INFLUENCE OF SELECTED FACTORS ON BIOLOGY INSTRUCTIONAL PROCESS IN SECONDARY SCHOOLS IN IMENTI-CENTRAL SUB-COUNTY, MERU COUNTY, KENYA

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been submitted for an award of diploma or conferment of degree in any university or institution.

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Recommendation

This thesis has been examined, passed and submitted with our approval as University supervisors

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DEDICATION

I dedicate this thesis to Sue Owen and Jim Monroe, Frank and Virginia Schitoskey, my mother Harriet Kanario and to my Father Michael Mwika.

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ABSTRACT

Biology is a core science subject that enables students understand fundamental concepts such as genetics, evolution and cellular processes that underpin all living entities which equips students with a comprehensive understanding of the living component of the world. Biological knowledge is also applied in addressing global challenges such as disease control, environmental conservation and sustainable food production in fields such as medicine, agriculture, ecology and biotechnology. The relevance of Biology education places Biology instructional process at the core of teaching and learning to facilitate achievement of envisaged benefits. However, despite relevance of Biology education, there has been a dismal performance in Biology in the country and Imenti-Central Sub- County for the last five years raising a concern on the effectiveness of the instructional process thus the need to undertake the study. This study investigated the influence of selected factors on Biology instructional process in secondary schools in Imenti-Central Sub- County, Meru County, Kenya. The study sought to determine the influence of the students' language skills on Biology instructional process, to establish the influence of attitude on Biology instructional process, to establish the influence of utilization of instructional resources on Biology instructional process and to determine the influence of institutional support on Biology instructional process. The study was guided by Lev Vygotsky's Social cultural theory and Jean Piaget's Constructivism theory. A descriptive research design that incorporated both qualitative and quantitative research methods was adopted for data collection and analysis. The study sampled 352 participants from 95 Biology teachers, 2806 form three Biology students and 49 Biology Heads of Subject from the study area. Data was collected using questionnaires and interview schedules. The instruments were validated through a pilot study in North Imenti sub-county. Cronbach's alpha was used to establish the reliability of the questionnaires whereby all variables had a reliability index of at least 0.7. Qualitative data was analyzed thematically as per the study objectives. Quantitative data was analyzed descriptively using percentages and frequencies and inferentially using Chi-square test with the aid of Statistical Package for the Social Sciences version 26.0 computer software. Findings on Biology instructional process indicated that teachers adequately prepared for Biology lessons and actively engaged students at the presentation stage. However, a majority of teachers did not assess learning effectively. Language skills of students, attitude and utilization of instructional resources by teachers had a significant influence on Biology instructional process. Students' language skills were essential for effective Biology instruction. Findings on attitude indicated that students had both positive and negative attitudes towards Biology. The study also showed that teachers underutilized instructional resources in Biology instruction. Findings on institutional support indicated that teachers hardly participated in professional development activities. Institutional support had no significant influence on Biology instructional process. Based on the findings, the study recommended establishment of language development activities to enhance students' language skills and varied teaching methods to demystify complex Biological terms. Biology teachers should increase utilization on instructional resources to enhance lesson delivery and overall effectiveness of Biology instructional process. The school administration should establish mechanisms to monitor implementation of recommended formative assessment practices in Biology. Ministry of Education in conjunction with school administration should organize and support teacher professional development programs to enhance effectiveness of Biology teachers.

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ABBREVIATIONS AND ACRONYMS

ASEI:	Activity, Student, Experiment, Improvisation
BIP:	Biology Instructional Process
CAL:	Computer-Assisted Learning
CBC:	Competency Based Curriculum
CGCE:	Cameroon General Certificate of Education Examination
ECDE:	Early Childhood Education and Development
HoS:	Head of Subject
HSBCS:	High School Biology curriculum standards
HSEE:	High School Exit Examination
IBL:	Inquiry-Based Learning
ICT:	Information and Communication Technology
INSET:	In Service Education Training
IR:	Instructional Resources
KCPE:	Kenya Certificate of Primary Education
KCSE:	Kenya Certificate of Secondary Education
KNEC:	Kenya National Examinations Council
KUCCPS:	Kenya Universities and Colleges Central Placement Service
LoB:	Language of Biology
LoI:	Language of Instruction
NACOSTI:	National Commission for Science, Technology and Innovation
PD:	Professional Development
PDSI:	Plan, Do, See, Improve
QASO:	Quality Assurance and Standards Officers
SMASSE:	Strengthening Mathematics and Science in Secondary Education
SPSS:	Statistical Package for the Social Sciences
STEM:	Science, Technology, Engineering and Mathematics
TEAMS:	Teacher Education in Mathematics and Science
UK:	United Kingdom
UNICEF:	United Nations Children's Funds report
USA:	United States of America
ZPD:	Zone of Proximal Development

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Science education is a vital enterprise for any nation to advance industrially. It equips students with competencies that are vital for survival and progress as an individual and society at large (Bal-Taştan, Davoudi, Masalimova, Bersanov, Kurbanov, Boiarchuk, & Pavlushin, 2018). Science education entails the study of how science is taught and learned, the role it plays in the curriculum and its application to real life (Hodson, 2020). In most countries globally, science education has evolved into a dynamic and multidisciplinary field referred to as Science, Technology, Engineering and Mathematics (STEM). For instance, Breiner, Harkness, Johnson and Koehler (2012) state that in the United States of America (USA), the most popular subject areas in the STEM domain include Physics, Chemistry and Biology which along with Mathematics and a myriad of applied science subjects constitute the STEM family. Within the science domain, Biology as a subject is built on the foundation of biological sciences, refers to the scientific study of living organisms and their interactions with their environments (Kareem, 2018). The study of Biology imparts biological literacy thereby developing and enhancing the understanding of students to apply biological knowledge and skills in a real-life situation (Mardonov, 2019). Therefore, Biology education enables students to understand the functioning of living organisms and application of Biological knowledge to real-life situations.

Biology is taught at various levels of education from Early Childhood Education and Development (ECDE) to tertiary levels. Most education systems embed Biology education in the science curriculum in early or primary education. Trundle (2012) avers that physical science, earth or space science and, life science constitute primary school science in New York. At primary level, students are taught biological knowledge in life science where they acquire knowledge about living things and nature. Larimore (2020) states that Biology education during the early school years introduces students to biological concepts and stimulates biological thinking. This means that Biology education taught and learned under the science curriculum in Pre-Primary and Primary school level builds a foundation for the structured science curriculum at the high school level.

At the secondary school level, science education is structured into pure and applied science curricula. Pure sciences entail three subjects namely; Physics, Chemistry and Biology. Basil (2021) posits that Biology exists as a distinct subject domain at the secondary school level where students are exposed to advanced levels of biological knowledge. This enables them to understand the complexity of plant, human and animal life forms. Biology education taught in secondary school equips students with biological knowledge, skills and attitudes to solve problems that threaten human existence such as diseases and hunger (Himschoot, 2012). This means that Biology education in secondary school level prepares students to specialize in Biology-related fields such as nursing, medicine and animal science at the tertiary level which are significant for human survival. This underscores the relevance of Biology education which places the instructional process of the subject at the core of the teaching and learning process, through which the goals and objectives of the Biology curriculum are achieved.

Biology instructional process (BIP) consist of three stages namely: preparation, presentation and evaluation. Preparation is the initial stage where teachers; identify learning objectives, select appropriate content, source for appropriate instructional resources and identify suitable teaching and assessment methods (Wieringa, Janssen, & Van, 2011). Preparation is proceeded by presentation where teachers employ various pedagogical methods and approaches to facilitate learning (Maeng & Bell, 2015). At this stage, methods such as lectures, teacher demonstration, multimedia presentations and hands-on-activities are employed to facilitate knowledge transfer. Evaluation sums up the instructional process where teachers assess whether or not the learning objectives have been achieved. Evaluation feedback obtained is utilized to address misconceptions, reinforce learning and refine teaching strategies, ensuring an ongoing cycle of improvement in the instructional process (Xiao, Cai, Ge, & Yang, 2023). As such evaluation enables teachers to determine the success and shortcoming of the instructional process which consequently reflects its effectiveness. This means that an effective instructional process should be characterized by appropriate planning, presentation and evaluation which is in turn reflected in satisfactory performance.

Despite the relevance of Biology education in life and society, its instructional process continues to face several challenges that in turn hinders successful implementation of Biology education. Such challenges have been suggested to be the major cause of students' poor performance in the subject at the national and sub-county level in Imenti central as illustrated by data in Table 1.

Table 1: Students' Performance in Biology in KCSE Nationally (2018-2022)

Year	2018	2019	2020	2021	2022
National Mean (%)	25.69	24.94	26.52	28.51	28.69
Grade	D	D	D	D	D
Sub-county Mean (%)	19.68	23.03	21.41	22.88	20.75
Grade	D-	D	D	D	D-

Source: Kenya National Examinations Council (KNEC) Report, 2022 and Sub-County Education Office, Gatimbi 2022.

Table 1 indicates that the sub-county Biology mean for the last five years has not only been below the average mark of 50% but also below the national mean. For instance, the sub-county achieved a mean of 22.88 in 2021 which further deteriorated to 20.75 in 2022. Nationally, the mean performance of students in the Kenya Certificate of Secondary Education (KCSE) Biology examination ranges from 25.69 % in 2018 to 28.69% in 2022. The poor performance at the national level and Imenti-Central has raised a concern on the effectiveness of Biology Instructional Process. The poor performance shows that most candidates attain a mark below the threshold required for entry into Biology related courses at the tertiary and University levels in Kenya. Nationally, students who pursue Biology-related courses at the tertiary level in Kenya are placed into various courses by the Kenya Universities and Colleges Central Placement Service (KUCCPS). The KUCCPS minimum Biology grade for Bachelor courses in Medicine and Health-related fields is a B plain and a C+ (plus) in applied and Biological sciences (KUCCPS, 2020). Data in Table 1 shows that the average performance of students in Biology is generally poor thus limiting the future career prospects of a majority of students in various Biology-related courses. This may result in low enrollment in such courses which may affect the country’s economy negatively in fields that require manpower from Biology-related courses such as agriculture and the health sector.

Researchers have endeavored to illustrate instructional process and factors that contribute to its effectiveness globally, regionally and locally in Kenya. In China, Lu and Liu (2012) studied the instructional process by focusing on alignment between pedagogical concepts of High School Biology Curriculum Standards (HSBCS) and the High School Exit Examination (HSEE) of 2009. Findings revealed low levels of alignment between cognitive complexities of the content taught and cognitive level of the examination content. The HSEE require lower level cognitive skills than HSBCS resulting in discrepancies between activities that take place during presentation stage and evaluation stage. This shows that the instructional process should be planned for to ensure synchrony between what is planned for, taught and evaluated. The study findings pointed out the need to conduct a study on activities that teachers and student engage in from preparation stage all through to evaluation stages of the instructional process.

Kubiatko, Torkar and Rovnanova (2017) studied teachers' contribution to students' perception of Biology at the lower secondary school level in Slovakia, Central Europe. Teacher's gender, student's gender and the number of Biology teachers who had taught the students were among the study variables. The study findings revealed that the number of teachers who teach the students, the teacher's personality and gender as salient factors that influenced students' perception of Biology. Students' perception of their Biology teacher positively correlated to their perception of Biology and consequently their attitude toward Biology. The study highlighted teachers' personality, attitude and teaching style as factors that influenced students' attitudes and motivation to learn Biology. This may reflect on the quality of the presentation stage in terms of students' engagement in the learning process and their progress as reflected by their performance at the evaluation stage. The study in response to the highlighted teacher-related factors, sought to establish the influence of teachers' perception on students' ability in Biology and students, utilization of instructional resources during the instructional process.

In the African context, Rahmouni and Aleid (2020) pointed out that teacher practices influenced learning motivation among science students in Tunisia. Practices such as clarification of scientific ideas and offering help to students who experience difficulties in particular topics increased students' motivation towards learning Science. As such,

teacher practices in a school set up towards their teaching subject play a role in cultivating students' positive attitudes and motivation to learn. The study however highlighted the importance of teacher practices toward students' motivation with little emphasis on how other teacher-related practices influence not only students' motivation to learn but the overall instructional process. This necessitated this study that focused on the influence of teacher-related practices like utilization of instructional resources on BIP.

Daworiye, Alagoa, Enaregha and Eremasi (2015) investigated factors that affected the teaching and learning of Biology in public secondary schools of Bayelsa state in Nigeria. The study centered on how teachers' competence and availability of educational facilities affected curriculum delivery. The findings revealed a disparity in the expected and observed teaching and learning practices in terms of pedagogy, allocation of resources and facilities and teacher's competence in terms of knowledge and skills. This showed that Biology education faced several challenges during the instructional process that hindered its successful implementation. Though providing useful findings, the study focused only on two variables and how they generally influenced the teaching and learning process with little emphasis on how the factors influenced the instructional process at each stage. This study thus sought to bridge the gap by investigating how other factors such as attitude, the language of instruction, institutional support and utilization of instructional resources influence Biology instructional process.

In Ghana, a new curriculum framework was introduced in 2018 that focused on constructivist approach to learning in which formative assessment was prioritized over summative assessment (Asare & Afriyie, 2023). However, teachers prioritized summative assessment over formative assessments. Asare et al. (2023) conducted a study to determine factors that hindered adoption of formative assessment practices in public primary school and junior schools. Data obtained from teachers revealed that time constraints, heavy workloads, overloaded curriculum, large class sizes and the number of lessons taught were identified as significant barriers in implementation of formative assessment. Findings implied that despite acknowledging the role of formative assessment, there are barriers that hinder its effective implementation which

may be of detrimental effect to the instructional process. Findings of the study informed this study that focused on the extent to which teachers conduct formative assessment in Biology. The researcher further included students as respondents to obtain a holistic view in regard to formative evaluation.

Lebata and Mudau (2014) focused on the identification of all factors responsible for the poor performance of high school Biology in Lesotho. A qualitative research design was employed whereby semi-structured interviews were used to collect data from Biology teachers. Findings indicated inadequate Biology textbooks, overloaded syllabus, use of English language as the language of instruction and poor internal evaluation procedures contributed to poor performance. Parents, teachers and students also contributed to performance. Similar observations are made in Rwanda by Ndayambaje, Bikorimana and Nsanganwimana (2021) whereby language of instruction, availability of instructional materials, school environment and teaching methodologies were among the salient factors that contributed to poor achievement of Biology in Rwandan secondary schools. Though providing useful findings, Lebata et al (2014) and Ndayambaje et al (2021) focused on performance and not on the instructional process as a whole.

Uganda has also been experiencing challenges in Biology instruction. Despite the availability of a wide range of teaching and learning aids, Tiken, Zebroni, Chepkwurui, Sseggirinya and Kinozi (2019) aver that students undertaking Biology in A-level secondary schools in do not pass their examinations as expected, evidenced by their poor grades in Biology. Similarly, Okello (2016) states that non-utilization and improper use of learning resources contributed to students' inability in Biology and consequently poor academic performance in Biology in Chua County, Uganda. Tiken et al (2019) and Aciro (2016) highlighted the role played by instructional resources to enhance the instructional process. Based on their findings, the current study focused on the extent to which Biology teachers utilized instructional resources (IR) in Biology instruction.

