachers did not.

Table 4.7 Teachers of Biology' response to "I encourage students to ask questions during teaching time."

Response	Frequency	% of Frequency
Strongly Agree	5	35.7
Agree	9	64.3
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	14	100.0

All Biology teachers (100%) encouraged their students to pose questions as displayed in Table 4.7.

Table 4.8 Teachers of Biology' response to "I allow students to ask scientific questions for investigation."

Response	**Frequency**	**% of Frequency**
Strongly Agree	5	35.7
Agree	3	21.4
Disagree	4	28.6
Strongly Disagree	2	14.3
Total	14	100.0

According to Table 4.8, 57.1% of the teachers allowed their students to ask scientific questions for investigation, while 42.9% did not.

Table 4.9 Teachers of Biology' response to "When carrying out investigations, the students determine what data they need to collect."

Response	Frequency	% of Frequency
Strongly Agree	2	14.3
Agree	2	14.3
Disagree	4	28.6
Strongly Disagree	6	35.7
Total	14	100

In Table 4.9, it was recorded that 28.6% of the teachers allowed students to choose what data they needed to gather, while 71.4% did not allow them to do so.

Table 4.10 Teachers of Biology' response to "In my class, student defend a scientific argument."

Response	Frequency	% of Frequency
Strongly Agree	5	35.7
Agree	3	21.4
Disagree	4	28.6
Strongly Disagree	2	14.3
Total	14	100.0

According to the data presented in Table 4.10, 57.1% allowed their students to defend a scientific argument while 42.9% did not allow students to do so.

Table 4.11 Teachers of Biology' response to "I encourage students to ask questions"

Response	Frequency	% of Frequency
Strongly Agree	9	64.3
Agree	5	35.7
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	14	100.0

Table 4.11 reveals that 100% of the teachers encouraged students to pose questions.

Table 4.12 Teachers of Biology' response to "During investigation, students are given opportunity to manipulate the materials and the equipment to gather data."

Response	Frequency	% of Frequency
Strongly Agree	8	57.1
Agree	4	28.6
Disagree	1	7.1
Strongly Disagree	1	7.1
Total	14	100.0

According to the data in Table 4.12, 85.7% gave students' the opportunity to manipulate materials and the equipment for data collection as compared to 14.2% of them who did not allow their students do to so.

Table 4.13 Teachers of Biology' response to "Students are permitted to design investigations in Biology."

Response	Frequency	% of Frequency
Strongly Agree	4	28.6
Agree	2	14.3
Disagree	2	14.3
Strongly Disagree	6	42.8
Total	14	100.0

Table 4.13 demonstrates that 42.9% the teachers permit students to design investigations in Biology, while 64.2% disagree to the statement.

Table 4.14 Teachers of Biology' response to "I encourage students to discuss results of investigations in small group."

Response	Frequency	% of Frequency
Strongly Agree	8	57.1
Agree	3	21.4
Disagree	1	7.1
Strongly Disagree	2	14.3
Total	14	100.0

According to the result found in Table 4.14, 78.5% were able to encourage students to discuss their results in small groups as compared to 21.4% who never did so.

Table 4.15 Teachers of Biology' response to "Step by step procedures are provide when carrying out investigations."

Response	Frequency	% of Frequency
Strongly Agree	8	57.1
Agree	6	42.9
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	14	100.0

The results indicates that 100% provide detailed guidelines during investigations.

Table 4.16 Teachers of Biology' response to "Students are encouraged to orally present their findings from the investigations they have conducted."

Response	Frequency	% of Frequency
Strongly Agree	6	42.9
Agree	8	57.1
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	14	100.0

As displayed, 100% encouraged oral presentation of findings among students.

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Table 4.17 Teachers of Biology' response to "I prepare inquiry-based activities for my class."

Response	Frequency	% of Frequency
Strongly Agree	9	64.2
Agree	3	21.4
Disagree	2	14.2
Strongly Disagree	0	0.0
Total	14	100.0

Table 4.17 demonstrates that 85.6% prepared IBA activities as compared to 14.3% did not.

Table 4.18 Teachers of Biology' response to "Based on the data collected during Biology investigation, students draw conclusions."

Response	Frequency	% of Frequency
Strongly Agree	7	50
Agree	5	35.7
Disagree	2	14.3
Strongly Disagree	0	0.0
Total	**14**	**100.0**

Based on the data presented, 85.7% of the teachers agreed to the statement, while 14.3% disagree to the statement.

Teachers of Biology were asked to rank the levels of inquiry according to practicality. There are four (4) levels of the ease of implementing of IBA: Confirmatory, Structured, Guided and Open Inquiry.

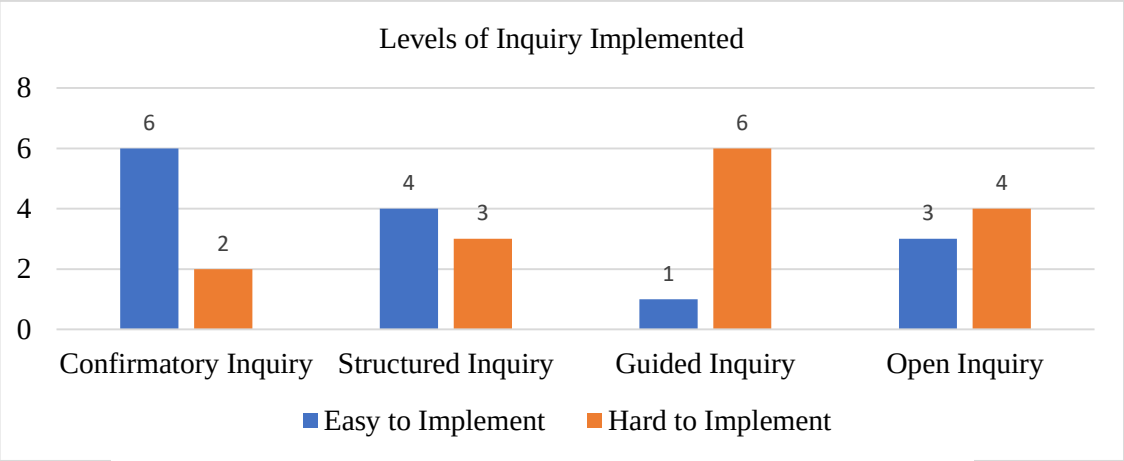

Figure 4.6 Levels of Inquiry Implemented

Based on the data in Figure 4.6, six (6) of teachers acknowledged that Confirmatory inquiry is the easiest to implement, four (4) teachers rated Structured inquiry as the easiest, six (6) teachers said that Open inquiry as the most difficult to use, followed by Guided inquiry.

4.4.2 Findings from Classroom Observation Guide on inquiry-based approach

Table 4.19 provides a summary of the researcher's observation on the extent of integration of IBA by teachers.

Table 4.19 Observation on Extent of Adoption of IBA by Teachers of Biology

	No		Yes	
Extent of Integration of IBA	**Count**	**%**	**Count**	**%**
Before beginning the class, teacher asks the students about their previous knowledge on the topic.	1	9.1%	10	90.9%
Teacher makes learning Biology interactive and interesting	6	45.5%	5	54.5%
During practical activities, teacher provides guidance	4	36.4%	7	63.6%
Teacher allows students to ask questions.	0	30.0%	11	70.0%
During a given task, tears permit students to work alone.	0	2.0%	11	80.0%
Teacher asks questions for students to think and answer	6	45.5%	5	54.5%
Teacher provides guidance for the students to think in answering	6	54.5%	5	45.5%
The students were able to put forth a question on their own	7	63.6%	4	36.4%

As shown in Table 4.19, 90.9% of the teachers elicited the prior knowledge of students before beginning the class and 54.5% of the teachers made Biology lesson engaging and interactive. Also, guidance was provided by 63.6%, 70% of them encouraged questions from their students, and 80% allowed students to work by themselves, while 54.5% of the teachers were able to ask students questions to think. It was also shown that 54.5% did not guide students to think and 63.6% did not permit the student to develop their own questions.