In Kenya, the output of Biology and other STEM subjects has been unsatisfactory which raised a concern on the teaching and learning of STEM subjects at the secondary

school level. Kiige and Atina (2016) indicate that following poor performance in Science and Mathematics, Strengthening Mathematics and Science in Secondary Education (SMASSE) project was introduced in 1999. SMASSE team developed an In Service Education Training (INSET) to focus on attitude and pedagogy to improve the instructional process in Mathematics and Science subjects in Kenyan secondary schools. In 2003, the SMASSE project was launched to be implemented countrywide and by 2007, 90% of the teachers were trained (SMASSE Report, 2007). SMASSE enhanced teachers' competence by providing them with professional development programs, resources and methodologies to improve their teaching effectiveness. INSET focused on cultivating positive attitude towards mathematics and science education among teachers which was a fundamental step for teachers to embrace SMASSE principles. SMASSE workshops also emphasized interactive, hands-on and learner-centered teaching methodologies whereby teachers are exposed to innovative teaching techniques, curriculum content and practical applications of mathematics and science concepts.

Imanda (2022) avers that despite pre-service and in-service training on how to teach Biology based on SMASSE approach, Biology teachers in Emuhaya, Vihiga County, hardly adopted the SMASSE approach. Teachers mainly adopted teacher-centered teaching methodologies limiting students' active engagement in the teaching and learning process. This shows that teachers may be aware of what is expected of them during the Biology instructional process but still fail to play their part as expected. This adversely affects the instructional process and its overall output which is the academic performance. Biology teachers in Mbeere South secondary schools, Embu County partially adopted SMASSE principles namely; Activity, Student, Experiment, Improvisation (ASEI) and Plan, Do, See, Improve (PDSI) in Biology instruction (Njiru, 2012). Teachers owed the partial implementation of ASEI and PDSI plans to inadequate instructional resources, large class sizes, high workloads, teachers' negative attitude toward science and pressure to cover syllabus on time. This means that besides efforts to streamline the instructional process, there are other factors that contribute to its effectiveness. These factors may include; students' language skills, attitude, institutional support and instructional resources.

Several studies have been conducted to establish factors that influence the effectiveness of Biology Instructional process in Kenya. Ong'amo, Ondigi and Omariba, (2017) studied the effect of the utilization of instructional resources on the academic performance of Biology students in public secondary schools in Siaya County. The findings indicated that Biology teachers mainly relied on textbooks at the expense of other resources while only a few teachers improvised resources. Nyambuoro (2012) studied how the institution leadership affected students' performance in KCSE in Homabay County and concluded that the school principals were the chief developers and drivers of the school in the desired direction. Eunice, Khatete and Ondigi, (2014) indicated that broad curriculum, student's entry behavior, large class sizes and inadequate time to plan for Biology lessons hindered effective instructional process. This led to poor performance of Biology in Migori District. Kirima and Kinyua (2016) argued that teacher presentation skills and techniques played a role in cultivating students' interest in the Biology hence influencing their decision on whether or not to enroll in Biology during selection of subjects in Imenti-central, Meru County.

Kenyan studies have mainly attempted to resolve poor performance by attempting to resolve challenges students face in Biology. Such challenges include students' inability to; link knowledge gained in class to real-life situations as evidenced in application questions, link concepts between various topics, poor comprehension of biological principles and processes which leads to a poor interpretation of data presented in tabular form (KNEC report, 2022). However, a majority of such studies concentrate on determinants of students' poor performance in Biology as an outcome rather than a process. For instance, Ong'amo et al., (2017), Nyambuoro (2012) and Eunice (2014) focused on the contribution of factors such as attitude and instructional resources in relation to performance of Biology. Studies that have specifically focused on attempts to resolve the challenges faced during the instructional process remain largely limited. This highlighted a gap on how the studied variables would influence the preparation, presentation and evaluation stages of the instructional process. The current study bridged the gap by determining the influence of factors such as attitude, institutional support, utilization of instructional resources and language skills of students on Biology instructional process in Imenti-Central, Meru County, Kenya.

1.2 Statement of the Problem

Biology education enables students to understand Biological phenomena they encounter in everyday life and creates awareness of healthy living as well as environmental conservation. At the secondary school level, Biology education equips students with prerequisite competencies for future career prospects at the tertiary level upon satisfactory performance at the secondary school level. However, evidence obtained from KNEC 2022 report reveals that performance of Biology in KCSE nationally has been poor over the last five years. A similar trend is observed in Imenti-central sub-county. The unsatisfactory performance raised concern and led to an inquiry into the effectiveness of the Biology instructional process. This is because it is through teaching and learning that students acquire knowledge, skills and attitudes to be tested and consequently reflected in the academic achievement. This study thus bridged the knowledge gap by focusing on the influence of selected factors on Biology instructional process with a specific focus on public secondary schools in Imenti-Central, Meru County, Kenya.

1.3 Purpose of the Study

The purpose of this study was to establish the influence of selected factors on Biology instructional process in Imenti-Central, Meru County, Kenya.

1.4 Objectives of the Study

i. To determine the influence of students' language skills on Biology instructional process in Imenti-Central sub-county, Meru County.
ii. To establish the influence of attitude on Biology instructional process in Imenti-Central sub-county, Meru County.
iii. To establish the influence of utilization of instructional resources on Biology instructional process in Imenti-Central sub-county, Meru County.
iv. To determine the influence of institutional support on Biology instructional process in Imenti-Central sub-county, Meru County.

1.5 Research Hypothesis.

H_O1: There is no statistically significant influence of students' language skills on Biology instructional process in Imenti-Central sub-county, Meru County.

H_O2: There is no statistically significant influence of attitude on Biology instructional process in Imenti-Central sub-county, Meru County.

H_O3: There is no statistically significant influence of utilization of instructional resources on Biology instructional process in Imenti-Central sub-county, Meru County.

H_O4: There is no statistically significant influence of institutional support on Biology instructional process in Imenti- Central sub-county, Meru County.

1.6 Significance of the Study

This study sought to provide useful information to the Ministry of Education to develop an insight into how the selected factors influence Biology instructional process. This would aid in development and implementation of policies and programs that may streamline the teaching and learning process. The findings may enable Quality Assurance and Standards Officers (QASO) to uphold or recommend reforms on the standards to be achieved by teachers during the Biology curriculum implementation process. The findings may also enable teachers to put into action the suggested remedial measures to improve their teaching practices. The study may also add to the body of knowledge on the influence of the selected factors on Biology instructional process.

1.7 Scope of the Study

This study investigated the influence of selected factors on the Biology instructional process in secondary schools. These factors included; students' language skills, attitude, institutional support and utilization of instructional resources. The study was confined in Imenti-Central sub-county, Meru County. The study population included Biology heads of subject, Biology teachers and from three Biology students from 49 public secondary schools in Imenti-Central. The study was conducted through a descriptive survey research design that incorporated quantitative and qualitative research methods to collect relevant data for this study. Data analysis, findings and recommendations were based on the study scope.

1.8 Limitations of the Study

During data collection process, Biology teachers were reluctant to provide information about the shortcomings in their teaching practices. To overcome this limitation, all the

respondents were assured that the information provided would be confidential and would only be used for the current study.

1.9 Assumptions of the Study

The following assumptions guided the study.

i. The respondents would be willing to cooperate and provide accurate information during the data collection exercise.
ii. Biology curriculum was uniform across all schools.
iii. The selected schools experienced challenges in Biology instruction.

1.10 Operational Definitions of Terms

The following are definitions of the operational terms that were used in this study:

Attitude	This is a psychological construct that predisposes the subject to respond to an object preferentially and influences behavior of people in terms of how they perceive, interact and respond to the world around them. In this study attitude refers to students' attitude toward Biology and Biology teachers' perception of students' ability in Biology.
Biology Instructional Process	It is a set of activities carried out during the teaching and learning of Biology. In this study, Biology Instructional Process refers to activities that take place during preparation, presentation and evaluation in Biology.
Institutional support	Institutional support refers to activities that are aimed at improving the teaching and learning of Biology. In this study, institutional support entails teacher professional development programs and academic support programs in Biology.
Language Skills	Language skills refers to ability to listen, speak read and write. In this study, Language skills refers to ability to listen, speak, read and write in reference to the English language, language of Biology and interpretation of Mathematical concepts incorporated in Biology instruction.
Resource Utilization	This is use of instructional resources to as aids to teaching and learning. In this study, it refers use of conventional, improvised and community instructional resources by Biology teachers in Biology instruction.

CHAPTER TWO
LITERATURE REVIEW

2.1 Biology Instructional Process

Instruction in Science education continues to be considered vital for the development of nations all over the world. Its immense contribution to technological innovation and economic competitiveness has made nations invest in science education at all levels of education (Bal-Taştan et al., 2018). In the Science domain, Mardonov (2019) states that Biology education deals with the study of the living world which focuses on the structure, function, genetics and evolution of living organisms. It also focuses on their interactions with one another and with their environment. Biology education thus enables students to develop an insight into the living world enabling them to take care of the environment and solve problems that threaten human existence such as environmental pollution, diseases and hunger (Jamil, Bokhari & Rafiq, 2024). Students are also able to venture into their careers of choice in Biological-related fields promoting both personal and community development (Adewuni & Adejoke, 2023). Benefits of Biology education underscores its instructional process through which Biology is taught and learned.

According to Random (2016), instruction means to provide structure and direction to a curriculum, which is achieved during the instructional process. The instructional process involves all teaching and learning activities set forth for the successful implementation of a curriculum. Applied to Biology instruction, the instructional process involves the interaction of students with Biology curriculum content, the teacher and instructional resources. Dick and Carey (2008) aver that instructional process begins with what students are expected to know and finishes with an evaluation of what students actually know. Usually, the teacher decides the content, skills and attitudes to teach, methods of teaching, evaluation and revision techniques to be used. This means that the instructional process is teacher-guided and requires rigorous planning to ensure productive interaction between students, teachers, curriculum content and instructional resources.

Akdeniz (2016) posits that the instructional process entails three primary stages namely preparation, presentation and evaluation. In the preparation stage, instruction is

designed as per the objectives and learning needs of the students. According to Wieringa et al. (2011) instruction in Biology is developed by specifying objectives and choosing instructional materials and activities that match the instruction's goals. Teachers decide on the instruction structure, create an appropriate learning environment and select suitable assessment methods. Presentation is the second stage which entails delivery of the subject matter. During this stage, Maeng et al. (2015) aver that instruction is delivered through a teaching model or style that best fits both the teacher's preference and students' needs. This step involves delivering instruction according to the previously designed instruction. Evaluation is the last step in the instructional process where teachers assess the instruction's objectives to determine if they were achieved (Isman, 2011). This enables Biology teachers to determine the success or shortcomings of the process, that is, the quality of preparation and presentation.

In Texas, Norman (2011) avers that appropriate lesson preparation revolves around understanding the content, students and mapping out the lesson's structure and components. This enables teachers to align the subject matter with the lesson's objectives and tailor instructional approaches and activities that accommodates students' needs and diversities. Savage (2014) points out that during the preparation stage, teachers map out the lesson plan from its introduction to materials, directions, closure and assessment strategies. In China, Lu et al. (2012) points out the need for adequate preparation to ensure alignment between curriculum standards, instruction and assessment to achieve the expected outcomes in the teaching and learning process. This shows that effective planning is vital to ensure a smooth flow of learning experiences, keeping students engaged and facilitating their understanding while allowing for effective assessment of their progress.

Presentation stage entails teacher, student and content interactions through utilization of instructional resources, language of instruction and involving students actively in the learning process. In Munich, Germany, teachers employ a constructivist student-centered lesson design to actively involve 11^{th} grade students in construction of scientific explanations in Biology classrooms (Nawani, Von, Spangler, & Neuhaus, 2018). This approach promotes in-depth understanding of Biological content and application of knowledge in new situations. This means that an effective instructional

process should actively engage students in the teaching and learning process. At the core of lesson delivery is the language of instruction (LoI) which acts as the link between teachers, content and students. Tawfik (2017) avers students' low proficiency in English language which is used as a medium of instruction affects their ability to express biological concepts orally and in written examinations in North America. Similar observations are made in Germany (Dorfner, Fortsch, & Neuhaus, 2020) and Spain (Llamas, Vila, & Sanz, 2012). This shows that presentation stage is a multifaceted stage that involves teachers, students, content interactions which are shaped by a variety of factors such as instructional resources and students' language skills in reference to the language used as a medium instruction.

Instructional process is summed up by evaluation to determine the extent to which instructional objectives have been achieved. Evaluation can be formative or summative. Black and Wiliam (2010) aver that formative evaluation is conducted alongside the learning process to provide continuous feedback that aids in identifying learning gaps, adjusting instruction and improving learning outcomes. Summative evaluation measures overall achievement of learning objectives and determines the level of proficiency or mastery attained by students for grading purposes and to make judgments about students' performance (Gardner, Harlen, Hayward, Stobart & Montgomery, 2010). Information obtained from summative assessment may also determine a student's readiness for advancement to the next level of education, employment, or training programs (Conley, 2014). Despite serving different purposes, formative and summative assessment should complement each other for the overall success of the instructional process. In conclusion, Biology instructional process entails three primary stages that should be planned for and implemented meticulously to achieve the overall goals of Biology education.

Researchers have previously endeavored to assess Biology instructional process at the global, regional and even locally in Kenya. In the United States of America (USA), Wyner and Blatt (2019) studied the ability of students, pre-service and in-service Biology teachers on food web concepts in ecology to environmental issues they encountered in their everyday lives. Findings reveal that though both teachers and students understand ecology concepts taught and learned in school, students

experienced difficulties in linking the concepts to real-life situations. For instance, they could not link food web concepts to the food they ate. From the findings, it is evident that the instructional process faces challenges that hinder successful teaching and learning process. This may affect transfer of learning yet the ultimate goal of any instructional process is to ensure students grasp the subject matter and apply the knowledge and skills acquired to new contexts in their everyday life.

Nawani et al. (2018) conducted a study on lesson presentation design among eleventh-grade students in Munich, Germany. The study focused on a constructivist student-centered lesson design to actively engage students in construction of scientific explanations during theory lessons in Biology. The six-phase lesson design entailed activating students' prior knowledge about phenomenon under study through how and why focus questions. The teacher then provided theoretical events or entities to enable students to refine the causal story behind the study phenomenon. Lastly, the students wrote down the revised refined causal mechanism. Findings revealed that the six-phase lesson design activated students cognitively in constructing explanations which promoted an in-depth understanding of the subject content and transfer of knowledge into new contexts. The study revealed the importance of preparation and presentation in lesson delivery whereby the teacher is the key planner in the preparation process and also the presentation stage which involves both teachers and students.

In South Africa, Mpeta, De Villiers and Fraser (2015) conducted a study in Limpopo province that investigated the influence of students' beliefs on learning and acceptance of evolution concepts. Findings revealed that a majority of students held on to the Christian faith which holds different views of the origin of mankind and other living organisms. As a result, some students did not accept evolution concepts based on their beliefs while others put their beliefs aside when learning which according to the researcher, alienated students from accepting evolution theories and concepts. This shows that students' beliefs determine their perception and consequently their attitude toward learning evolution among other controversial science-related topics. However, this study highly concentrated on evolution as a topic and not learning Biology as a subject.

Hamunyela, Makaye and Cruz (2022) studied the implementation of the revised competency-based Biology curriculum in junior secondary schools in Namibia. In the new competency-based curriculum, instruction is learner-centered and its implementation process was more rigorous compared to the old curriculum which was mainly teacher-centered. However, despite the alignment of the updated Biology curriculum goals and objectives with the needs of 21st-century students, teachers highlighted several challenges they encountered during implementation. The challenges included: lack of in-service training on how to handle the new curriculum, inadequate facilities and instructional resources and, overcrowded classrooms. This shows that besides improving or changing a curriculum, its implementation is affected by factors within the teaching and learning environment. These factors range from those related to teachers, students and institutional support.

In Tanzania, Mkimbili (2022) studied the extent to which secondary school Biology syllabi provided students with opportunities to acquire and develop critical thinking skills. The Biology syllabi were analyzed whereby elements of inquiry-based learning, problem-solving and Bloom's taxonomy provided aspects of measuring the provision of critical thinking skills. Opportunities were provided by engaging students in carrying out experiments, manipulating and interpreting data to come up with conclusions and deductions. Findings revealed that specific objectives of the syllabi majored in lower-level cognitive skills which hindered acquisition and development of critical thinking skills, a competency that was to be achieved in the Tanzanian curriculum. The syllabi objectives did not meet the curriculum expectations despite proper implementation. This shows that with poor coordination and alignment of instruction from planning to evaluation, the output then fails to achieve the expected goals and objectives.

Several studies have been conducted in regard to Biology education in Kenya. Nyongesa (2015) investigated teacher-related factors that influenced the performance of Biology in Secondary schools in Bungoma County. Findings revealed that teachers had average expectations of their students' performance based on students' previous tests and examination records. Impersonal interactions between students and teachers resulted in negative attitudes by teachers and students toward teaching and learning Biology. Furthermore, instruction in Biology was mainly through the lecture method

which is largely based on the transmission of knowledge with little emphasis on practical work which would enhance understanding of concepts. Female teachers also exhibited higher levels of science anxiety and attributed poor student achievement to inappropriate teaching methods. This resulted in low self-efficacy which affects teachers' vigor in implementing the instructional process from preparation, lesson delivery and evaluation. The study provided useful information on teacher-related issues that contribute to performance in Biology at the summative stage. However, it did not include how the study factors influenced the instructional process in preparation, presentation and formative evaluation stages.

Eunice, Khatete and Ondigi (2014) conducted a study on pedagogical practices that hindered effective Biology instructional process in Secondary Schools in Migori County. In the study, teachers revealed that Biology curriculum was too wide making it hard to use appropriate teaching techniques while at the same time covering the syllabus within the stipulated four years. Demonstration and lecture methods emerged as the most common teaching methodologies. As such the instruction was mainly teacher-centered which did not encourage student-centered instruction which would enable students understand concepts better and acquire critical thinking skills essential for problem-solving skills. Findings further indicated that poor lesson planning influenced instruction as 60 % of the sampled teachers were inadequately prepared for lessons. Other factors such as students' low entry behavior and inadequate instructional resources also contribute negatively to instructional process evidenced by student's poor performance in Biology. The study concludes that learner characteristics and teaching techniques are the salient factors that contribute to performance in Biology.

Literature reviewed globally, regionally in Africa and East Africa as well as locally in Kenya show an attempt by researchers to underscore the dynamics of Biology instructional process in secondary schools. At the global scene, a majority of the literature give little regard to the extent and contribution of the selected factors towards Biology curriculum implementation and learning outcomes. Such findings may or may not apply to the current study. Findings regionally in Africa and in East Africa as well as locally in Kenya tend to concentrate on the contribution of the factors towards Biology learning outcomes in disregard of Biology instructional process. Such findings

may or may not provide an insight to the dynamics of Biology instructional process from preparation to evaluation stage which was the focus of this study. This study thus sought to establish the influence of the selected factors on Biology instructional process in Imenti-Central, Meru County, Kenya as a contribution in bridging the existing knowledge gap.

2.2 Factors affecting Biology Instruction

Biology education continues to face challenges that hinder attainment of its envisaged benefits. Empirical literature shows a persistent poor achievement in Biology by a majority of students in most countries globally. For instance, Villarino and Villarino (2023) project that in Cebu, Philippines, the performance in Biodiversity, digestive system and ecosystem competencies among grade eight students in public schools was below expectations. In Charlotte, USA, K-12 students' poor performance in Biology among other science subjects limits their opportunities to pursue further studies in science-related fields (Liu & Cavanaugh, 2011). In the African context, similar trends have been observed. Lebata et al. (2014) posit that Biology 5090 has been performed poorly from 2016 to 2012 in Lesotho. In Tanzania, the performance of Biology at the ordinary level has been declining despite efforts to streamline pedagogical approaches in science education (King'Aru, 2014). Similarly, Nyambuoro (2012) and Samwiko (2013) agree that performance in Biology has been poor in Kenya as evidenced by data on Table 1. The poor performance raises a concern about the underlying issues that may be affecting the instructional process in Biology resulting in unsatisfactory output evidenced by poor academic performance.

Researchers posit that challenges facing Biology instruction could be attributed to student-related factors, instructor-related factors, government policies, Biology curriculum and institutional-related factors among others. Instructor-related factors include professional knowledge in terms of content and pedagogy (Gess-Newsome, Taylor, Carlson, Gardner, Wilson, & Stuhlsatz, 2019), instructors' low expectations of learner's ability in Biology (Gbore & Daramola, 2013), inadequate practices such as non-utilization of the available resources, poor planning, poor teaching methods and, inadequate assessment practices, (Ong'amo et al., 2017; Nascimento-e-silva, 2019). Learner-related factors include poor language skills (Van Aesaert & Braak, 2014), peer

influence and negative attitude toward Biology (Ahmad, Sultana, & Jamil, 2022. Institutional-related factors include inadequate instructional resources and facilities (Samikwo, 2013; Lebata et al, 2014) and school academic culture (Nyambuoro, 2012; Ndayambaje et al, 2021). The presence and interaction of the above factors may pose a barrier to the successful implementation of Biology curriculum hence hindering achievement of the expected learning outcomes.

In the USA, Quillin and Thomas (2015) focused on drawing as a learning tool to enhance analysis of complex and abstract concepts in Biology among students from K-16 level and beyond in Michigan State. Findings revealed that visual representation of biological content appealed to visual, kinesthetic and read/write students. Students were actively engaged in the learning process by processing biological ideas, constructing mental models and representing them visually. Drawing to learn incorporated the cognitive, affective and psychomotor domains of learning and interventions in visual literacy and the affective domain. Visual literacy interventions taught students the skill of verbal-to-visual and visual-to-verbal information translations consequently engaging their cognitive capacities in drawing activities. Affective interventions motivated students and improved their attitude towards drawing as a learning tool. This shows that students' cognitive ability as well as affective dimensions such as motivation and attitude contribute to the learning process. These findings informed this study that focused on the relationship between factors in the affective domain such as attitude and Biology instructional process in secondary schools in Kenya.

Rytkönen, Parpal, Lindblom-Ylänne, Virtanen and Postareff (2012) studied factors that affected the academic performance of Bioscience first-year students in Helsinki. The study focused on the relationship between teaching and learning environment and the study success of students. It also focused on students' perceptions of factors that hindered or enhanced their studies in their respective courses. Data analysis revealed that teaching and learning environment, perception of learning and study success positively correlated to organized studying. Organized studying entailed good time management and personal effort to study which was reflected in higher grades and more credits earned by the students. On the other hand, poor study habits in addition to the teaching method which was mainly in the form of lectures discouraged students'

engagement in learning. This study reveals that factors related to instructors as well as students contribute to the overall success of learning.

Tabotabo-Picardal and Pano (2018) conducted a study to determine the effectiveness of contextualizing molecular Biology among 10^{th}-grade students in Cebu City, Philippines. The contextualized strategy incorporated an inquiry-based approach as per John Dewey's inquiry-based model. It also incorporated instructional resources such as videos, simulations and locally available materials to enhance understanding of complex concepts in genetics. The study findings revealed that contextualizing molecular Biology concepts enhanced students' conceptual understanding and promoted higher cognitive skills. It also revamped their attitudes and interests toward learning genetic concepts at the molecular level. The study further recommended that teachers should become resourceful in delivering abstract Biology concepts in a more relatable manner to enable students to relate concepts learned class in class to real-life situations. Based on the study recommendation, this study focused on other factors that influence contextual learning and teaching not only in genetics but in Biology as a subject taught at the high school level. These factors included attitude, students' language skills, institutional support and utilization of instructional resources.

In the African context, Berie, Damtie and Bogale (2022) conducted a content analysis study on inquiry-based learning (IBL) in science education in Ethiopia. Quantitative analysis of data obtained from IBL-related articles, thesis and dissertations revealed that among science subjects, Biology is the most explored subject with a specific focus on teaching and learner achievement. However, the implementation of IBL strategies was below the expected threshold due to low motivation, resource constraints and teachers' low comprehension of IBL teaching and learning activities in science classrooms. The study findings provided valuable insights into the nature and status of inquiry-based learning in science education in Ethiopia. However, there was no specific focus on factors that hindered incorporation and implementation of IBL strategies and approaches such as active engagement of students in learning process. This necessitated the current study that on how factors such as attitude, institutional support and language skills influence the incorporation and implementation of the proposed practices during Biology instructional process in Kenyan Secondary schools.

Lohay, Mwonge, Naho and Wandela, (2022) studied determinants of students' academic performance in Biology in Ngara district, Tanzania. The determinants included parental level of education, students' perception of Biology, motivation to teachers, in-service training, conducive learning environment and availability of well-equipped learning facilities such as laboratories and libraries. Quantitative and qualitative data was obtained from 12 Biology teachers and 120 students from six secondary schools. Data analysis revealed that the aforementioned factors contributed to students' academic performance in Biology. Factors within the institution such as facilities, instructional materials and resources and learning environment had a greater influence on academic performance. Based on this, the current study primarily focused on these factors in relation to the instructional process instead of performance which is an end product of the instructional process. These factors included utilization of instructional resources and institutional support. The current study also used a larger sample size in regard to the number of schools and students to increase reliability of the findings.

In Kenya, teacher-related practices and inadequate instructional materials and equipment contributed to persistent poor performance in KCSE Biology in Nyakach district (Albert, Osman, & Yungungu, 2014). Teacher demonstrations were rarely conducted during practical lessons. Teachers administered practical sessions occasionally and hardly allowed students to ask questions during Biology lessons. Teachers also failed to provide immediate feedback on students' assignments and examinations. This shows that Biology teachers' approach in terms of how they conduct their teaching has a great impact on the instructional process. A similar performance trend was observed in in Eldoret municipality where students' negative attitude toward Biology, low interest and inability to engage in practical activities affected Biology performance (Joy, 2013). Additionally, Kiilu, Mwania and Mumo (2022) observed a declining trend in performance of Biology in Makueni County which was attributed to students' negative attitude towards Biology. This shows that affective domain factors such as attitude contribute to a learner's performance. The Kenyan picture as revealed by Albert et al. (2014) and Joy (2013) show that teacher-related and learner-related factors contribute to Biology instruction

Literature reviewed globally reveals that an array of factors contributes to the teaching and learning of Biology. These factors range from those related to the students, teachers and school environment. Globally, the focus is on different aspects of Biology education which include performance in Biology-related courses (Rytokonen, et al., 2012), IBL in molecular Biology (Tabotabo-Picardal et al., 2018). The regional level in Africa and East-Africa and locally in Kenya reveals a specific focus on the factors in relation to performance which is the end product of the instructional process. The findings may thus not provide a true reflection on how the said variables contribute to the instructional process. This necessitated a study that focused on the process itself because a streamlined instructional process results in satisfactory output. This study thus focused on the influence of the selected factors on Biology Instructional process in secondary schools. These factors include students' language skills, attitude, utilization of instructional resources and institutional support.

2.3 Language Skills and Biology Instruction

Language is a medium through which organized and refined thoughts are expressed to facilitate transmission of the intended message to the recipient (Karwitha, 2016). Instruction on the other hand refers to the process of teaching a person how to do something through demonstration, talking, illustration, or explaining. Effective instruction depends on communication of the intended message between teachers and students. Effective communication during instruction depends on language skills which form the basis for intellectual growth (Ramadhanty, Meylani, & Hernawan, 2020). Language literacy in Biology classrooms is therefore necessary to enable students be fully engaged in the teaching and learning process through reading, writing, listening, and speaking (Alvermann & Wilson, 2011). This means that learners' proficiency in reference to language skills determine the extent to which they comprehend the subject matter. As such, learners should be proficient in language skills to be actively engaged in the instructional process which might be the problem in Imenti-Central schools. In this context, the focus is on learner's language skills in reference to the language of instruction LoI in Biology.

The LoI constitutes three aspects namely: the language used to deliver Biology content, subject-specific language which in this study refers to the language of Biology and Mathematical skills and concepts incorporated in Biology instruction. The language of instruction in Biology refers to the language used to communicate scientific concepts and information to students. The language used to deliver biological content can either be learner's first language that is acquired and spoken by learners at birth or second language acquired in the course of a learner's interaction with the environment after the first language. According to the United Nations Children's Funds report (UNICEF, 2021), a majority of learners are taught using a second language due to the global mobility of students and international migration. As such, most education systems have adopted English as the language of instruction in teaching Biology because English is now almost entirely used as the language of science (Drubin & Kellogg, 2012). However, Van Laere, Aesaert and Van Braak, (2014) aver that students whose first language differs from the LoI face difficulties in science subjects. This shows that adoption of English language as the medium of instruction may pose a challenge to non-native English speakers.

Biology as a branch of science has domain-specific scientific language which in the current study was referred to as Language of Biology (LoB). LoB is composed of specialized terminology, vocabulary and communication conventions used by Biologists to describe, explain and discuss scientific processes, concepts, theories and phenomena (Fang, Lamme, & Pringle, 2010; Snow, 2010). According to Parkinson (2012), the specialized vocabulary and technical terms used by scientists and experts in the field of Biology is often in the form of scientific English. LoB also includes technical terms of Latin origin which according to Tawfik (2017) may present a challenge for students, especially those from non-Latin linguistic backgrounds. Tawfik (2020) further avers that Scientific English commonly incorporates both standard and technical terms of Latin origin that Biology students ought to master during the instructional process. Students' proficiency in LoB is therefore essential for effective teacher-student interactions and peer discussions, allowing for precise and coherent exchange of information during the instructional process.

Instruction in Biology also integrates concepts and skills from other STEM disciplines such as Mathematics and Chemistry. For instance, Feser et al (2013) aver that Biology consists of quantitative data in fields such as genetics and ecology, whose analysis and interpretation require the application of mathematical skills and concepts. This means that Mathematical tools and techniques enable students to make sense of complex biological phenomena, such as population dynamics and genetic inheritance (Brewer & Smith, 2011). This underscores the need to foster quantitative competencies in Mathematics skills that aid in the manipulation, analysis and interpretation of biological data. This means that, if learner's struggle with the mathematical components of Biology, it may limit their understanding and engagement with the subject. Pross (2016) further suggests that chemistry concepts such as chemical reactions, chemical bonds and molecular structure enable Biologists to understand how biological molecules such as nucleic acids and proteins, interact and function. Moreover, knowledge of chemical reactions enables students to understand biological processes whose biochemical pathways rely on chemical reactions such as deamination, cellular respiration and photosynthesis. The interconnectedness of the above fields posits that students need to be conversant with relevant concepts and skills from other STEM-related disciplines that are applied in Biology to promote holistic learning.