4.4.3 Findings on Extent of Use of IBA

Biology teachers were requested to describe the level of inquiry they emphasized in their lessons. The statements were coded and analysed as display in Figure 4.7.

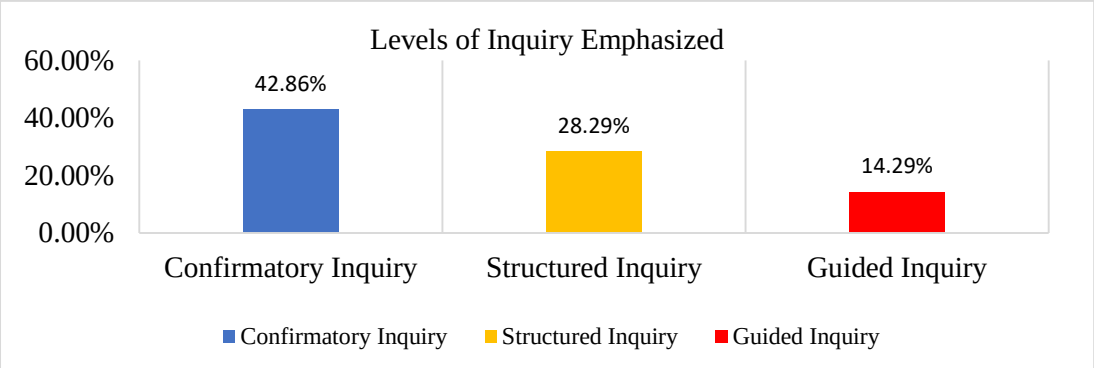

Figure 4.7: Levels of Inquiry Emphasized

According to Figure 4.7, 42.86% of the teachers emphasized on confirmatory inquiry compared to 28.57% of teachers who prioritised structured inquiry. Guided inquiry was prioritised by 14.29% of the teachers.

4.4.4 Discussion

This section contains the results from the first objective. The questionnaires for teachers, an interview guide, and an observation checklist were utilized for data collection. The results of these tools are given in tables of frequency and Figures.

The findings demonstrate that teachers of Biology did not often adopt IBA. It was found that eight (8) of the teachers, representing 57.2% did not often adopt IBA, while six (6) of the teachers representing 42.8% often adopted Inquiry- Based Approach. This result conforms to a study done by Nzomo (2023). According to Nzomo, teachers adopted IBA once a week. Clarifying on the adoption of inquiry-based approach, Letina (2019) reported that teachers who frequently implemented IBA were those that likely received training in using inquiry-based approach than those who did not. According to Otara et al. (2019), if the teachers are not properly trained, they will not adopt a learner-centred approach such as IBA. Therefore, continual teachers' training programme in using inquiry-based approach in Githunguri sub-County should be considered for an extensive adoption of the approach in public secondary schools.

During IBA implementation, it was found that majority of the teachers, representing 92.9%, selected the procedures on behalf of the students to investigate problems in an inquiry-based class. Further, the percentage of teachers who placed strong emphasis on confirmatory inquiry, was 42.86%.

The teachers were interviewed on the frequency of adoption of IBA. They said;

> *"We emphasized on confirmatory inquiry because students are used to getting answers for a question without doing research. The students also lack the knowledge and skills to study through higher levels of inquiry."*

Unlike this finding, where confirmatory inquiry was most often used, Eltanahy and Forawi (2019), discovered that among the four (4) levels of inquiry, teachers find it easier to used structured inquiry often. Inquiry-based approach implementation should be done holistically, by utilizing all of the four (4) levels which include Confirmatory, Structured, Guided and Open inquiry; beginning from the least to the highest.

4.5 Ability levels of teachers to implement inquiry-based approach in teaching Biology

4.5.1 Findings from Teacher's Questionnaires on Ability levels of teachers to implement inquiry-based approach in teaching Biology

The study's second objective was to identify teacher' ability or competence levels to implement inquiry-based approach in Biology instruction.

Table 4.20 Teachers of Biology' response to "I understand how to use inquiry-based approach."

Response	Frequency	% of Frequency
Strongly Agree	6	42.8
Agree	4	28.6
Disagree	2	14.3
Strongly Disagree	2	14.3
Total	**14**	**100.0**

In Table 4.20, 71.4% of the teachers understood how to use inquiry-based approach whereas, 28.6% of the teachers lack the understanding on the usage of IBA.

Table 4.21 Teachers of Biology' response to "I can implement IBA through teaching."

Response	Frequency	% of Frequency
Strongly Agree	9	64.3
Agree	2	14.3
Disagree	0	0.0
Strongly Disagree	3	21.4
Total	**14**	**100.0**

In Table 4.21, it is demonstrated that 78.6% of the teachers can implement IBA, while 21.4% of the teachers lack the ability to do so.

Table 4.22 Teachers of Biology' response to "It is difficult to teach Biology through inquiry-based approach."

Response	Frequency	% of Frequency
Strongly Agree	8	57.1
Agree	4	28.5
Disagree	2	14.4
Strongly Disagree	0	0.0
Total	**14**	**100.0**

Table 4.22 demonstrates that 85.6% acknowledged the difficulty to teach using IBA. However, 14.4% of the teachers asserted that IBA implementation was easy.

Table 4.23 Teachers of Biology' response to "I enjoy teaching using IBA."

Response	Frequency	% of Frequency
Strongly Agree	5	35.7
Agree	1	7.1
Disagree	2	14.3
Strongly Disagree	6	42.9
Total	**14**	**100.0**

As demonstrated, 42.8% enjoyed teaching Biology using IBA, while 57.2% of them disagree to the statement.

Table 4.24 Teachers of Biology' response to "Students work together in a class project and present their findings in class."

Response	Frequency	% of Frequency
Strongly Agree	2	14.3
Agree	9	64.3
Disagree	2	14.3
Strongly Disagree	1	17.1
Total	**14**	**100.0**

This reveals that while 78.6% of Biology teachers agreed that students work together in a class project and present their findings in class, 31.4% disagreed.

Table 4.25 Teachers of Biology' response to "Based on the data collected during Biology investigation, students draw conclusions."

Response	Frequency	% of Frequency
Strongly Agree	4	28.6
Agree	6	42.9
Disagree	3	21.4
Strongly Disagree	1	7.1
Total	**14**	**100.0**

Table 4.25 records that the percentage of teachers who allowed students to draw conclusions based on the data collected, was 71.5% as compared to28.1% who disagreed to the statement.

Table 4.26 Teachers of Biology' response to "Students are encouraged to work together in a class project and present their findings in class."

Response	Frequency	% of Frequency
Strongly Agree	6	42.9
Agree	8	57.1
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	**14**	**100.0**

This shows that 100% encouraged their students to work together in a class project and present their findings in class.

Table 4.27 Teachers of Biology response to "Students are encouraged to think and ask questions in class"

Response	Frequency	% of Frequency
Strongly Agree	8	57.1
Agree	6	42.9
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	14	100.0

As recorded 100% encouraged students to think and ask questions.

Table 4.28 Teachers of Biology' response to "I allow students to think and ask questions."

Response	Frequency	% of Frequency
Strongly Agree	6	42.9
Agree	5	35.7
Disagree	3	21.4
Strongly Disagree	0	0.0
Total	**14**	**100.0**

Table 4.28 shows that 78.6% allowed students to think and ask questions students draw, while 21.4% strongly disagree to the statement.

Table 4.29 Teachers of Biology' response to "Step by step procedures are provided when carrying out investigations"

Response	Frequency	% of Frequency
Strongly Agree	6	42.9
Agree	8	57.1
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	**14**	**100.0**

Table 4.29 shows that 100% teachers provided step by step procedures.