The three aspects of LoI play a crucial role in the teaching and learning of Biology because they impact students' understanding and comprehension of the subject matter. Poor language skills in regard to LoI may also lower students' self-confidence and limit their participation and engagement in learning whereby they may hesitate to ask questions, seek clarification, or participate in discussions. Students also need to be conversant with the syntax, lexicons and semantics of Biology to enable them to understand biological concepts better and at the same time express themselves like Scientists. Relevant skills from fields such as mathematics, computer science and chemistry are also vital for understanding and manipulating biological data. Overall, proficiency in the three aspects of LoI cannot be overlooked since they contribute to the learning of Biology. In this light, this study will focus on the relationship between students' language skills in the three aspects of LoI and instructional process in Biology.

Several studies have been conducted on the relationship between language skills and instruction in Biology and other STEM-related subjects. Tawfik (2017) carried out a study on the integration of language and content in Biology classrooms for non-native English speakers in North America. The results revealed that learning outcomes increased with increased instruction time in English but at an insignificant rate. This was due to low proficiency in the English language demonstrated by students' limited knowledge of English grammar and vocabulary. Low proficiency affected students' ability to express biological concepts orally and in written examinations. Students also pointed out that science classes had many scientific vocabularies that were difficult to understand. The study revealed that English language students whose native languages were Latin-based were more familiar with scientific terms and understood new terms better than their counterparts with non-Latin linguistic backgrounds. This shows that when a second language is selected and adopted for instructional purposes, it may pose a challenge for non-native speakers of the language which may be the case in Kenyan secondary schools.

To remedy poor performance, Thayamathy, Elango and Karunarathna (2018) evaluated factors affecting the academic performance of undergraduate students in the faculty of Science Eastern University, Sri Lanka. Findings revealed that fluency in English language contributed to academic performance. Fluency in the English language had a positive correlation with Biology Grade Point Average (GPA) and other subjects offered by the faculty of science. The findings provided an insight into how proficiency in language of instruction affected students' performance in Science subjects. However, it mainly focused on student performance and not the instruction process itself. This study sought to fill the gap by investigating the influence of language of instruction on the Biology instructional process in Kenyan secondary schools both at presentation and evaluation stage.

Llamas, Vila and Sanz (2012) studied the relationship between Mathematical concepts and skills and learning of Biology-related courses at the tertiary level in Spain. The study focused on determining difficulties encountered by students in solving plant physiology problems that required mathematical skills. Findings revealed that students demonstrated persistent weakness in answering questions that required the application

of mathematical skills such as calculations, graphs and tables due to their low competency in Mathematics. This view was in agreement with the findings of Eastwood, Boyle, Williams and Fairhall (2011) who pointed out that nursing students in Australia exhibited mathematical errors in calculations of drug concentrations. It may therefore be deduced that students' competency in Mathematics influences learning in Biology as it influences comprehension and interpretation of quantitative data. Although Llamas et al. (2012) and Eastwood et al, (2011) focused on Mathematical skills and Biology instruction at the University level, there was a need to focus on students' proficiency in Mathematical skills incorporated in secondary school Biology.

Oyekan (2015) studied teachers' perception of the relationship between language competency and academic performance in Biology among Senior School Certificate students in Nigeria. Teachers pointed out that limited biological vocabulary, mother tongue interference and misinterpretation of questions lead to poor performance in Biology and consequently lack of interest in Biology lessons. This shows that proficiency in the language of instruction enhances understanding of concepts and promotes communication and presentation skills in the description and application of Biological concepts day to day life. However, the main focus of the study was academic performance which is the end product of the instructional process and not the process itself. This study sought to fill the gap by investigating the influence of learner's proficiency in the language of instruction not only at the evaluation stage but also during presentation stage in Kenyan secondary schools.

Ferreira (2011) used a qualitative research design to investigate the influence of the English language in teaching life sciences in South Africa. Findings revealed that students with low comprehension of the English language failed to grasp biological concepts being taught. This shows that use of the English language as a medium of instruction may create challenges for non-native English speakers. Students also found biological terms unfamiliar which made it difficult to master and comprehend the terminologies. Though the study provided useful findings, it employed a qualitative research design such as focus groups to collect data which did not provide statistical representation. The current study sought to supplement the qualitative data findings by

incorporating quantitative research design to generate quantitative data to establish the degree of the influence of the learners' language skills on Biology instructional process.

In the East African context, Ahmed (2017) conducted a case study to determine problems faced by high school students when learning speaking skills in Sudan. The study findings pointed out that speaking performance was affected by: little time allocated for speaking tasks, fear of criticism and little motivation to express themselves in English. Additionally, students were under pressure to pass their exams at the expense of enhancing speaking skills while at the same time, they mainly used Arabic to communicate. This may mean that different aspects of language skills are prioritized based on their presumed importance. Teachers were thus advised to offer students more time and opportunities to participate in English-speaking activities. Teachers were further advised to encourage their students to use English language more often without worrying about making mistakes to sharpen their speaking skills. This shows that students should be competent in writing, listening, speaking and reading domains in reference to the language of instruction for effective instruction in Biology.

Hakorimana, Oyebimpe and andala (2020) studied relationship between English language skills and academic performance of students in public secondary schools in Rwanda. Data analysis gave a correlation coefficient of 0.874 which revealed a positive relationship between students' proficiency in English as the LoI and student academic performance. The study revealed that instruction in the English language was difficult for some students who have not mastered the language yet, thus hindering their understanding in regard to the subject matter. Instruction in English language also discouraged student participation in class discussions. As such, students with a good command of English language skills dominated class discussions and generally performed better academically than their counterparts with low proficiency in English skills. The study findings highlighted the importance of students' proficiency in the language used as a medium of instruction. Findings implied that poor language skills in the LoI may limit learner's engagement in learning activities such as asking and answering questions, participating in class discussions and expressing themselves in written assignments and examinations.

In Kenya, most subjects taught at the secondary school level including Biology are taught in English. However, most students predominantly communicate using their mother tongue before they start schooling (Dhillon & Wanjiru, 2013). This means that English language is a second language that most students mainly encounter in a school setup. Tella, Indoshi and Othuon (2010) aver that students at the primary and secondary school levels demonstrate poor mastery of English language which hinders effective learning. This shows that proficiency in the language of instruction is required for subject matter conception in all education levels. Karwitha (2016) conducted a study on the relationship between literacy and numeracy and achievement in Science Subjects in KCSE. Numeracy skills were reflected by performance in mathematics while literacy skills were reflected by Kiswahili and English grades in KCSE. Data analysis using revealed that numeracy and literacy skills had a high correlation with Physics, Chemistry and Biology. Kiswahili and English strongly influenced performance in Biology. This shows that performance in language subjects contributes to instruction in Biology. Though providing useful information, the study focused on all science subjects with no specific focus on Biology. This study thus narrowed its scope to the influence of literacy skills in English language on Biology to provide insight into how language skills influence Biology instruction.

Another study on the influence of language on Mathematics instruction was conducted by Ogembo and Geteregechi (2018) in Mombasa County, Kenya. The study focused on language skills in English as the language of instruction and learner's proficiency in language of mathematics. Findings revealed that students' ability to read, write, listen and speak predicted their ability to master the language of mathematics. Students were found to be poor in all domains of language skills which affected conception of mathematical concepts during learning resulting in poor performance. This means that students must be proficient in the language of instruction to understand subject-specific language which ultimately enhances understanding of the subject matter during the instructional process. Though providing insightful information on language skills and their influence on instruction, the primary focus of the study was Mathematics and not Biology instruction. Consequently, this study will focus on the relationship between proficiency in the language of instruction and Biology instructional process in Imenti-Central, Meru County.

2.4 Attitude and Biology Instruction

Attitude is a psychological construct that predisposes the subject to respond to an object preferentially (Oroujlou & Vahedi, 2011). This means that attitude influences people's behavior in terms of how they perceive, interact and respond to the world around them. Thibaut, Knipprath, Dehaene and Depaepe, (2018) define attitude as an evaluative judgment about a situation, person, or object. In this context, the object encompasses Biology instruction. Hussain, Ali, Khan, Ramzan and Qadeer (2011) further add that attitude is a multidimensional entity that involves affective, behavioral and cognitive components. The affective component refers to the emotional aspect of an attitude, such as feelings of love, hate, or anger towards an object, event, or individual. The behavioral component refers to the observable actions that a person takes in response to an object, event, or individual. The cognitive component refers to the beliefs and judgments that a person has about an object, event, or individual. The affective, behavioral and cognitive component thus interact to influence a person's overall attitude as either negative or positive.

Attitude influences an individual's thoughts, actions and preferences which determines judgment towards an individual or an event as either good or bad, positive or negative (Oluwatelure & Oloruntegbe, 2010). In this context, attitude refers to teachers' perception of students' ability in Biology and student's feelings, beliefs and actions toward teaching and learning of Biology. Imsa-Ard (2020) states that attitude influences learning and teaching through its impact on motivation. Abraka, Onah and Asarhasa (2021) add that attitude influences how students perceive the information being taught in class. However, according to Lee (2019), students' perception depends on how the subject is taught and student-teacher interactions during the instructional process. Chang and Hwang (2018) further add that teachers' attitudes influence their teaching approaches and efforts to create a supportive and engaging teaching environment. Teachers' and students' attitude is an important because it influence the degree to which teachers and students are motivated, engaged and invested in the teaching and learning process.

In Florida, Fowler and Meisels (2010) conducted a study on teachers' attitudes toward teaching evolution, a topic in Biology. The study assessed how teachers' personal beliefs, religious beliefs and evolution-related knowledge influenced their instructional practices in teaching evolution in secondary schools. The study results showed that 85 percent of the teachers believe they are competent to teach the subject content for Biology as established in the state's Biology curriculum standards. However, despite being competent, their personal and religious beliefs influenced their attitudes about teaching evolution which had an impact on their teaching practice. Teachers who held positive attitudes toward teaching evolution were found to have a higher level of competence in teaching the subject compared to those who held negative attitudes. This shows that teacher attitudes may have a significant influence on the quality of Biology instruction in secondary schools in terms of lesson presentation.

Rubie-Davies, Peterson, Sibley and Rosenthal (2015) conducted a study to establish the relationship between teacher expectations and students' outcome in New Zealand. The study employed an experimental design involving a teacher expectation intervention. Teachers were selected and trained to implement practices commonly used by high-expectation teachers. These practices included setting high academic standards, providing constructive feedback, fostering supportive classroom environment and encouraging student autonomy. Findings indicated that teachers who participated in the intervention successfully adopted most of the high-expectation practices which were positively correlated with improvements in student outcomes. Students taught by teachers who implemented high-expectation practices showed greater engagement in classroom activities, higher levels of self-efficacy and increased academic performance. The intervention was particularly beneficial for students who were initially performing at lower academic levels. Such students demonstrated significant gains, suggesting that high-expectation practices could help close achievement gaps. While the study provided valuable insights into the benefits of high-expectation practices, it highlighted limited focus on specific subject areas and teachers' perception of students' ability in specific subjects. The intervention was generalized across various subjects, but it did not delve deeply into how teacher expectations might differ in more specialized fields like Biology. This necessitated the current study that focused on teachers' perception of students' ability in Biology.

Brandmiller, Dumont and Becker (2020) studied teachers' perception of student motivation and classroom behavior in Germany. The study sought to establish how teachers' perceptions were shaped by factors such as students' academic performance, socio-economic background and gender. Findings revealed that teachers' perceptions were significantly influenced by student characteristics, with higher academic performance and socio-economic status correlating with more favorable evaluations. Gender also played a role, with boys often being perceived as less motivated and more prone to disruptive behavior than girls. These insights suggest that teacher biases, whether conscious or unconscious, could impact classroom dynamics and student outcomes. Though providing useful findings the study highlighted a limited focus on subject-specific perceptions of student ability. This gap necessitated further research focusing on teachers' perceptions of students' abilities in Biology which often involves unique cognitive and practical skill sets.

Cimer (2012) conducted a study on learning difficulties in Biology and students' views on how Biology learning can be made effective in Turkish secondary schools. Findings revealed that students' negative attitude hindered effective learning. The negative attitudes were attributed to the teacher's teaching style and the theoretical nature of Biology. Students felt that teachers focused more on theoretical aspects making Biology abstract in nature and hard to understand complex concepts and difficult topics. This study shows that student attitude can have an impact on the quality of instruction if their voices are not heard and taken into account when designing instructional strategies. This makes it crucial for Biology teachers to consider attitudes of students during the instructional process.

Ahmad et al. (2022) conducted a study on how attitude related to students' achievement in Biology among 10^{th}-grade secondary school students in Islamabad, Pakistan. Data analysis reveal that students' attitudes had a positive correlation to academic achievement. The findings further indicated that attitude varied between male and female students whereby female students had more positive attitude than their male counterparts. Furthermore, the type of school shaped students' attitudes whereby those in public secondary schools portray a more positive attitude. The above findings

indicate that several factors such as gender and type of school influence students' attitude toward Biology. Based on the above findings, this study focused on factors that play a role in developing a positive or negative attitude toward Biology among students in Kenyan Secondary schools.

In Botswana, Hinneh (2017) posits that senior secondary school students have a positive attitude towards practical work irrespective of age and gender. However, despite acknowledging the importance of practical work, students were not motivated to pursue Biology studies or Biology-related careers after secondary school level. This was due to their experiences during practical work regarding how practical activities were conducted. This means that students may understand the importance of learning Biology but their interest in the subject may be influenced by the manner in which instruction is conducted. While the study focused on practical activity and academic achievement, the current study focused on students' attitudes toward Biology as a subject and factors that contribute to the overall positive or negative attitude toward the subject.

In the East-African context, Kabunga, Habiba and Mnjokava (2018) studied factors that determined students' attitude in science subjects and the relationship between attitude and academic performance among form five and six students in Uganda. Based on gender, most female students had more positive attitudes toward science subjects than their male counterparts and consequently, females performed better than male students. Similarly, there was a positive correlation between attitude and performance as students with positive attitudes scored better than those with negative attitudes. The study findings provided useful information on the importance of students' attitude in the learning process as it determines students' motivation to learn and participate in the teaching-learning process not only in science subjects but across all fields of study.

Chebotib and Kering (2021) studied students' attitudes toward Computer-assisted Learning (CAL) Biology in Uasin Gishu County, Kenya. Pre-test and post-test analysis revealed that embracing and adopting CAL made learning interesting. CAL tools such as simulations enabled students to visualize complex biological processes and phenomena that would otherwise be difficult to comprehend with textbooks or static

pictures. CAL also allowed students to learn remotely at their own pace since they could explore more content and revisit challenging topics. Generally, the adoption of CAL in Biology fostered positive attitudes among students which consequently lead to improved mastery and retention of the subject matter. This study shows that students' attitude is shaped by a variety of factors including teaching strategies. Based on the findings of this study, the current study will focus on other factors that may contribute to learner's attitudes toward Biology such as teacher's perception of students' abilities in Biology.

Baraiywo (2019) conducted a study in Nandi County, Kenya that focused on student-related characteristics that led to poor performance in Biology whereby student's attitude was among the study variables. From the study sample, 80.27% of the students had a positive attitude towards Biology because being an optional subject, it was selected by those who liked it. Students with a positive attitude performed better than their counterparts with a negative attitude. Similarly, Kiilu, Mwania and Mumo (2022) attributed poor performance in Biology to students' negative attitude towards Biology. The study, though providing useful information on the contribution of attitude, its primary focus is on academic performance and not the instructional process as a whole. This study sought fill this gap by focusing on how students' attitude influences metacognition, motivation to study and their engagement during presentation and evaluation stages of the instructional process particularly in Imenti-Central sub-county, Meru County.

2.5 Instructional Resources and Biology Instruction

The process of imparting knowledge, skills and attitudes in educational settings incorporates Instructional Resources (IR) to facilitate teaching and learning. Busljeta (2013) defines IR as tools and materials employed during the instructional process to facilitate effective instruction by fostering meaningful learning experiences. In the context of Biology instruction, these resources include microscopes, specimens, dissecting kits, chemical reagents, charts, models, real objects, photographs and computers among others (Okori, & Jerry, 2017). IR can be classified as teaching and learning resources. Moluayonge and Park (2017) state that teaching resources are materials and tools that serve as a framework for instructors to structure their lessons

and convey information to students effectively. Oyier, Odundo, Ngaruiya and Mwangi (2017) define learning resources are materials and tools that enable students to acquire knowledge, develop desired skills and consolidate their understanding of the subject matter. Accordingly, IR act as teaching and learning aids during the instructional process.

Instructional resources are used at various stages of the instructional process from preparation to evaluation. During preparation, teachers consult the syllabus and course books to identify specific lesson objectives as well as the national goals of education (Musingafi, Mhute, Zebron, & Kaseke, 2015). This ensures that lesson objectives are consistent with broader educational priorities. IR also enable teachers to plan for differentiated instruction which ensures that unique learning needs of every learner are met (Ordu, 2021). This enhances accessibility and inclusivity of all students in the learning process regardless of their abilities. IR enable teachers to have an elaborate outline of where and how to conduct the intended lesson and thus essential during preparation stage.

During presentation, Kimeu, Tanui and Ronoh (2016) state that IR facilitates conception and understanding of the subject matter by breaking down complex concepts into manageable and understandable units. Technological resources such as videos and hands-on activities cater to diverse learning styles which enable teachers to plan and create interactive lessons that encourage active participation of students in the learning process (Thomas & Edson, 2019). Textbooks, diagrams, charts and digital media such as slide shows provide multiple representations which facilitates understanding of complex and abstract concepts (Okeze, 2022). Use of thought-provoking resources such as videos and photographs encourages curiosity, critical thinking and development of problem-solving skills among students (Rizki, Wati, & Misbah, 2021). In conclusion, IR provide teachers with tools and materials to present content in a meaningful and interesting way, offer individualized instruction and encourage active participation of students in the learning process.

Instructional resources are also crucial at the evaluation stage. Pop-Pacurar and Ciascai (2010) aver that textbooks contain practice questions, exercises and projects which can be used by teachers for formative assessment purposes. Biology assessment usually

involves practical work that tests students' scientific skills, (Ongowo & Indoshi, 2013). This requires the use of IR such as laboratory equipment, specimens and reagents to provide an avenue to assess student's practical and analytical competencies in Biology. Computer-based statistical analysis tools such as Microsoft Excel spreadsheet software perform complex calculations and analysis quickly and accurately generating comprehensive reports about students' progress (Britten & Cassady, 2012). This facilitates tracking of long-term trends in student performance and development of targeted curriculum interventions and adjustments to enhance the teaching and learning of Biology. This indicates that incorporation and utilization of IR is essential in teaching and learning Biology from planning all through to evaluation.

Researchers have explored the contribution of IR to the teaching and learning process. Teixeira, Benchimol, Crepaldi and de Souza (2012) designed and developed 2-dimensional (2D) and 3-dimensional models (3D) to teach the life cycle of a protozoan parasite, *Trypanosoma cruzi* in Brazil. The results revealed that use of animations, 2D and 3D models enabled visualization of the microscopic phenomena. The use of 2D, 3D schematics and 3D videos provided better visualization and a comprehensive view of the complex life cycle of *T. cruzi.* Students explored and comprehended the microscopic concept with greater clarity. The study findings underscored the need to integrate multimedia resources in teaching biological concepts because they facilitate a deeper understanding of complex biological processes and also make the learning experience more engaging and accessible. Based on the above findings, the current study will focus on utilization of instructional resources at various stages of instruction in Biology.

Jacquemart, Lhoir, Binard and Descamps (2016) designed and developed a website with an interactive multimedia dichotomous key as a teaching and learning aid in Botany in Belgium. As a learning aid, the interactive dichotomous key was developed to enable university students to grasp botanical terms and hone their skills in plant identification through practice and assessment. The interactive key was then utilized in teaching and learning of plant systematic course after which examination results pre and post-website release were analyzed to determine its effectiveness. The findings revealed that students performed better in theoretical and practical tests after the release

of the website. Students acknowledged the website as a complimentary tool to their learning which complemented their laboratory sessions and field activities. The findings of this study provided tangible benefits of multimedia tools in enhancing learning outcomes, engagement and overall understanding of complex biological concepts.

Hamidi, Kharamideh and Ghorbandordinejad (2011) adopted a quasi-experimental research design to study the effect of multimedia resources in Biology instructional process in Tehran, Asia. The study compared the effects of interactive multimedia, that is, Compact Disk-Read-Only Memory (CD-RoM) and film as the non-interactive media on learning pace, learning accuracy and students' retention rate. Findings revealed that use of CD-RoM positively correlated with learning pace and accuracy among grade one high school female students in Tehran. The study provided valuable insights into the effect of interactive multimedia resources in Biology instruction. The global picture as presented by Teixeira, Benchimol et al. (2012), Jacquemart et al. (2016) and Hamidi et al. (2011) highlighted the importance of incorporating multi-media resources in Biology instruction. This study widened its scope to include utilization of other conventional, improvised and community instructional resources recommended for teaching and learning Biology.

In African context, Arum (2015) undertook a study on the availability of instructional materials and their utilization in implementation of the then newly established Biology curriculum in Lagos, Nigeria. Data analysis revealed textbooks, preserved specimens, models, microscopes, dissecting kits, reagents, bones, Petri dishes and general laboratory apparatus such as beakers, boiling tubes and test tubes were the most available resources in all senior secondary schools. However, 67 % of the schools lacked digital resources such as computers, projectors, Biology software and access to internet services. In regard to utilization, textbooks, charts and whiteboards are the most commonly utilized resources while dissecting kits, computers, projectors and school botanical gardens are hardly used in most Biology lessons. This shows that resources may not be incorporated into the teaching and learning process due to their unavailability while others may be available but still underutilized during the instructional process as in the case of dissecting kits in the context of this study. Based

on the study findings, this study focused on utilization of the available instructional resources in Kenyan secondary schools particularly those in Imenti-central sub-county.

Shadreck (2013) conducted a study in Zimbabwe to determine availability, adequacy and utilization of IR for teaching science in Buhera district secondary schools. Data analysis revealed that most laboratory resources recommended for science instruction such as apparatus, water and laboratory assistants were inadequate in most schools. In terms of utilization, computers and laboratories were underutilized while libraries and laboratory apparatus were not utilized at all. Despite science being a practical subject, inadequacy of resources coupled with underutilization of the available resources resulting in science lessons being taught theoretically. Though providing useful information, the study focused on science education in general. This highlighted a research gap on the specific influence of utilization of IR on Biology instructional process in secondary schools.

In an attempt to provide the Rwandan picture, Mukagihana, Nsanganwimana and Aurah (2020) conducted a study on availability of Biology IR and their extent of use in teaching pre-service Biology teachers. 90.2% of pre-service teachers agreed that their universities were adequately equipped in terms of IR. However, despite being well-equipped, the findings show that only 7.3% of Biology lectures were taught using IR meaning that IR were underutilized by lecturers. ICT resources like video tapes and digital cameras were not available. Besides projectors, internet connectivity, student computers, printers and photocopying machines were available but hardly used in teaching Biology. This shows that despite availability of resources, they were underutilized in Biology teacher training in Rwandan Universities. While this study focused on utilization of IR in teaching pre-service teachers at the University levels, the current study focused on utilization of IR by in-service Biology teachers in teaching secondary school students.

In Kenya, Wambui (2013) conducted a study to determine the effectiveness of instructional resources on students' participation in science lessons in Kiine Zone preschools, Kirinyaga County. Data analysis revealed that instructional materials were not effectively utilized because of various challenges like: overcrowded classrooms,

inadequate infrastructure in early childhood education centers, lack of confidence among students, language barriers, negative teacher attitudes, insufficient professional skills among teachers and domestic violence among the students. This hindered students' participation which affected effective curriculum delivery at the classroom level. The study indicated that IR are crucial and their non-utilization may lower students' engagement and motivation to learn which may be the case in Imenti-Central secondary schools.

Kabesa and Okioma (2019) conducted a study to establish how utilizing community resources enhanced acquisition of science process skills among secondary school students in Uasin Gishu County, Kenya. Study findings revealed that various community resources such as school grounds, zoos, parks, botanical gardens, resource persons, museums, models and dioramas significantly contributed to students' acquisition of science process skills. School grounds and local specimens fostered direct observation and practical inquiry. Zoos, parks and botanical gardens provided dynamic environments for experiential learning. Museums and dioramas offered contextual learning and historical perspectives. Resource persons brought expertise and real-world experience into the classroom. The aforementioned community resources provided dynamic, real-life learning opportunities that were essential for developing scientific skills like observation, classification, measurement, inference, prediction and communication. Findings of the study thus underscored the value of community resources in resources on science skill acquisition the overall in enhancing effectiveness of Biology education.

Kerubo, (2015) investigated the utilization of community resources in instruction of Business Studies in Ruiru District, Kiambu County, Kenya. The study focused on the extent to which community resources were integrated into the teaching process and the benefits and challenges associated with their use. Data was collected from Business Studies teachers and students through questionnaires and interviews. Findings revealed that community resources such as local businesses, financial institutions and community leaders with expertise in business matters were available. Teachers who utilized the available community resources reported improved student engagement and understanding of business concepts. However, despite availability of a variety of

community resources in Ruiru District, their use in teaching Business Studies was relatively limited. Inadequate use of community resources was due limited time allocated for a business lesson making it hard to incorporate community resources, pressure to cover the syllabus within the stipulated time and lack of financial support from parents and school administration. Study findings highlighted a gap regarding use of community resources in other subjects, such as Biology. Given the unique nature of Biology, which often requires practical, hands-on experiences to enhance understanding, a similar study in this field was therefore beneficial.

Ungaya (2020) avers that despite Starehe sub-county secondary schools experiencing challenges in acquisition of technological resources, 70 % of the schools provided Biology teachers with necessary ICT tools such as desktop computers and access to the internet for instructional purposes. However, students did not have access to resources such as internet services which limited their opportunity to conduct online research and expand their knowledge on the subject matter. The study thus provided valuable insight into the role played by technological resources in improving performance in Biology. However, though providing valuable insights on the benefits of utilization of IR, the study mainly focused on technological resources negating other types conventional, improvised and community resources. This prompted a study on the influence of the aforementioned categories of IR on the Biology instructional process in secondary schools, particularly in Imenti-Central, Meru County.

2.6 Institutional Support and Biology Instruction

Teaching learning of Biology occurs in a school set up run by administrators who supervise the overall operations of the institution to ensure smooth- running of its activities. Owiti (2017) states that decisions made by administrators determine the effectiveness of the teaching and learning process and the overall success or failure of an institution. This underscores the role played by school administrators to offer the necessary guidance and support for the smooth running of its operations (Leithwood, Sun, & Schumacker, 2020). Institutional support includes academic, social and, emotional aspects that are essential for student and teacher success (Mestry, 2017). Institutional support in schools refers to the resources, structures, policies and programs put in place by educational institutions for holistic development and success of students.

This shows that institutional support is a multifaceted enterprise with a common goal of enhancing the effectiveness of the instructional process.

Academic support entails organizing and supporting teacher professional development programs, provision of instructional resources, well-equipped laboratories and libraries and academic support programs aimed at enhancing the teaching and learning process (Sukandar, 2018). Social and emotional support include counseling services and peer support programs (Maponya, 2020). Motivational is another form of institutional support aimed at recognizing and celebrating teachers and students' achievements. As such, rewarding teachers (Agnes, 2021) and students (Chen, 2023) acts as a reinforcement for their efforts and achievements, thereby reinforcing desirable behaviors and academic achievements. Institutional support thus enhances the quality of teaching and learning by providing teachers and students with tools and support systems to succeed. In the context of this study, institutional support will encompass professional development of Biology teachers and academic support programs and policies put forth by school administration to enhance effective teaching and learning of Biology in Secondary schools.

Institutional support plays a vital role in the effectiveness of Biology instructional process. It creates an environment that nurtures both teachers and students which ensures that they have the necessary resources and support for effective teaching and learning (Fourie, 2018). Gonzalez, Eberiel and Shea, (2019) aver that mentorship programs in Biology foster a sense of belonging which reduces feelings of isolation among teachers which may help in retaining experienced teachers. Peer observation and feedback enable novice teachers to navigate the challenges of their early career leading to improved instructional practices and classroom management techniques (Schwan, Wold, Moon, Neville, & Outka, 2020). Belay, Khatete and Mugo, (2020) point out the need for training colleges to train pre-service teachers on how to integrate ICT, a competency required to teach Biology at the secondary school level. This shows that the school administration should organize and support ICT-related training programs and workshops to enable Biology teachers to integrate technology effectively in their lessons to make learning more interactive and accessible. Professional development programs such as mentorship programs, peer observation and feedback, ICT training,

assessment and evaluation workshops enhance teacher effectiveness as they contribute to professional growth, job satisfaction and ultimately, student success.

Globally, studies have been conducted on mechanisms adopted by schools to support teachers and students during the instructional process. Gonzalez, Eberiel and Shea, (2019) focused on collaborative mentorship to retain veteran secondary school Biology teachers in Massachusetts, USA. Collaborative mentoring involved partnerships between experienced high school teachers, university professors and other veteran colleagues. Collaborative mentorship focused on professional development activities centered on improving classroom practices, such as publication tips, committee work and presentation opportunities. The findings revealed that the collaborative mentorship approach was more beneficial to veteran teachers unlike the one-to-one talk approach practiced in most schools. However, prevalent mentorship programs focused on one-to-one talk, resembling a therapeutic relationship, which did not align with the way schools operated. Additionally, mentoring programs often lacked ongoing support for experienced teachers, leading to feelings of burnout, attrition and job dissatisfaction. The study therefore suggested embedment of mentoring programs into regular school practice using a collaborative mentoring approach which would be more beneficial to veteran teachers. The study points out the need to understand specific professional needs and develop effective support structures for Biology teachers who have been in the profession for different periods.

Li, Chan and Hu (2023) conducted a study on the role of principals' instructional leadership on students' academic performance in Chinese primary schools. The study sought to establish the direct influence of instructional leadership on students' academic performance and the influence of instructional leadership on students' academic performance through teachers. Teachers moderated the effect of instructional leadership on students' academic performance through professional development and teaching strategies. Teacher PD dimensions included professional guidance, cooperation and communication and individual teacher reflection. Principals' instructional leadership activities included: involving teachers in decision-making, encouraging teacher innovation during teaching and supporting professional development of teachers. Teaching strategies adopted were individualized instruction,

guided inquiry and collaborative learning. Findings revealed that Principals' instructional leadership had minimal positive direct effect on students' academic performance. Teacher PD also had minimal effect on the relationship between instructional leadership on students' academic performance. Despite, Principals' instructional leadership having minimal direct influence, it influenced teaching strategies through cooperation and communication which in turn had the greatest positive effect on students' academic achievement. The study findings prove that instructional activities organized and supported by heads of institutions may have a direct or indirect influence on the teaching and learning process. This informed this study that focused on the influence of institutional support activities on Biology instructional process. These activities included teacher professional development and academic support programs in Biology.