Table 4.30 Teacher's response to "It becomes easier to adopt inquiry-based approach lessons when the teacher gives students the questions and procedures to guide them during investigation."

Response	Frequency	% of Frequency
Strongly Agree	11	78.6
Agree	3	21.4
Disagree	0	0.0
Strongly Disagree	0	0.0
Total	**14**	**100.0**

Table 4.30 displays that the percentage of the instructors who agreed to the statement was 100%.

4.5.2 Findings from Students' Questionnaires on Ability levels of teachers to implement inquiry-based approach in teaching Biology

Table 4.31 Students' response to "Biology teacher fairly shares questions among all students"

Response	Frequency	% of Frequency
Strongly Agree	148	42.9
Agree	123	35.7
Disagree	73	21.4
Strongly Disagree	0	0.0
Total	**344**	**100.0**

Table 4.31 demonstrates that 78.6% of the students acknowledged that their Biology teacher distributed questions fairly, while 21.4% of the students disagree to the statement.

Table 4.32 Students' response to "I am given the chance by my teacher to share my ideas with other students."

Response	Frequency	% of Frequency
Strongly Agree	152	44.2
Agree	98	28.6
Disagree	74	21.4
Strongly Disagree	20	5.8
Total	**344**	**100.0**

Table 4.32 reveals that 72.8% of the students agreed that teachers of Biology gave them opportunity to share their ideas with other students, while 27.2% of the students disagreed to the statement.

Table 4.33 Students' response to "I am given the chance by my teacher to ask questions in class."

Response	Frequency	% of Frequency
Strongly Agree	202	58.6
Agree	49	14.3
Disagree	93	27.1
Strongly Disagree	0	0.0
Total	**344**	**100.0**

Table 4.33 reveals that 72.9% of the students said that teachers of Biology gave them the opportunity to ask questions in class, whereas 27.1% of them disagreed.

Table 4.34 Students' response to "During the process of conducting investigations in Biology, we develop our own procedures"

Response	Frequency	% of Frequency
Strongly Agree	73	21.4
Agree	49	14.3
Disagree	74	21.4
Strongly Disagree	148	42.9
Total	**344**	**100.0**

Table 4.34 demonstrates that 35.7% of the students agreed that the teachers gave them an opportunity to design investigations, whereas 64.3% disagreed to the statement.

Table 4.35 Students' response to "We develop our own procedures for conducting investigations in Biology."

Response	Frequency	% of Frequency
Strongly Agree	73	21.4
Agree	49	14.3
Disagree	73	21.4
Strongly Disagree	148	42.9
Total	**344**	**100.0**

In Table 4.35, 35.7% of the students acknowledged developing their own procedures for conducting investigations in Biology. However, 64.3% disagreed to the statement.

Table 4.36 Students' response to "The Biology teacher gives us questions to investigate in Biology."

Response	Frequency	% of Frequency
Strongly Agree	221	64.3
Agree	0	0.0
Disagree	74	21.4
Strongly Disagree	49	14.3
Total	**344**	**100.0**

Based on the results, 64.3% of the students agreed that their Biology teachers gave them questions to investigate in Biology. Further, 35.7% disagreed to the statement.

Table 4.37 Students' response to "When we are working on investigations in Biology, our Biology teacher provides guidance."

Response	Frequency	% of Frequency
Strongly Agree	202	58.6
Agree	49	14.3
Disagree	93	27.1
Strongly Disagree	0	0.0
Total	**344**	**100.0**

Based on the result, 72.9% of the students said, teachers of Biology guided them in working on investigations in Biology, while 27.1% of the students disagreed to the statement.

4.5.3 Findings on Ability levels of teachers to implement IBA in teaching Biology

Table 4.38 Teacher's Ability Levels to Implement IBA

	No		Yes	
Teacher's Ability Levels to Implement IBA	**Count**	**%**	**Count**	**%**
Teacher asks students to make their prior ideas explicit before presenting new concepts	7	63.6%	4	36.4%
Teachers connect new knowledge and understanding to real life context	4	36.4%	7	63.6%
Teachers explain to students Biology concepts in simple terms	1	9.1%	10	90.9%
Teacher evaluates concept learned by students through questioning	7	63.6%	4	36.4%
Teacher guided students to think of questions	5	63.6%	6	36.4%
Teachers challenge students to think of questions	10	90.9%	1	9.1%
Students came up with questions on their own	9	81.8%	2	18.2%

Based on the result, 63.6% did not question students to make their prior ideas explicit before presenting new concepts, while 63.6% to connected new knowledge and to real life context. Further, 90.9% of the teachers were able to explain to students Biology concepts in simple terms and 63.6% did not evaluate concept learned by students through questioning. Moreover, 63.6% of Biology teachers provided no guidance that could engage students' critical thinking to pose questions, 90.9% could not challenge students to think of questions, while 81.8% could not provide opportunity for students develop and raise questions on their own.

4.5.4 Findings from Teacher's Interview Schedule on the ability levels of teachers to implement inquiry-based approach in teaching Biology

Figure 4.8 displays the results of a questionnaire given to teachers regarding their understanding of IBA in teaching.

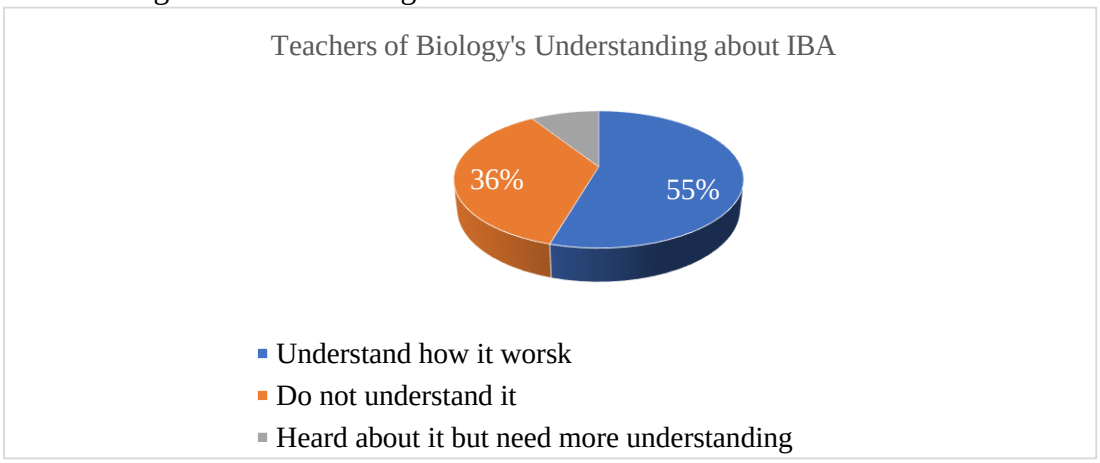

Figure 4.8 Teachers of Biology's Understanding about IBA

In Figure 4.8, 55% of the teachers said that they understand about IBA and how it works. Further, 36% of them do not understand IBA while 9% heard about IBA but do need more understanding.

Teachers of Biology were asked in an interview to about their ability to implement IBA and the findings are recorded in Figure 4.9.