Omeodu and Iziren (2023) conducted a study on the relationship between administrative strategies and Biology teacher's performance in Nigerian secondary schools. The study sought to establish the impact of principals' constant supervision of classroom activities and encouragement of teachers' professional development on Biology teachers' performance. Based on the findings, teachers and principals agreed that teacher professional development was essential for a teacher. Principals organized in-service training for teachers and encouraged teachers to develop an interest in professional growth and development. Moreover, principals monitored the extent to which teachers participated in PD activities. Constant planning, supervision and encouragement of professional development by principals had a positive impact on Biology teachers' performance. This study provided insights into the role played by school principals in enhancing the effectiveness of Biology teachers by supporting and organizing professional development activities.

Venance (2020) studied the role played by school principals in mitigating the shortage of science teachers and its influence on the academic performance of students in Butiama District, Tanzania. It involved school principals, deputy principals, science teachers, form three and form four science students. Data analysis revealed that school heads mitigated the shortage of teachers by hiring new teachers. Government schools hired form six leavers because they were less demanding in terms of wages. Private

schools hired highly qualified teachers but due to financial constraints, they would sometimes opt to share science teachers with the neighboring government schools. Unlike government schools, private schools also motivated teachers who improved students' academic achievement by putting in extra effort to address the shortage of science teachers. Despite financial constraints, school heads strived to provide good teaching and working conditions by providing science instructional resources and encouraging social interaction with teachers to make them feel appreciated and valued. The study findings provided insights into the role played by school administrators in providing necessary support that promotes effective science instruction. However, the study generally focused on science subjects without a specific focus on Biology. Based on the above findings this study narrowed its scope to Biology instructional process.

In Kenya, researchers have endeavored to establish how institutional support contributes to teaching and learning in secondary schools. Kiniaru (2014) avers that schools with well-established induction programs perform better than schools without such programs. Properly inducted teachers settled fast, became aware of school management expectations and created a good rapport with students. This aided in creating a healthy work environment for new teachers which enabled them to perform their duties diligently. Teachers in schools with reward systems were motivated and highly dedicated to their work in school. Collaboration among teachers evidenced by common goal setting in academics, team teaching and healthy interactions with school heads enhanced teamwork which influenced KCSE performance positively. The study findings revealed that schools which support their teachers socially, emotionally and professionally contribute to the overall effectiveness of teachers.

Munene, Peter and Njoka (2017) conducted a study on the relationship between remedial academic programs and the academic performance of primary school pupils in Nyahururu district, Kenya. Results indicated that teachers embraced remedial teaching to cover the syllabus on time and improve pupils' academic performance. Teachers also pointed out that administrative support was a key factor in determining teachers' attitude toward remedial teaching. Similarly, pupils acknowledged the role played by remedial teaching in improving academic performance. However, pupils (93%) were not comfortable with the time the remedial teaching was conducted since

it consumed break time which made concentration in class hard. The study highlighted the importance of academic support programs such as remedial teaching and the need to establish clear guidelines on when such programs should be conducted. However, the main focus of this study was the primary school level and overall academic performance of pupils. The findings of the study may therefore not reflect the state of remedial programs at the secondary school level and the influence of such programs on Biology. This study sought to bridge the gap by focusing on the influence of academic support programs but shifted its scope to secondary school level and narrowed its focus to Biology instructional process.

Institutional support may also involve rewarding teachers and students for better performance. Geofrey (2014) focused on the relationship between rewarding students and academic performance in Kiswahili in Bomet County. Rewards in the form of Kiswahili badges, biscuits, trips and money were awarded to students (8.3%) who performed well in Kiswahili. However, most students (91.4%) were not rewarded since they performed poorly. Despite a small number of students being awarded, 91 % of the students embraced the reward culture as motivation to work harder. A similar observation was made by Ratemo, Maria and Odaya (2024) who pointed out that rewards in the form of certificates, sponsored trips and monetary awards motivated teachers to put more effort which positively influenced performance. This shows that institutions should recognize and award teachers and students for their achievements in Biology. The Kenyan picture as provided by Geofrey (2014) and Ratemo et al. (2024) was specific to Kiswahili and overall school performance respectively with no focus on Biology. This necessitated the current study that focused on the influence of rewarding teachers and students who do exemplary work in Biology.

2.7 Theoretical Framework

The study was anchored on Lev Vygotsky's (1979) Social cultural theory and Jean Piaget's (1978) Constructivism theory.

2.7.1 Social Cultural Theory

The social cultural theory was formulated by Lev Vygotsky to understand the interplay between cognitive development and the social-cultural environment. The theory postulates that human cognition and development are inherently social processes. In an

educational context, Vygotsky posits that cognitive development is not a solely innate process, rather, it is influenced by students' social and cultural environments (McLeod, 2014). Two concepts were put forth to explain the Social Cultural theory: Zone of proximal Development (ZPD) and Scaffolding. ZPD refers to the gap between students' current cognitive development level and their potential level of competence with support and guidance from more knowledgeable individuals. The more knowledgeable individuals who can be teachers, or peers, better understand the concepts and tasks the learner is striving to learn or complete. This means that learning occurs when students are challenged to work on their ZPD. Scaffolding on the other hand refers to the support and guidance provided to aid students in actualizing their potential in their ZPD. This support is gradually reduced as students become more competent. The theory also underscores language as a vital cognitive tool that shapes human thought and mediates interactions with the world around them (Vygotsky, 2012). Language serves as a primary tool in the scaffolding process by enabling students to internalize knowledge, skills and cultural practices of their society through conversation, discussions and interaction with more knowledgeable individuals. Generally, the social-cultural theory posits that learning is a social process that occurs through facilitation by more knowledgeable individuals, with language serving as a means of mediating these interactions and shaping cognitive development.

Vygotsky's Social cultural theory was used in the context of this study to provide a comprehensive framework for understanding and analyzing the study themes which included: language skills, institutional support, attitude and utilization of instructional resources. According to the theory, language is an important cognitive tool that enables students to internalize Biological concepts. This shows that the students' language skills in language of instruction influences comprehension and engagement with the subject matter consequently facilitating or hindering learning. Learning involves scaffolding which may include utilization of instructional resources by more knowledgeable individual to enable students to understand concepts or complete tasks within their ZPD. This theory also posits that learning is a social phenomenon that involves interaction of students with more knowledgeable individuals. Biology teachers act as the more knowledgeable other to facilitate learning. Perception of Biology teachers towards students' ability in Biology may shape how teachers prepare for Biology

lessons, deliver the content and engage with students at the presentation and evaluation stage. Students' attitude towards Biology may also influence their willingness to engage in tasks which are within their ZPD. Learning as a social process is also characterized by institutional support activities such as teacher professional development and academic support programs in Biology. These programs enable institutions to create a more effective learning environment that promotes collaboration, scaffolding ultimately enhancing students' learning experiences and outcomes. Vygotsky's Social cultural theory highlights the role played social-cultural factors in teaching and learning which provided a framework to establish how the language skills, attitude, utilization of instructional resources and institutional support influenced the Biology instructional process.

2.7.2 Constructivism Theory

Constructivism theory was developed by Jean Piaget and later expanded by scholars such as Lev Vygotsky, Jerome Bruner and Ernst Von Glasersfeld. This theory was formulated to develop an insight into how children develop cognitive structures and mental representations of the world around them. Constructivism views learning as an active personal endeavor that is based on constructing knowledge from one's environment through social interaction. As such, students actively construct knowledge rather than acquiring it. According to this theory, students come into the learning setup with various schemas that influence how they interpret and process new information (Krahenbuhl, 2016). Constructivism considers learning as an active process in which students actively construct knowledge based on both their previous experience as well as their interaction with the environment. Despite learning being a personal endeavor, it occurs through collaboration and engagement in social setups (Fosnot, 2013). This underscores the need to embrace cooperative and collaborative learning activities. Lastly, constructivism is task-oriented and focuses on the assessment of understanding and application of knowledge and continuous feedback to suggest areas that need improvement and address any misconceptions.

Applied to Biology instruction, the theory advances that Biology instructional process should be an active process in which students are involved in constructing their own knowledge. Biology teachers should plan for teaching and learning activities and provide opportunities for active engagement of students during the presentation stage.

Since knowledge construction is partly based on prior knowledge, teachers should assess students' schemas to understand their prior knowledge related to the topic under study. This helps in addressing misconceptions and designing instructional activities that build upon what students already know. During lesson delivery, teachers should adopt learner-centered teaching approaches such as discussions, group work, hands-on experiments, or case studies which enable students to be actively involved in construction of their own knowledge. Constructivism also underscores the role of social interaction in the learning process, therefore, cooperative and collaborative learning strategies such as group work should be embraced to promote exchange of ideas and construction of knowledge through the interaction. Assessment in constructivist's approach not only involves evaluating the final product of learning but also the process through which students arrive at the product. This means that Biology teachers should mainly focus on formative assessment in Biology to provide regular and continuous feedback on learning progress.

2.8 Conceptual Framework

The study conceptualizes the influence of selected factors on Biology instructional process as illustrated in the figure 1.

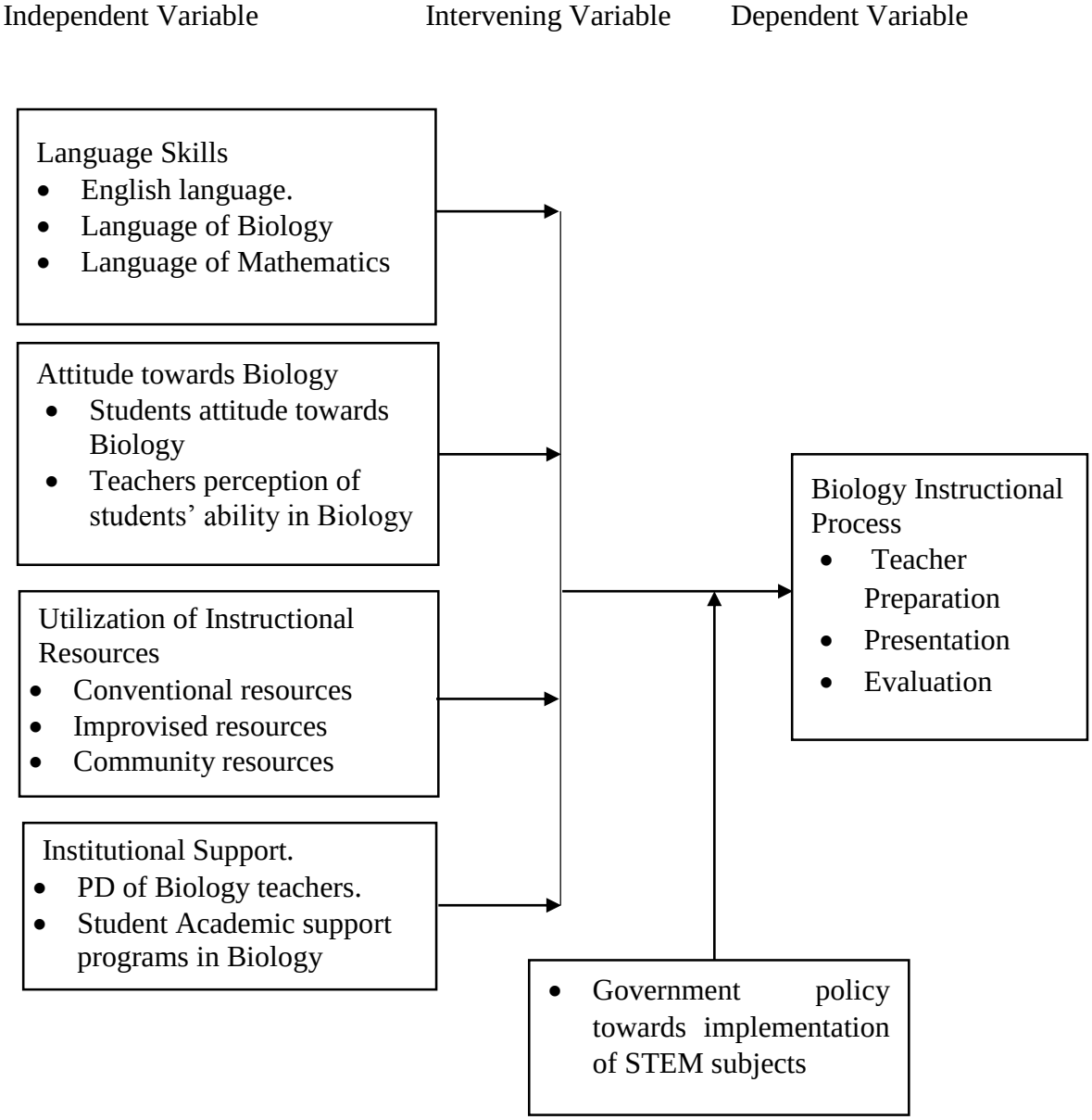

Figure 1: Conceptual Framework

Information in Figure 1 shows the interaction between the variables of the study. In the study, selected factors such as the language of instruction, attitude, utilization of instructional resources and institutional support which were the independent variables to some extent predicted the Biology instructional process which is the dependent variable. Contextually, the language of instruction incorporated three aspects: the language selected as a medium of instruction, Biology language which refers to specific terminologies, vocabularies and communication conventions used to describe

Biological content and lastly, Mathematical concepts and skills incorporated in the context of Biology Instruction. Attitude included attitudes of students toward Biology and Biology teachers' perception of students' ability in Biology. This study also assessed utilization of the available conventional, community and improvised Biology resources since they play a vital role in instruction as aids to teaching and learning. Institutional support in terms of professional development (PD) of teachers and Biology supplementary programs was assessed to establish how they shape Biology instruction in secondary schools. Essentially, the study focused on how the independent variables influenced Biology instructional process in terms of preparation, presentation and evaluation in Imenti-Central secondary schools, Meru County. However, the interaction between the dependent and independent variables is affected by government policy on curriculum implementation of STEM subjects. Government policies influence allocation and distribution of resources such as laboratories, textbooks and instructional resources in public secondary schools. This may influence utilization of instructional resources in Biology instruction. Government policies influences teacher training and development programs aimed at enhanced teacher effectiveness. Government policy also influence assessment and evaluation strategies with a higher focus on theory-based assessments compared to practical assessments. This may influence how Biology teachers conduct preparation, presentation and evaluation activities.

CHAPTER THREE
METHODOLOGY

3.1 Location of the Study

This study was conducted in Imenti-central Sub-county in Meru County. This sub-county was considered a suitable study location following a consistently dismal performance of Biology in KCSE for the last five years. While studies related to Biology education had been conducted across different parts of Kenya such as Vihiga (Imanda, 2022), Embu (Njiru, 2022), Siaya (Ong'amo et al., 2017), Homabay (Nyambuoro, 2012) and Uasin Gishu (Chebotib et al., 2021), there remained a research gap on Biology performance in Imenti-Central Sub-County. Notably, only one study by Kirima et al. (2016) focused on enrollment of Students in Biology in Imenti-Central Sub-County. The poor performance and limited studies on Biology education in Imenti-Central Sub-County underscored the need to conduct a study that focused on factors that influenced BIP in the area ultimately leading to poor performance in the Subject.

3.2 Research Design

The study adopted a descriptive survey design that primarily focused on describing the characteristics, conditions or attitudes of the study sample to make generalizations or predictions. Bryman (2016) avers that in descriptive surveys, variables are explored in their natural setting without manipulations or interventions. Contextually, this design was appropriate for exploring the current state of students' language skills, utilization of instructional resources, attitude and institutional support regarding Biology instructional process. According to Creswell and Creswell (2017) descriptive survey allows collection of standardized data from a large sample which was essential in this study to provide a comprehensive overview of the factors influencing Biology instruction. Adoption of descriptive survey research design was therefore appropriate to comprehensively explore and describe the selected aspects of Biology instruction within its natural educational context.

The study adopted a mixed-methods research approach that incorporated both qualitative and quantitative research methods. Denzin, Lincoln, Giardina and Cannella (2023) aver that qualitative methods involve collection and analysis of non-numerical data to provide insights into participant's perceptions, experiences and social constructs

of the event under study thereby enhancing the interpretation of complex phenomena. This shows that qualitative methods aim to explore context-specific insights and mainly involve in-depth analysis of themes and patterns. On the other h and, Creswell et al. (2017) avers that quantitative methods involve numerical data that is subjected to statistical analysis to quantify and measure relationships and patterns. This provides numerical evidence to test and support hypotheses and extrapolate findings to larger populations. The mixed method approach provides multiple data sources which enables triangulation of findings thereby enhancing the validity and reliability of research findings (Bryman, 2016). This approach also builds upon the combined strengths of both qualitative and quantitative methods while at the same time counteracting weaknesses associated with individual methods. Therefore, due to the aforementioned benefits of the mixed method approach, this study incorporated both qualitative and quantitative research approaches to provide a comprehensive understanding of how the selected factors influence Biology Instructional process.

3.3 Study Population

The study population comprised Biology teachers, form three Biology students and Biology Heads of Subject (HoS) from 49 public secondary schools in Imenti-Central. Biology teachers were suitable participants because they actively interact every day with students during the teaching and learning process and therefore able to point out problems that hinder effective teaching and learning of Biology. Biology HoS were involved since they are more experienced and more likely to provide valuable insights on teaching and learning of Biology. Form three students were involved in the study because they had selected subjects in schools where Biology was an optional science subject. This meant that form three students undertaking Biology had selected the subject preferentially among other optional sciences. Comparatively, form three students were less busy than form four students therefore more available to fill in the questionnaires. Additionally, form three students had been in the secondary school setup for a longer period than form one and form two students. This means that they were more likely to provide valid and reliable data on how the selected factors influence the teaching and learning of Biology.

Particularly, the target study population comprised 95 Biology teachers, 2806 form three Biology students and 49 Biology HOS from 4 wards of Imenti-Central sub-county as shown in Table 2.

Table 2: Study Population

Ward	Teachers	Students	Biology HOS	Total
Abothuguchi West	25	729	14	768
Abothuguchi Central	21	674	11	706
Mwanganthia	23	717	13	753
Kiagu	26	686	11	723
Total	95	2806	49	2950

3.4 Sampling Technique and Sample Size

3.4.1 Sample size

The study adopted Yamane's formula to determine the study sample. According to Yamane's formula, the sample size is determined as follows:

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

Where:

"n" is the required sample size.

"N" is the total population size.

"e" is the sampling error at 0.05.

$n = 2950 / [1 + 2{,}950 \times (0.05)^2]$

n=352

3.4.2 Sampling Technique

This study adopted multistage sampling incorporating stratified, simple random and purposive sampling as illustrated in Table 3.

Table 3: Sampling Frame

Ward	Population	Sample			Total
		HOS	Teachers	Students	
Abothuguchi West	768	2	14	76	92
Abothuguchi Central	706	2	6	76	84
Mwanganthia	753	2	12	76	90
Kiagu	723	2	8	76	86
Total	2950	8	40	304	352

The sample comprised 304 form three Biology students, 8 Biology HOS and 32 teachers Biology teachers. Schools were sampled across the four wards of Imenti-central sub-county. Schools were selected by stratified sampling which involved placing Imenti-Central secondary schools in each ward into two strata based on the school category; county schools and sub-county schools. This ensured that different categories of schools were adequately represented (Parsons, 2014). A school was randomly picked from each stratum by picking lots to ensure that all categories of school in the four wards of Imenti-Central were given equal chances to be selected for the study. Students were obtained from 8 schools which had been selected for study. Form 3 Biology class was purposively sampled from the 8 sampled schools. In schools with more than one stream, one stream was randomly selected to take part in the study. In streams with 38 or fewer students, all students were selected while in streams with more than 38 students, 38 students were randomly selected to participate in the study. Biology HoS and two Biology teachers in the selected schools were purposively selected to participate in the study. The remaining 24 teachers were selected from 7 county schools and 5 sub-county schools not sampled in each stratum. The schools were picked randomly from each stratum. Two Biology teachers were randomly selected from the sampled schools to participate in the study.

3.5 Research Instruments

Questionnaires and interview schedule to collect data on the influence of selected factors on Biology instructional process. Interview schedule gathered qualitative data from Biology teachers while questionnaires collected quantitative data from Biology teachers and students.

3.5.1 Questionnaires.

Questionnaires with close-ended statements were used to collect data from students (Appendix III) and Biology teachers (Appendix II). Blair, Czaja and Blair (2013) aver that a questionnaire is a set of questions that respondents are required to record responses in written or electronic form. It provides a set of standardized questions with predefined response options such as Likert scale, multiple choice or open-ended text to all respondents which enhances the reliability and comparability of the data collected. A questionnaire was thus cost-effective because of efficient data collection from a large

number of participants (Dillman, Smyth, & Christian, 2014). Questionnaires were a valuable tool in this study since they offered a systematic and efficient way to collect data from a large number of respondents. Both the students' and teachers' questionnaires consisted of six sections. Section one contained demographics while sections two to six consisted of questionnaire items designed from the four study objectives with each section addressing a particular objective. Specifically, section two solicited information regarding Biology instructional process, section three addressed the influence of learner's language skills on Biology instructional process and section four gathered participant's perceptions of the influence of attitude on Biology instructional process. Sections five and six consisted of questionnaire items on the utilization of instructional resources and institutional support respectively. The responses were based on a 5-point Likert scale that provided quantitative data that was subjected to statistical analysis.

3.5.2 Interview Schedule for Biology Head of Subject

The study employed interview schedule to collect qualitative data from Biology HOS (Appendix IV). Rubin and Rubin (2011) aver that an interview schedule is an appropriate tool for collecting in-depth qualitative data because respondents are asked the same similar questions in the same order which maintains consistency in data collection. This ensured uniformity in data collection, which was essential for reliability and validity. Interview schedule also minimized bias and allowed the researcher to make comparisons between the responses. An interview schedule consists of questions tailored from the research objectives which enables the exploration of context-specific issues (Bryman, 2016; Babbie, 2020). This enabled the researcher to maintain the focus by collecting the intended data as per the study objective. In this study, an interview schedule with structured questions was utilized to explore the perspectives of Biology teachers on the influence of the selected factors on Biology instructional process. The schedule consisted of seven open-ended questions to provide Biology teachers with an opportunity to express their views and experiences in regard to the study objective. This enabled the researcher to gain a comprehensive understanding of the complexities and interplay of the selected factors and the Biology instructional process.

3.6 Piloting of Research Instruments

Piloting was conducted in two secondary schools in Imenti-North Sub-County to test and refine research design, methods, instruments and data collection procedures before conducting a full-scale study. The pilot study population consisted of 2 Biology HOS, 4 Biology teachers and 76 Biology students from a county school and a sub-county school. The population was distributed equally in the two pilot schools. Data was collected from the selected participants and analyzed to assess the reliability of the research instruments. This allowed detection and rectification of unforeseen challenges leading to a robust and well-structured research project (Hulley, Cummings, Newman, Browner, & Grady, 2013; Doody & Doody, 2015). Piloting thus allowed the researcher to test research methods, data collection instruments and procedures on a small scale before conducting a full-scale investigation. This refined research protocols by identifying and rectifying potential issues, ambiguities and flaws. Piloting was also cost-efficient since it saved time and resources that would otherwise be wasted on flawed large-scale research plans.

3.7 Validity

This study established face and content validity to establish whether the designed research instruments provided a true representation of the influence of selected factors on Biology instructional process. Holden, (2010) posits that face validity establishes the degree to which a research instrument appears, on the surface, to measure what it is intended to measure. Face validity is therefore subjective and depends on the researchers' and experts' ability to use their judgment to assess whether the items in the research instruments seem to measure the intended construct. Face validity was established by the researcher by ensuring questionnaire items were aligned with the study objectives and conceptual framework. On the other h and, content validity ensures that the study content and measurement tool adequately represent the theoretical construct being studied (Lakshmi & Mohideen, 2013). As such, the items, questions and assessment procedures used should be comprehensive enough to cover all aspects of the concept being studied. Content validity was established through expert judgment by the academic and research supervisors at Chuka University. Face and content validity ensured clarity, technical soundness and content adequacy of the questionnaire and interview schedule items to ensure that they would be measuring what they were

intended to measure. Moreover, piloting was conducted to identify any potential issues with the items and necessary adjustments made before the data collection process.

3.8 Reliability of Research Instruments

Cronbach's alpha was used to determine the internal reliability of questionnaire items which enabled the researcher to minimize the potential for measurement error by ensuring that the measurements are reliable (Tavakol, & Dennick, 2011). Testing reliability of questionnaire items ensured that the research instruments produced dependable results which enhanced the validity of research findings. Pilot study data obtained from students was analyzed and the findings are as per Table 4.

Table 4: Pilot Study Reliability Index

Variable	Students' Questionnaire	
	Items	Cronbach's Alpha
Biology Instructional Process	8	0.747
Language skills	12	0.742
Attitude	15	0.796
Utilization of Instructional Resources	19	0.761
Institutional Support	5	0.713

The reliability coefficient for pilot study ranged from 0.713 for institutional support to 0.796 for attitude on students' questionnaire. The current study adopted questionnaire items with a reliability index of at least 0.7 since Cronbach's alpha value of at least 0.7 indicates good internal consistency (Mohajan, 2017). All the variables achieved the required Cronbach's alpha reliability index and were therefore adopted for actual data collection. Moreover, expert review from academic supervisors enhanced the reliability of the instruments by identifying and addressing potential clarity, wording, or interpretation issues.

3.9 Data Collection Procedure

The first phase involved the researcher visiting sampled schools for introduction and familiarization with sampled participants. During this phase, the researcher sought participants' permission and consent to participate in the study. During the second Phase the researcher administered the questionnaires to the participants and provided instructions on how to record the responses. A one-on-one interview with Biology HOS

was also conducted based on the interview schedule during which the response from the respondents were written down.

3.10 Data Analysis

Raw data from the field was sorted into either qualitative or quantitative form for qualitative and quantitative analysis respectively.

3.10.1 Quantitative Data Analysis

Teacher and student questionnaires provided a data set that was analyzed quantitatively. Prior to statistical analysis, quantitative data was cleaned to handle issues such as missing values and outliers based on the inclusion and exclusion criteria established by the researcher. Inclusion and exclusion criteria was based on the validity of the responses. Valid responses included responses that were complete and relevant to questionnaire items while invalid responses referred to incomplete and unrelated responses to the questionnaire item. Questionnaires with valid responses were selected for analysis while questionnaires with invalid responses were excluded to ensure that the data to be analyzed was reliable. Then, data was coded to transform it into a suitable analysis format. This involved creating variables that represented different study variables and assigning numerical values to questionnaire responses. The coded data was then analyzed using descriptive and inferential statistics with the aid of Statistical Package for the Social Sciences (SPSS) version 26 computer software. Descriptive statistics organize and summarize information to aid in the identification of patterns, trends and outliers and simplify complex information in a comprehensive manner facilitating a deeper understanding of the dataset (Kaur, Stoltzfus, & Yellapu, 2018). Descriptive statistics also serve as foundational statistics whose output provides a basis for advanced statistical analysis. Descriptive statistics particularly frequency and percentages were used to provide an overview of the responses regarding study variables. On the other h and, inferential statistics provides information used to make inferences about a population from a given sample (Weiss & Weiss, 2017). Chi-square analysis was used to predict the influence of the selected factors on the Biology instructional process at a 0.05 level of significance.

3.10.2 Qualitative Data Analysis

Qualitative analysis began with data preparation and organization to ensure that it was ready for in-depth examination. Data organization then followed which was done through open and axial coding to identify, organize and connect themes. Coding involved identifying and labeling themes and sub-themes and linking related concepts within the responses. Data was then analyzed thematically through content analysis based on the four study objectives. These themes included, language of instruction, attitude, utilization of instructional resources and institutional support.

Table 5: Data Analysis Matrix

Objectives	Independent variable	Dependent Variable	Test Statistics
There is no statistically significant influence of students' language skills on Biology instructional process in Imenti-Central sub-county, Meru County	Students' language skills	Biology instructional process	-Frequencies and percentages -Chi square
There is no statistically significant influence of attitude on Biology instructional process in Imenti-Central sub-county, Meru County	Attitude	Biology instructional process	-Frequencies and percentages -Chi square
There is no statistically significant influence of utilization of instructional resources on Biology instructional process in Imenti-Central sub-county, Meru County	Utilization of instructional resources	Biology instructional process	-Frequencies and percentages -Chi square
There is no statistically significant influence of institutional support on Biology instructional process in Imenti-Central sub-county, Meru County	Institutional support	Biology instructional process	-Frequencies and percentages -Chi square

3.11 Ethical Consideration

Ethical considerations and principles were followed to ensure that the study was within the ethical dimensions of research projects. The researcher sought ethical approval (Appendix V) from Chuka University Ethics Review Board. Upon approval, the researcher submitted the Ethics approval letter (Appendix VI) to NACOSTI to seek for research permit. With the research permit (Appendix VII), the researcher visited sampled schools, booked appointments and sought informed consent from sampled respondents. Informed consent was adhered to by communicating the purpose of the study to the participants before taking part in the research. This ensured that participants were aware of their rights, potential risks and benefits of the study. Additionally, respondents' privacy and confidentiality were maintained by ensuring that participants' identity and any sensitive information was not divulged at all cost. Data collected was recorded and stored in a password-protected computer to restrict access to authorized personnel only. The study findings were then reported as per data analysis without manipulation. Gajjar (2013) avers that research misconduct such as fabrication and falsification compromises the validity and reliability of findings. Therefore, to uphold honesty, the study findings were reported transparently without bias and manipulation to ensure that the findings were valid and reliable. The researcher adhered to intellectual property rights by acknowledging information sources and avoiding plagiarism. Essentially, upholding ethical standards in research, such as obtaining informed consent, protecting participants' rights and privacy and disclosing potential conflicts of interest, is critical to maintaining the ethical conduct of research (Hasan, Rana, Chowdhury, Dola, & Rony, 2021). Therefore, the aforementioned ethical considerations were followed to ensure the protection and well-being of participants and the integrity of the study.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Response Rate

A total of 352 respondents were sampled to participate in the study. However, of the 352 respondents sampled, only 349 respondents participated in the study. They included 8 Biology heads of subject, 40 Biology teachers and 301 form three Biology students. This means that the study attainted 99.15% response rate which according to Babbie and Mouton (2011) is an acceptable response rate.

4.2 Reliability Index

Prior to data analysis, reliability of the study variables was tested using Cronbach's Alpha and the findings were as per Table 6.