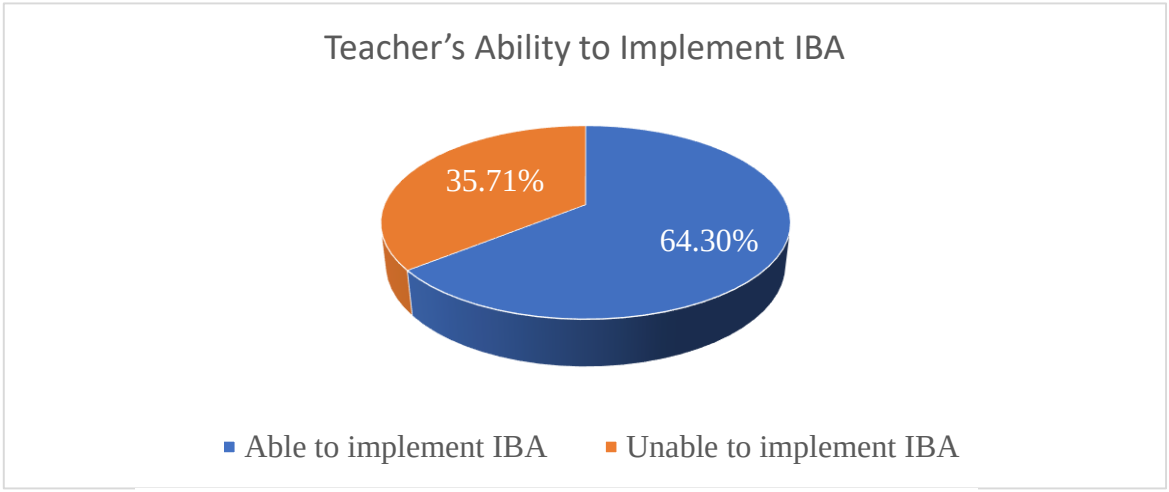

Figure 4.9 Teacher' Ability to Implement IBA
N=11

Figure 4.9 shows 64.30% of the teachers expressed their ability to implement IBA, while 35.71% said they are unable.

4.5.4.1 Discussion

The findings revealed that eleven (11) teachers representing 78.6%, have the ability to implement IBA through teaching. These teachers may have had some levels of training in using IBA. Figure 4.4 records that 81.40% of the teachers have Bachelor's degree with post-graduate diploma. According to Khavugwi and Amolloh (2017), teachers who are trained in teaching through IBA effectively implemented inquiry-based approach. Reporting on teachers' ability levels, the results demonstrated that teachers provided systematic procedures for students when conducting investigations. Nevertheless, 222 students, representing 64.3% said that teachers did not give them opportunity to design investigations and to develop their own procedures for conducting investigations. All of the teachers felt that giving the questions to students and the processes to follow during investigation makes it simpler to implement IBA. This may have been very easy as the text books have in them the steps for every activity. However, though the text books were designed by providing the steps for the practical activities, teachers can develop an alternative investigation so that the students determine the steps to solve the problems. This will enhance the ability levels of the teachers, thereby, engaging the students into critical thinking.

In an observation, it was found that almost all of the teachers, representing 90.9% were not able to challenge students to think of questions and did not give students the chance to develop their own questions. Majority of the teachers, representing 78.6%, rated themselves above their ability to adopt IBA as compared to what was observed. According to Sizer et al. (2021), despite the ability levels of teachers, continual training should be provided on the adoption of

IBA in teaching. When teachers are well trained, Isaboke et al. (2021) said, they will be able to implement the syllabus. According to Kiige and Atina (2016), SMASSE, one of Kenya's Science teachers' training programmes, should be strengthened and supported to train teachers on the implementation of IBA at the County level.

4.6 Impact of inquiry-based approach on the attitude student towards Learning Biology

The section focuses on establishing the impact of IBA on the attitude of students which was the third objective.

4.6.1 Impact of inquiry-based approach on students' attitudes towards Biology

The students were instructed to rank the statements as follows: Strongly Disagree (SD), Disagree (D), Agree (A) and strongly agree (SA). The outcomes are recorded in Table 4.39.

Table 3.39 Students responses on Impact of IBA on the Attitude of Student Towards Learning Biology

Statements on impact of IBA on students' attitudes towards Biology	**SD**	**D**	**A**	**SA**
1) I collaborate to create knowledge	7.6%	11.0%	33.7%	47.7%
2) I learn from each other by asking questions during class discussion or hands-on-activities	11.3%	12.2%	29.1%	47.4%
3) I am motivated to learn	2.0%	2.0%	29.7%	66.3%
4) I ask scientifically oriented questions	30.3%	12.8%	40.0%	16.9%
5) I am able to handle and manipulate the apparatus during practical	15.0%	25.0%	30.0%	30.0%
6) I am able to plan and design experiments	28.2%	4.6%	37.0%	30.2%
7) I am able to collect and record data during lab	20.1%	8.6%	28.4%	42.9%
8) I enjoy Biology lessons	0.0%	7.1%	50.0%	42.9%
9) I compete to answer questions to make my points	25.0%	12.0%	42.9%	20.1%

Based on the data in Table 4.39, 81.4% of the students in Form three (3) collaborated to create knowledge, 76.5% learned from each other by asking questions during class discussion or hands-on-activities, 96% of the students were motivated to learn, 56.9% asked scientifically

oriented questions, while 60% of the students handled and manipulate apparatus during practical. On the other hand, 67.2% had the ability to plan and design experiments, 71.3% were able to collect and record data during lab, 92.9% enjoy Biology lessons, while 63.0% of the students compete to answer questions to make their points.

4.6.2 Findings from Teacher's questionnaires on impact of IBA on students' attitudes towards Biology

Findings from Teacher's questionnaires on the third objective are displayed in Table 4.40.

Table 4.40 Teachers of Biology' responses to Impact of IBA on the Attitude of Student Towards Learning Biology.

Statements on impact of IBA on students' attitudes towards Biology	SD	D	A	SA
1) My students collaborate to create knowledge	14.3%	7.1%	35.7%%	42.9%
2) My students learn from each other by asking questions during class discussion or hands-on-activities	0.9%	21.4%	42.0%	35.7%
3) My students are motivated to learn	1.1%	6.0%	64.3%	28.6%
4) My students ask scientifically oriented questions	7.1%	14.3%	50.0%	28.6%
5) My students handle and manipulate the apparatus during practical	15.7%	14.3%	31.4%	38.6%
6) Students plan and design experiments	16.1%	31.4%	12.3%	40.2%
7) My students collect and record data during lab	4.7%	14.2%	28.2%	52.9%
8) My students enjoy Biology lessons	2.9%	7.1%	50.0%	40.0%
9) My students compete to answer questions to make my points	20.0%	8.6%	42.9%	28.5%

Based on the data in Table 4.40, 78.6% of teachers of Biology said, students collaborated to create knowledge, 77.7% of the teachers said, students learn from each other by asking questions during class discussion or hands-on-activities, and 92.9% said students are motivated to learn. Further, the data demonstrated that 78.6% of them acknowledged that students pose scientifically oriented questions, 70% of the teachers agreed that students handle and manipulate apparatus during practical. Moreover, 52.5% agree that students plan and design

experiments. The data also shows that 81.1% of the teachers consented that their students collect and record data during lab, 90% said students enjoy Biology lessons and 71.4% agree that students compete to answer questions to make my points.

4.6.2.1 Discussion

The discussion of the third objective is presented in this section.

According to the study, it was established that integration of IBA has an impact on students' attitude towards learning Biology. Most of the students were found to be actively participating in the process of creating knowledge by working together. It was shown that 76.5% of the students learned from each other by asking questions during class discussion and 96% of the students expressed their motivations to learn Biology**.** It was also found that majority of the students enjoyed Biology lessons. This relates to what was found by Chu et al. (2017), Bezen and Bilgisi (2020). These research studies established that implementation of IBA Impacts students' attitude, improves questioning ability, and engagement into deep thinking and reasoning. However, it was observed that the students rated themselves higher than what the teachers imagined about them. This shows that students experienced high positive impact of IBA on their attitude towards learning than what the teachers perceived. As a result of these findings, teachers of Biology should be encouraged to integrate inquiry-based approach to impact attitude and enhance the capacity of students to retain the information learned.

4.7 Attitude of Students Towards Learning Biology

Objective four (4) aimed at determining the attitude of students towards learning Biology.

4.7.1 Findings from the Questionnaires of students on their attitudes towards Learning Biology

Table 4.41 Students' response to "I like Biology."

Response	Frequency	% of Frequency
Strongly Agree	235	68.3
Agree	49	14.2
Disagree	46	13.4
Strongly Disagree	14	4.1
Total	**344**	**100.0**

Table 4.41 demonstrates that 82.5% of the students in Form three (3) like Biology, while 17.5% dislike it.

Table 4.42 Students' response to "In my Biology class, I learn about interesting things in their lesson."

Response	Frequency	% of Frequency
Strongly Agree	172	50
Agree	49	14.3
Disagree	74	21.4
Strongly Disagree	49	14.3
Total	**344**	**100.0**

Table 4.42 demonstrates that during Biology session, 64.3% learnt about intriguing things.

Table 4.43 Students' response to "I enjoy learning Biology."

Response	Frequency	% of Frequency
Strongly Agree	147	42.7
Agree	99	28.8
Disagree	98	28.5
Strongly Disagree	0	0.0
Total	**344**	**100.0**

Based on the data, 71.5% enjoyed learning about Biology as compared to 28.5% who di not.

Table 4.44 Students' response to "I prefer Biology more than other subjects at school."

Response	Frequency	% of Frequency
Strongly Agree	147	42.7
Agree	74	21.5
Disagree	74	21.5
Strongly Disagree	49	14.3
Total	**344**	**100.0**

As recorded, 64.2% of the students preferred more of Biology as compared to 35.8% who did not.

Table 4.45 Students' response to "I regret choosing to study Biology."

Response	Frequency	% of Frequency
Strongly Agree	24	7.1
Agree	74	21.4
Disagree	148	42.9
Strongly Disagree	98	28.6
Total	**344**	**100.0**

Table 4.45 shows that 71.5% did not regret choosing to study Biology, as compared to 28.5% who regrated doing so.

Table 4.46 Students' response to "Biology is difficult to understand no matter how hard I try."

Response	Frequency	% of Frequency
Strongly Agree	49	14.3
Agree	74	21.4
Disagree	98	28.6
Strongly Disagree	123	35.7
Total	**344**	**100.0**

Based on the result, 35.7% asserted that Biology is difficult to comprehend despite their attempt to do better, as compared to 64.3% who found Biology to be easy.

Table 4.47 Students' response to "I perform poorly in Biology."

Response	Frequency	% of Frequency
Strongly Agree	123	35.8
Agree	98	28.6
Disagree	74	21.4
Strongly Disagree	49	14.2
Total	**344**	**100.0**

Table 4.47 shows that 64.4% of them did not perform better in Biology, as compared to 35.6% who acknowledged good performance at Biology.

Table 4.48 Students' response to "I perform better in Biology."

Response	Frequency	% of Frequency
Strongly Agree	49	14.2
Agree	74	21.4
Disagree	98	28.6
Strongly Disagree	123	35.8
Total	**344**	**100.0**

As demonstrates, 64.4% of the students did not perform better in Biology, whereas 35.6% performed better.

Table 4.49 Students' response to "I have good understanding about Biology."

Response	Frequency	% of Frequency
Strongly Agree	98	28.6
Agree	49	14.3
Disagree	123	35.7
Strongly Disagree	74	21.4
Total	**344**	**100.0**

Table 4.49 reveals that the percentage of students who agreed to the statement was 42.9%, compared to 57.1% who did not have good understanding in the subject.

Table 4.50 Students' response to "Biology is one of my favourite subjects."

Response	Frequency	% of Frequency
Strongly Agree	221	64.3
Agree	0.0	0.0
Disagree	123	35.7
Strongly Disagree	0	0.0
Total	**344**	**100.0**

It is recorded that, 64.3% said biology is their favourite subject as compared to 35.7% who refuted the statement.

Table 4.51 Students' response to "I am given the chance by my teacher to ask questions in class."

Response	Frequency	% of Frequency
Strongly Agree	148	42.9
Agree	123	35.7
Disagree	49	14.3
Strongly Disagree	24	7.1
Total	**344**	**100.0**

The data demonstrates that 78.6% of the students were provided with the chance to put forth thier questions, as compared to 21.4% who were not given the opportunity.

Table 4.52 Students' response to "I become excited doing Biology practical in my school."

Response	Frequency	% of Frequency
Strongly Agree	148	42.9
Agree	123	35.7
Disagree	74	21.4
Strongly Disagree	0	0.0
Total	**344**	**100.0**

In Table 4.52, 78.6% of the students were excited doing Biology practical than 21.4% who were not excited.

Table 4.53 Students' response to "I collaborate with my classmates during practical in Biology."

Response	Frequency	% of Frequency
Strongly Agree	98	28.6
Agree	148	42.9
Disagree	74	21.4
Strongly Disagree	24	7.1
Total	**344**	**100.0**

According to Table 4.53, 71.5% work together with their colleagues, as compared to 28.5% who did not do so.

Table 4.54 Students' response to "I do not have the opportunity to do practical in Biology."

Response	Frequency	% of Frequency
Strongly Agree	148	42.9
Agree	98	28.6
Disagree	98	28.5
Strongly Disagree	0	0.0
Mean	**344**	**100.0**

Table 4.54 reveals that 28.4% of the students were not given the chance to do practical compared to 71.5% who were opportune.

Table 4.55 Students' response to "I like more of practical work in Biology lessons."

Response	Frequency	% of Frequency
Strongly Agree	221	64.3
Agree	49	14.3
Disagree	49	14.3
Strongly Disagree	24	7.1
Total	**344**	**100.0**

As recorded, it reveals that 78.6% prefer more practical work, as compared to 21.4% who dislike more of practical lessons.

Table 5.56 Students' response to "My interest to study Biology is to pass exam."

Response	Frequency	% of Frequency
Strongly Agree	221	64.3
Agree	49	14.3
Disagree	0	0.0
Strongly Disagree	74	21.4
Total	**344**	**100.0**

Based on the result, 78.6%, interest to study Biology was to pass exam as compared to 21.4% who had a different view.

Additionally, question on students' motivation for choosing Biology are provided Figure 4.10.

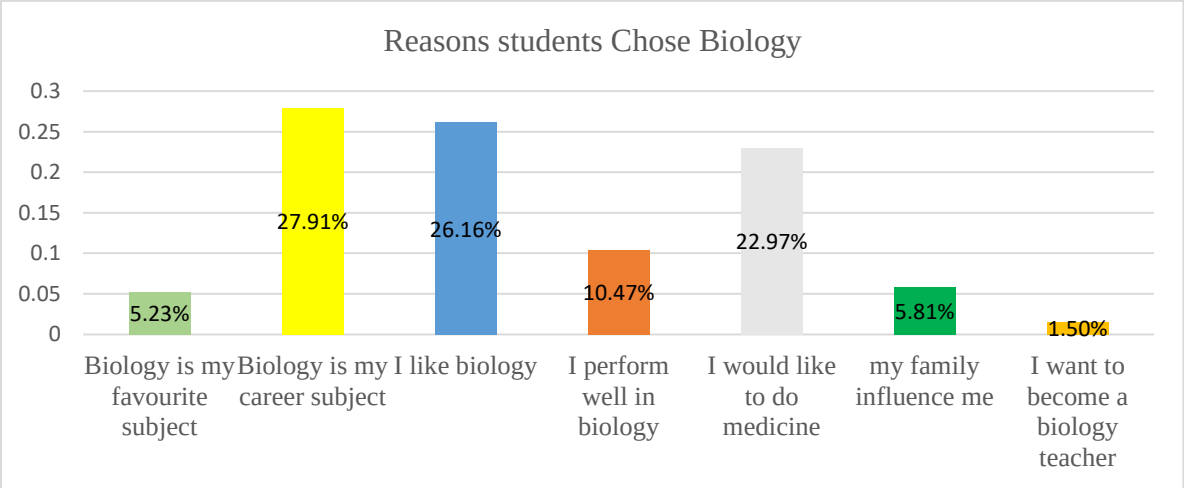

Figure 4.10 Reasons Students Chose Biology

As illustrated in Figure 4.10, 27.91% of the students in Form Three (3) chose Biology as a career subjects, as compared to 26.16% who like and chose it. Further, 5.23% selected it is the subject they favoured, while those who chose it to become future doctors or nurses were 22.97%. Also, 10.47% of the students choose Biology because they do well in it. Only 5.23% want to become Biology teachers, and a small percentage of them, 5.81% were influenced their family members.

4.7.2 Findings from Teacher's Interview Schedule on students' attitudes towards Biology

Figure 4.11 contains responses of Biology teachers in an interview.

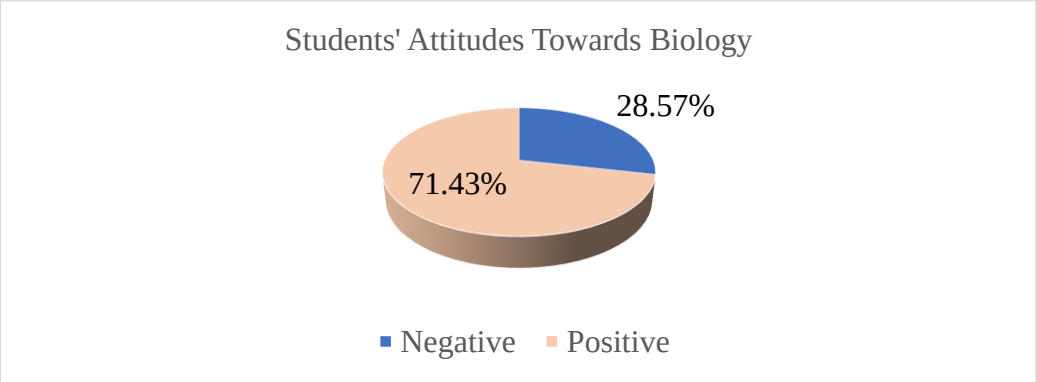

Figure 4.11 Students' Attitudes Towards Learning Biology

Figure 4.13 reveals that 71.43% noted that the attitude of students towards Biology was positive, as compared 28.57% who acknowledged the negative attitude of students.

4.7.2.1 Discussion

The findings of the fourth objective are discussed in this section.

It was found that most of the students in Form three (3) have positive attitude towards learning Biology. It was found that ten (10) out of 14 teachers, representing 71.43%, acknowledged that students possess positive attitude toward. The attitude may have been prompted by what students did in class. It was found that 64.3% of the students learned exciting or interesting things. This result was double-checked in an open-ended question on why students pursued Biology. Based on the finding, 27.91% picked the subject as a career subject. Majority of the students representing 82.5% study Biology because they enjoy Biology classes. This result is consistent with Dibiase and Mcdonald (2015) who reported that attitude towards learning Biology is dependent upon like or dislike of the subject.

In terms of performance, 35.6% of the students performed better while 64.4% performed poorly. It was reported that over half of the students, 57.1%, did not understand Biology concepts. This might have contributed to majority of the students performing poorly in Biology, and may have led to the 28.57% of the students developing negative attitude towards learning the subject. The research finding is consistent with that of Diaz et al. (2021) who recognized that students' attitude towards learning Biology influenced their performance.

Regarding students' attitude towards learning Biology and potential improvements, teachers of Biology were interviewed and provided responses as follows:

"*Some students have positive attitude while other have negative attitude towards learning Biology. Those with negative attitude are those students coming in Form three (3) with weak entry behaviour in Biology concepts. Students are shy and extrovert and cannot present or collaborate with others*". "*One of the reasons for students' weak entry behaviour is the 100% transition policy that says, all students should obtain promotion at the end of the school year despite level of performance and understanding of the subject. The Ministry of Education needs to revisit this policy to help strengthen students' conceptual understanding to promote positive attitude and improve performance. The students should also be encouraged and provided with computers and internet facilities to facilitate ability to do research."*

Similar results were obtained by Kaya et al. (2021), who found that teachers' ability to implement IBA was influenced by students' preparedness for learning through IBA activities.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The summary, conclusions and recommendations for policymakers and further studies are covered in this chapter.

5.2 Summary of the Findings

This section provides a summary of the findings based on these objectives: to determine the extent of adoption IBA by Biology teachers, determine the ability levels of teachers to implement inquiry-based approach, establish impact of IBA on student's attitude towards learning Biology and to determine students' attitude towards learning Biology.

5.2.1 Extent of Adoption of IBA by Teachers of Biology

This purpose of the study was to determine how often IBA was adopted in Githunguri sub-County. The study found that teachers of Biology did not often adopt inquiry-based approach. It was found that out of 14 sampled Biology teachers, only six (6), representing 42.8%, often adopted inquiry-based approach during practical activities. Also, it was found that teachers often place greater emphasis on Confirmatory inquiry more than on Structured, Guided and the Open inquiry. To encourage critical thinking and knowledge creation among students, it is recommended that teachers employ higher levels of inquiry, such as the Structured, Guided and Open inquiry. Therefore, continual teachers training programmes in adopting IBA in Githunguri sub-County should be considered for an extensive adoption of the approach in public secondary schools.

5.2.2 Ability levels of teachers to implement inquiry-based approach in teaching Biology

This research aimed at determining teachers' ability levels in teaching Biology, using the four (4) levels of IBA: which are Confirmatory inquiry, Guided inquiry, Structured inquiry and Open inquiry. It was found that, most of the teachers of Biology were able to implement IBA using Confirmatory inquiry through teaching and not the higher levels of inquiry-based approach. Classroom observations showed that the main reason for not implementing the higher levels of the approach was how the materials in the text books were arranged. The text books provided the questions and procedures for investigation. It was recommended that teachers should not depend on the procedures and questions provided in text books for hands-on-activities in an IBA classroom. Teachers, apart from the questions and instructions provided in the text books, should consider developing investigations and ask the students to determine the steps to solve the problems. This will enable them to use Structured, Guided, and Open inquiry. Continual training will also enable teachers to implement higher levels of inquiry-based approach.

5.2.3 Impact of IBA on the attitude of student towards learning Biology

The research established the impact of integration of IBA on students' attitude. It was discovered that integration of IBA impacts students' attitude towards learning Biology. It was found that majority of the students collaborated to create knowledge, 63.4% learned from each other by asking questions during class discussion or hands-on-activities, and almost all of the students were motivated to learn. Teachers of Biology should be motivated to integrate inquiry-based approach to impact the development of positive attitude in students. This will enhance students' ability to retain information learned.

5.2.4 Students' Attitude Towards Learning Biology

This research aimed at determining the attitude of students towards Biology. It was revealed that majority of the students in Form three (3) have positive attitude towards learning Biology

in Githunguri sub-County. It was also discovered that 10 out of 14 teachers of Biology, whose percentage was 71.43%, acknowledged that students possess positive attitude. Form three (3) students reported that they enjoy studying Biology because good performance in the subject increases their career choices. The results showed that 284 students, representing 82.5%, like Biology.

It was discovered that most of the students performed better while majority performed poorly due to the misconception of Biology knowledge and weak entry behaviours. The misconception of Biology knowledge as emphasized by Kenya National Examinations Council (KNEC), students' weak entry behaviours and the 100% transition policy by the Government of Kenya, could have led to the low academic achievement of the students. This might have contributed to the negative attitude of most students. During an interview, teachers of Biology lamented on the attitude of students by saying;

> *"The negative attitude of the students was due to weak entry behaviour, poor foundation in the basis of understanding the concepts of Biology, and the inability to work together with classmates. Another reason could be the 100% transition policy by the Government of Kenya.*

5.3 Conclusions

The study determined the extent to which IBA has been used by teachers, teachers' ability levels to implement IBA, established the impact of IBA and determined students' attitude towards learning Biology. It was concluded that most of the teachers did not often adopt IBA in their lessons. Also, teachers emphasize on Confirmatory inquiry often than Structured, Guided and open inquiry. Teachers of Biology have the ability to implement one of the levels of IBA which is Confirmatory inquiry. In the context of Confirmatory inquiry, the teacher produces the question

and the methods for investigation. The reason was, in the text books, the questions and procedures are provided for investigation. It established that integration of IBA positively impacts students' attitude. It was also concluded that Form three (3) students in Githunguri sub-County have positive attitude toward learning Biology.

5.4 Recommendations

The research provided results that are used to make recommendations for policymaker and further study.

5.4.1 Recommendations for policymaker

i. Continual training of teachers in the use of IBA should be considered for enhancing adoption of IBA in public secondary schools.

ii. Continual training of teachers to enhance their ability to implement all four (4) levels of IBA, Confirmatory, Guided, Structured and Open inquiry should also be considered.

iii. Teachers of Biology should be given opportunities to attend short courses on integration of inquiry-based approach, collaboration, creativity, and critical thinking.

iv. Learning resources should be provided by the teachers and the schools to facilitate students to experience the process of learning.

5.4.2 Recommendations for Further Studies

Areas for further research could include:

i. A research study similar to this one should be conducted in other parts of Kenya in metropolitan areas.

ii. A study on Biology teachers' ability levels to adopt IBA should be investigated in other regions of Kiambu County.

iii. A study on students’ attitude towards learning Biology should be investigated in other parts of the Country.

iv. A study on Biology teachers' perspectives about IBA integration in secondary schools should be done in other parts of the Country.

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APPENDICES

Appendix I: Inform Consent Form for Participants

Dear Respondent,

Request for Consent to Participate in Research Project

My name is Jackson T. Doboyou, a Masters student at Kenyatta University, in the Department of Educational Communication and Technology, School of Education. I am researching how inquiry-based approach is use in secondary schools and how it impacts the attitude of students towards learning Biology. I am seeking your active involvement to contribute to the improvement of teaching and learning Biology is needed.

In order to gather information on the aforementioned topic, I would kindly ask that you be available to respond to a few questions I have prepared for you. Furthermore, please keep in mind that your participation in this exercise is voluntary. Also, the responses you offer will be kept confidential.

If you are willing to take part in this study, kindly sign on this form.

I am aware that my involvement in this activity is at my will and pleasure and may.

I accept to voluntarily participate in this research project.

Signed……..……..…. Date…...……...……

Appendix II: Teacher's Questionnaires

Introduction:

The research sought to obtain information on how frequently Biology teachers Biology teachers implemented IBA, their ability to implement it in their lessons and how IBA influences students' attitudes to learn. With the help of Inquiry based approach, which is a strictly student-centred, students participate in active learning by being guided towards independent learning.

The findings will enable the researcher to make quality decision to improve process of teaching. Your information will be kept private to ensure the success of this research. It's going to be used for research. Please respond to each question as completely and accurately as you can. Please respond to each question as completely and accurately as you can you can.

SECTION A

1. **Background Information**

Kindly mark (√) the information that applies to you

a. Gender of teachers: Male ( ) Female ( )
b. Teaching experience using IBA 0-5 yrs ( ), 6-10 yrs ( ), 11-15 yrs ( ), 16-20 yrs ( ), 21 above.
c. Subject specialization: Biology/Chemistry ( ), Biology Maths ( ), Biology/Agriculture ( ), Biology/Physics ( )
d. Professional Qualification Untrained ( ), Diploma in Education ( ), Bachelor of Education ( ), Bachelor with PGDE ( ), MED ( ), other ( ).

SECTION B: Please check (√) the column that contains the stamen of your choice using the following keys: **SA= Strongly agree, A=Agree, D=Disagree and SD=Strongly disagree**

No	Extent of Adoption of inquiry-based approach	SA	A	D	SD
1	I often use IBA to teach Biology				
2	I decide the process to use during investigation				
3	Students choose the process for solving a problem they chose				
4	I motivate the students solve the problem they are investigating				
5	During practical exercise, I assist students in arriving at the solution to the problem				
6	I encourage students to design their own experiment offer their own responses to the questions				
7	I encourage my students to pose questions during lectures				

8	I permit students to pose critical question that leads to scientific investigation				
9	When carrying out investigations, students can decide which information they need to collect				
10	Students present and defend scientific investigations in my class				
11	Students are motivated to pose questions during teaching sessions				
12	During investigation, students are given the chance to carefully handle and use the materials to gather data.				
13	Students are permitted to design investigations in Biology				
14	In small groups, I motivate students to debate the results of their studies				
15	Students are encouraged to orally present their results from the investigations they have conducted				
16	Based on the data collected during Biology investigation, students draw conclusions				

SECTION C

No	**Ability Levels of Teachers**	**SA**	**A**	**D**	**SD**
1	I understand how to use inquiry-based approach				
2	I can teach using inquiry-based approach				
3	It is difficult to teach Biology through inquiry activities				
4	I enjoy teaching through inquiry				
5	In a class project, students collaborate and share their results**.**				
6	Students learn better when they are guided to develop their own questions for investigation.				
7	Students are encouraged to work together in a class project and present their findings in class				
8	I encourage students to think and ask questions				
9	Students are allowed to think and ask questions in class				
10	When doing investigations, I give detailed instruction				
11	When the teacher offers students the questions and methods, it is simpler to implement inquiry-based approach classes				

Source: (Dibiase & Mcdonald, 2015)

SECTION D: to the best of your comprehension, please provide answers to the following questions.

i) Confirmatory inquiry, Structured inquiry, Guided inquiry and Open inquiry are the four stages of inquiry. Kindly rearrange them in the order of being easy to implement starting with the easiest.

ii) Please give reasons for the level of inquiry you have indicated as being difficult to implement…… ……

SECTION E

No	Impact of IBA on Students' Attitudes Towards Biology	SA	A	D	SD
1	My students collaborate to create knowledge				
2	My students learn from each other by asking questions during class discussion or during hands-on-activities				
3	My students are motivated to learn				
4	My students ask scientifically oriented questions				
5	My students handle and manipulate the apparatus during practical				
6	My students plan and design experiments				
7	My students collect and record data during practical				
8	My students enjoy Biology lessons				
9	My students compete to answer questions to make their points				

Appendix III: Students' Questionnaires

Introduction:

This study aimed at collecting data on how frequently Inquiry-Based Approach is used by Teachers of Biology and how IBA improves students' attitudes about learning. With an IBA, student take an active role in their education by being guided towards independent learning. The findings from this research will enable the researcher to make quality decision to improve the process of presenting Biology contents. Please keep in mind that your thoughts or opinions will be kept private. Please respond to all questions as fully and accurately as you can.

1. Gender Male [ ] Female [ ]

SECTION A: Information about Biology

Kindly place a check (√) against the options provided against each statement as per your satisfaction. The following Keys can be used: **SA= Strongly agree, A=Agree, D=Disagree and SD=Strongly disagree**

No	Attitude of Students Towards Learning Biology	SA	A	D	SD
1	I like learning about Biology				
2	I learn about interesting topics in the lesson				
3	I enjoy learning about Biology				
4	I prefer more of Biology topics than other subjects				
5	I regret choosing to do Biology				
6	I try my hardest to grasp Biology, but it's not easy				
7	I perform poorly in Biology				
8	I perform better in Biology				
9	I have good understanding about Biology				
10	Biology is one of my favourite subjects				
11	I have the opportunity to raise questions in class				
12	Doing Biology practical excite me the most				
13	During the practical, I work with my colleagues				
14	I am not given the chance to do Biology practical				
15	The reason I am studying Biology is to pass exams				
17	I prefer doing more Biology practical				

18. Why did you choose to do Biology? Please explain.....

SECTION B: Kindly place a check (√) against the options provided against each statement as per your satisfaction.

No	Ability Levels of Teachers	SA	A	D	SD
1	Biology teacher fairly shares questions among all students				
2	I am given the chance by my teacher to share my ideas with other students				
3	I am given the chance to ask questions in class				
4	We are given the opportunity to design our own investigations				
5	During the process of conducting investigations in Biology, we develop our own procedures.				
6	We are given questions to investigate by our biology teacher				
7	When we are working on investigations in Biology, our biology teacher provides guidance				

SECTION C

No	Impact of IBA on Students' Attitudes Towards Biology	SA	A	D	SD
1	I collaborate to construct knowledge				
2	I learn from each other by asking questions during class discussion or during hands-on-activities				
3	I am motivated to learn				
4	I ask scientifically oriented questions				
5	I am able to handle and manipulate the apparatus during practical				
6	I am able to plan and design experiments				
7	I am able to collect and record data during lab				
8	I enjoy Biology lessons				
9	I compete to answer questions to make their points				

Source: (Prokop et al., 2007)

Appendix IV: Classroom Observation Guide

In the course of observing the classroom during teaching, the researcher closely observed teachers' ability to implement IBA and the frequency to which he or she uses the approach to teach inquiry. The students' attitudes displayed toward the lesson during teaching was monitored to describe how they are involved in the learning activities that are deemed to be active learning by the students, as applied, and checked them off as yes or no with a brief description under the comment section.

No	A: Ability Levels of Teachers	Yes	No	Comments
1	Teachers ask Students to make their prior ideas explicit before presenting new concepts			
2	Teachers connect new knowledge and understanding to real life context			
3	Teachers explain to students Biology concepts in simple terms			
4	Teacher evaluates concept learned by students through questioning			
5	Students were guided by the teacher to think of questions			
6	Students were challenged by the teacher to think of questions			
7	When teaching was taking place, students were politely raising questions own their own			
B: Extent of Integration of inquiry-based approach				
1	Before beginning the class, the teacher finds out what students already know through questioning.			
2	Teachers provides guidance during practical activities			
3	Teacher makes learning Biology interactive and interesting			
4	Teacher encourages questions from students			
5	When working on a task, the teacher lets the students work alone.			
6	Teacher poses questions for students			
7	Teacher guides students to think			
8	Students independently came up with a question.			

Source: (Dibiase & Mcdonald, 2015)

Appendix V: Teacher's Interview Guide

The researcher will ask the interviewee the below questions and tick (√) the information most applicable to him or her in the bracket provided. Recording the responses to the questions will be a major concern for accuracy in analysing the data.

A. Extent of Adoption of Inquiry-Based Approach

1. Which of these levels of inquiry do you emphasize while teaching Biology: (1) Confirmatory, (2) Structured, (3) Guided, and (4) Open.
2. How frequently do adopt IBA teaching Biology content?
3. Are there times when you do not use IBA?

B. Students' Attitude Towards Biology

1. What are the attitudes of your students toward learning Biology?
2. What can be done to improve students' attitude or to develop their interests to study Biology?

Appendix VI: Approval of Research Proposal

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Executive Dean, Graduate School

DATE: 15th February 2023

TO: Jackson T. Doboyou
C/O Ed. Comm.Tech

REF: E55F/21644/2020

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board, at its meeting on **15th February 2023**, approved your Research Proposal for the M.Ed. Degree entitled, **"Integration of Inquiry- Based Approach in Learning and Its Influence on Students' Attitudes Toward Biology in Secondary Schools in Kiambu County, Kenya."**

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The Forms are available at the University's Website under Graduate School webpage downloads.

Also, please ensure that you publish article(s) from your thesis before submitting it to Graduate School for examination as per the Commission for University Education and Kenyatta University guidelines.

Thank you.

KENYATTA UNIVERSITY OFFICE OF DEAN 15 FEB 2023 GRADUATE SCHOOL P.O. Box 43844-00100, NAIROBI

JOHN ODONGI
FOR: EXECUTIVE DEAN, GRADUATE SCHOOL

CC. Chairman, Ed. Comm.Tech

Supervisors:
Dr. Grace N. Orado
C/o Ed. Comm.Tech
Kenyatta University

1. Dr. Florence K. Nyamu
C/o Ed. Comm.Tech
Kenyatta University

RM/eww

Appendix VII: Research Authorization

MINISTRY OF EDUCATION

State Department of Early Learning and Basic Education

Telephone: Kiambu (office) 0768 970412

Email:directoreducationkiambu@yahoo.com
When replying please quote

COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY
P. O. Box 2300
KIAMBU

KBU/CDE/DEPT/ 8/VOL.II

12th April, 2023

Jackson T. Doboyou
Kenyatta University
P.O Box 43844-00100
NAIROBI - KENYA

RE: RESEARCH AUTHORIZATION

Reference is made to NACOSTI letter NACOSTI/P/23/24208 dated 30th March, 2023.

You have been authorized to research on **"Integration of inquiry-based approach in learning and its influence on students' attitudes toward Biology in secondary schools in Kiambu County, Kenya"** for a period ending 30th March, 2024.

Please accord him the necessary assistance. You are requested to share with us a copy of your research findings when you conclude your research.

COUNTY DIRECTOR OF EDUCATION
12 APR 2023
FORT THE KIAMBU COUNTY

EMILY NYAGA
For: COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY

MY EDUCATION, MY FUTURE ***MY EDUCATION, MY FUTURE***

Appendix VIII: Authority to Conduct Data Collection

Republic of Kenya
MINISTRY OF EDUCATION
State Department for Basic Education

Telegrams: EDUCATION-NAIROBI
Telephone: Nairobi 3318581
FAX. NO: 254-2-214287
Email:ps@education.go.ke
Web: www.education.go.ke
When replying, please quote

JOGOO HOUSE "B"
HARAMBEE AVENUE
P.O. BOX 30040
NAIROBI

Ref. No: MOE.HQS/3/6/85 Vol. II (65)

Date: 11th April, 2023

Jackson T. Doboyou
C/O. Ed. Comm. Tech
Kenyatta University
P.O. Box 43844-00100
NAIROBI

RE: AUTHORITY TO CONDUCT DATA COLLECTION FOR RESEARCH STUDY IN PUBLIC SCHOOLS IN KIAMBU COUNTY

Reference is made to your application dated 30th March, 2023 over the above-mentioned subject.

Your request to collect data for research by interacting with teachers and students in public schools in Githunguri Sub-County, in Kiambu County, is hereby granted on condition that the exercise will be carried out professionally.

A report on the exercise will be required on completion.

Evelyne Owoko
For: PRINCIPAL SECRETARY

Copy to: County Director of Education: - Kiambu

Appendix IX: NACOSTI Research Permit

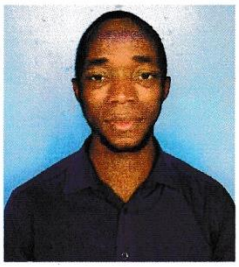
REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **376161**

Date of Issue: **30/March/2023**

RESEARCH LICENSE



This is to Certify that Mr.. Jackson T Doboyou of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kiambu on the topic: Integration of Inquiry-Based Approach in Learning and Its Influence on Students' Attitudes Toward Biology in Secondary Schools in Kiambu County, Kenya for the period ending : 30/March/2024.

License No: **NACOSTI/P/23/24208**

376161

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix X: Study Area Map Showing Githunguri Sub-County