Table 6: Reliability Index

Variable	Teachers' Questionnaire		Students' Questionnaire	
	Items	Cronbach's Alpha	Items	Cronbach's Alpha
Biology Instructional Process	13	0.695	8	0.787
Language skills	12	0.661	12	0.701
Attitude	15	0.843	15	0.872
Utilization of Instructional Resources	19	0.697	19	0.761
Institutional Support	10	0.724	5	0.758

Information on Table 6 show that the reliability index of study variables for students' questionnaire ranged between 0.701 (language skills) to 0.872 (attitude). Similarly, the index of teachers' questionnaire ranged between 0.661(language skills) to 0.843 (attitude). This means that reliability index of all study variables were within the acceptable limits and therefore all their elements were adopted for further analysis.

4.3 Demographic Information

This section presents findings on sampled respondents' demographic information. Respondents whose demographic information was sought included Biology HoS, Biology teachers and form three Biology students.

4.3.1 Demographic Information of Biology HoS

Qualitative data was obtained from Biology HoS to compliment the quantitative data obtained from students and teachers. Eight Biology HoS whose experience ranged from 3 to 7 years participated in the interview. Letters P, Q, R, S, T, U, V and W were adopted to present data obtained from each of them to ensure anonymity and confidentiality of the participants.

4.3.2 Biology Teachers' Demographic Information

Demographic information sought included gender, age, level of education, teaching experience and schools taught based on ranking, gender and accommodation as per Table 7.

Table 7: Biology Teachers' Demographic Information

Variable	Category	Frequency	Percentage
Gender	Male	21	52.5
	Female	19	47.5
	Total	40	100.0
Age in Years	Below 30	14	35.0
	30-50	22	55.0
	Above 50	4	10.0
	Total	40	100.0
Highest Level of Education	Degree	36	90.0
	Masters	4	10.0
	PhD	0	0.0
	Total	40	100.0
School category by rank	County	22	55.0
	Sub-county	18	45.0
	Total	40	100.0
School Category by Accommodation	Day	16	40.0
	Boarding	24	60.0
	Total	40	100.0
School Category by Gender	Boys only	11	27.5
	Girls only	11	27.5
	Mixed	18	45.0
	Total	40	100.0
Teaching Experience in Years	Below 5	13	32.5
	5-10	19	47.5
	Above 10	8	20.0
	Total	40	100.0
Refresher course in Biology Teaching	Yes	5	12.5
	No	35	87.5
	Total	40	100.0

Findings on Table 7 indicate a fair distribution of Biology Teachers based on gender with males (52.5%) being slightly more than females (47.5%). This indicates gender parity among Biology teachers which adheres to the requirements of the 2010 constitution of Kenya. Based age, majority of the teachers (90%) were found to be below 50 years age bracket compared to those above 50 years (10%). This means that most teachers were in the productive stages of career development which implies an energetic workforce. In regard to the highest level of education, (90%) had a Bachelor's degree and (10%) had a master's degree meaning that all teachers had relevant academic qualifications for teaching Biology at the secondary school level. Information on categories of schools where the teachers taught indicate that most teachers were from boarding county schools (60%) as compared to those from sub-county day schools (40%). This indicates that the study focused on more established boarding county schools as compared to sub-county day schools. School category based on gender indicates that (27.5%) of the teachers taught boys only, (27.5%) taught girls only while (45%) taught both girls and boys in mixed schools. Therefore, nearly half of the teachers (45%) taught both girls and boys in mixed schools, with half proportions (27.5%) teaching exclusively boys or girls. This suggests a relatively balanced distribution of teachers with nearly half teaching both girls and boys, while the rest are divided between teaching only boys or only girls. This depicts a balanced distribution of teachers who exclusively teach boys or girls, with the majority teaching both genders. Information on teaching experience indicate that sampled respondents' teaching experience ranged from less than 5 years (32.5%), between 5-10 years (47.5%) and above 10 years (20%). This show that more than half of Biology teachers had taught for more than 5 years (67.5%) and therefore were adequately experienced to provide the required information in regard to Biology instructional process. Besides the relevant academic qualifications for teaching Biology, only (12.5%) had attended a refresher course to become more competent in Biology teaching practice. This highlights the need for more opportunities for Biology teachers to engage in continuous professional development to keep up with trends in the field thereby enhancing their teaching effectiveness.

4.3.3 Students' Demographic Information

Demographic information sought from form three Biology students included: gender, age, science grade in KCPE, Biology grade in the last end of term exam and school category by ranking, accommodation and gender. The information obtained is summarized in Table 8.

Table 8: Students' Demographic Information

Variable	Category	Frequency	Percentage
Gender	Male	119	39.5
	Female	182	60.5
	Total	301	100.0
Age in Years	15	18	6.0
	16-17	258	85.7
	18-19	25	8.3
	Total	301	100.0
School category by rank	County	149	49.5
	Sub-county	152	50.5
	Total	301	100.0
School Category by Accommodation	Day	152	50.5
	Boarding	149	49.5
	Total	301	100.0
School Category by Gender	Boys only	71	23.6
	Girls only	78	25.9
	Mixed	152	50.5
	Total	301	100.0
Biology Grade	B+ to A	24	8.0
	C to B	133	44.2
	E to C-	144	47.8
	Total	301	100.0

Data obtained shows a skewed distribution of Biology students based on gender with females (60.5%) being more than males (39.5%). This means that more females proceeded with Biology subject compared to males since it was an optional science subject in all the sampled schools. Regarding school category, county boarding schools accounted for (49.5%) of the respondents while sub-county day schools accounted for (50.5%) suggesting a balanced representation from each category. Information on school category by gender indicates that mixed schools were the most sampled (50.5%) followed by boys' schools (25.9%) and girls' schools (23.6%). This shows variation in sampling across different school categories, with a higher representation of mixed schools compared to boys' schools and girls' schools. Data on student's Biology grade

in their last end of term examination show that very few students scored above average (8.0%) in the end of term test. A significant proportion of students scored average (44.2%) while a majority (47.8%) scored below average. Findings suggest that a majority of students' experienced challenges in learning of Biology which led to poor performance.

4.4 Biology Instructional Process in Secondary Schools

The study sought to assess Biology instructional process from preparation stage through presentation to evaluation stage. Respondents were provided with a set of Likert scaled statements to show the extent to which teachers undertook activities in each stage of the instructional process. Table 9 presents a summary of the data obtained from students and teachers in regard to Biology instructional process.

Table 9: Biology Instructional Process in Secondary Schools

Statement	Students (N=301)		Teacher (N=40)	
	N/R/S %	O/A %	N/R/S %	O/A %
Identifying learning objectives	-	-	50.0	50.0
Selecting relevant and appropriate content	-	-	2.5	97.5
Sourcing for relevant instructional resources	-	-	7.5	92.5
Identifying suitable instructional methods to deliver the content	-	-	-	100.0
Choosing an appropriate assessment method	-	-	15.0	85.0
Engaging students actively throughout the lesson	21.9	78.1	10.0	90.0
Guiding students in handling and manipulation of materials	16.6	83.4	17.5	82.5
Facilitating students in undertaking group activities such as discussions	34.6	65.4	40.0	60.0
Giving students opportunities to ask questions	22.6	77.4	10.0	90.0
Give assignments daily	66.1	33.9	55.0	45.0
Organize Biology practical weekly.	46.2	53.8	55.0	45.0
Mark assignments	47.2	52.8	57.5	42.5
Facilitate correction of assignments.	50.8	49.2	47.5	52.5

Key: Never (N), Rarely(R), Sometimes(S), Often (O), Always (A).

Findings indicate that teachers undertook lesson preparation activities which included identifying lesson objectives (50.0%), selecting relevant and appropriate content

(97.5%), sourcing for relevant instructional resources (92.5%), identifying suitable instructional methods to deliver the content (100.0%) and choosing appropriate assessment methods (85.0%). This shows that almost all teachers (85%) took time to adequately prepare for Biology lessons. During presentation, teachers engaged students actively throughout the lesson (90.0%), guided students in handling and manipulation of learning materials (82.5%), facilitated students in undertaking group activities (60.0%) and gave students opportunities to ask questions (90.0%). Findings show that most teachers (80.6%) adopted teaching activities that were learner-centered. At the evaluation stage, data obtained indicated that teachers gave assignments daily (45.0%), organized Biology practical lessons on a weekly basis (45.0%), marked leaners assignments (42.5%) and, facilitated correction of assignments (52.5%). Information obtained indicated that less than half of the teachers (46.25%) sampled conducted formative evaluation to determine the extent to which learning had occurred. Findings imply that more than half of the sampled teachers (53.75%) did not assess learning outcomes effectively. Findings on evaluation therefore indicates gaps in adoption of formative evaluation practices among teachers which may be the challenge with BIP. Generally, a significant proportion of Biology teachers (70.6%) adopted appropriate practices necessary for effective Biology instructional process.

Information obtained from students reveal that students agreed that during presentation, teachers: encouraged active participation (78.1%), guided them on handling and manipulation of learning materials (83.4%), monitored group activities they undertook (65.4%) and gave them opportunities to ask questions (77.4%). This means that more than two-thirds (76.05%) of the teachers created an engaging and supportive learning environment. At the evaluation stage, teachers gave assignments daily (33.9%), organized Biology practical activities weekly (53.8%), marked assignments (52.8%) and facilitated the correction of assignments (49.2%). On average, students pointed out that less than half of the teachers (47.4%) actively assessed learning which indicates a gap in commitment to ongoing evaluation and feedback in teaching and learning of Biology.

Descriptive data indicates that most teachers (85.0%) adopted appropriate practices during preparation stage. In agreement with the findings, Wieringa, et al. (2011)

indicated that instruction in Biology is developed by specifying objectives and choosing instructional materials and activities that match the instruction's goals. At the presentation stage majority of teachers (78.55%) engaged in learner-centered teaching and learning activities. In a similar view, Maeng et al. (2015) asserts that instruction is effective when delivered through a teaching model or style that best fits both the teacher's preference and students' needs. Despite adoption of appropriate practices during preparation and presentation stage, less than half of the teachers (46.8%) adopted formative assessment practices. This may hinder effective instruction since that formative evaluation provides continuous feedback that aids in identifying learning gaps, adjusting instruction and improving learning outcomes (Black et al., 2010). Additionally, Albert et al. (2014) pointed out that teacher's failure to provide immediate feedback on students' assignments and examinations contributed to poor performance in Biology in Nyakach district, Kenya. Findings therefore suggest the need to improve on formative assessment practices to streamline the instructional process.

Information was also sought from HOS on the dynamics of Biology instruction through an interview. Interviewees were requested to provide responses on how teachers conduct lesson preparation, presentation and evaluation and the trend in performance of Biology in KCSE for the last 5 years. In response, interviewee P indicated that:

> *Our school is witnessing declining trend of performance in Biology indicative of challenges in Biology instructional process among other causative factors*.

This observation was supported by other interviewees including R, S, V and W. In particular, interviewee S attributed the declining trend of performance to:

> *Poor comprehension reflected when answering questions that require students to explain a concept or a process contributing to poor performance.*

Similarly, interviewee W noted that:

> *Students' poor study habits, that is, reading when examinations are around the corner and low proficiency in English language which is used a medium of instruction are the main causes of poor performance in our school.*

Qualitative findings confirm that a majority of schools in the study area have been experiencing declining student performance in Biology and believe that part of the reason could be due to dynamics of Biology instructional process. A similar trend of poor performance in Biology in Migori County was observed by Eunice et al (2014)

who attributed poor performance to students' entry behavior, large class sizes and inadequate time to plan for Biology lessons. A change performance trend was observed in Eldoret municipality where learner's negative attitude toward Biology, low interest and inability to engage in practical activities affected Biology performance (Joy, 2013) indicative of several factors influencing BIP.

The study also sought to gauge interviewee conception of how Biology teachers conduct lesson preparation, presentation and evaluation and their contribution to the instructional process. In response, most interviewees agreed that most teachers adopt appropriate practices during lesson preparation, presentation and evaluation. For instance, during preparation, Interviewee R observed that:

> *Most experienced teachers feel competent enough in regard to mastery of content. Therefore, preparation mainly involves sourcing for IR to use during presentation*

Interviewee S felt that:

> *Teachers prepare for lessons which mainly involves sourcing for IR and devising appropriate teaching methods.*

A majority of sampled interviewees pointed out that teachers prepared for Biology lessons. Preparation mainly involved sourcing for instructional resources for use during presentation. Findings align with Lu et al. (2012) who points out the need for adequate preparation to ensure alignment between curriculum standards, instruction and assessment to achieve the expected outcomes in the teaching and learning process. On the contrary, Eunice et al (2014) observed that in Migori County, teachers inadequately prepared for Biology lessons due to time constraints.

At the presentation stage, interviewee S indicated that:

> *Teachers adopt teacher-centered methods such as lecture and demonstration methods to facilitate syllabus coverage within the stipulated time but engage students through question and answer sessions.*

Interviewee W observed that:

> *Most students actively participate in class during practical activities in the laboratory as they conduct experiments.*

Majority of the interviewees agreed that teachers adopted teacher-centered teaching methods such as lecture method but were striving to engage students actively in conducting experiments and asking and answering questions. Findings illustrated a focus on teacher-centered teaching methods at the expense of learner-centered methods which would encourage active learner engagement in the teaching and learning of Biology. Teacher-centered teaching methods may pose students as copious recipients of knowledge which is contrary to scientific approach of learning Biology. In agreement, Maeng et al. (2015) underscores the importance of adopting a teaching style that fits the teacher's preference and students' need for effective instruction.

At the evaluation stage, Interviewee U pointed out that:

> *Formative evaluation occurs mainly through question and answer sessions during learning and assignments which are given and marked by the teacher or jointly in class where students exchange books and mark with teacher's guidance.*

Similar observations were made by interviewee P, V and W who agreed that assignments were given regularly for evaluation purposes. However, teachers hardly marked assignments on their own. Marking was mainly done by students under the teacher's guidance. Teachers also facilitated correction of the assignments during the joint marking process. Findings suggest that there were challenges in marking of assignments among Biology hindering effective formative evaluation. This finding supports that of Asare et al. (2023) who avers that public primary and junior high school teachers in Ghana do not implement formative assessment as expected due to overwhelming workload, high student to teacher ratio and overloaded curriculum. Findings are also in line with Albert et al. (2014) who found out that Biology teachers in Nyakach District failed to provide immediate feedback on students' assignment and examinations. Findings on Biology instructional process therefore indicate that in quest to adopt appropriate practices, teachers still experience challenges in adopting learner-centered teaching methods and comprehensive formative evaluation practices. These challenges may be as a result of time constraints, curriculum overload (Eunice et al., 2014) and misalignment of instructional activities in the three stages of BIP (Lu et al., 2012).

4.4.1 Language Skills and Biology Instructional Process

The first objective of the study sought to determine the influence of students' language skills on Biology instructional process. Teachers and students were provided with 12 statements on Language skills in regard to English language as the medium of instruction, Biology specific language which contains biological vocabularies and, STEM skills incorporated in Biology instruction. Findings obtained from students are summarized in Table 10.

Table 10: Language Skills and Biology Instructional Process (Students)

Statement	Students (N=301)					
	NE%	LE %	ME%	GE %	VGE %	Total %
Reading correctly Biological concepts written in English	3.0	9.6	19.6	37.9	37.9	100.0
Writing accurately Biological concepts in English	1.7	7.3	19.3	38.2	38.2	100.0
Speaking fluently in English	2.7	6.6	16.6	43.2	43.2	100.0
Understanding Biological concepts presented in the English language	2.7	9.0	18.6	36.9	36.9	100.0
Reading Biological terms correctly	5.0	11.0	17.7	38.9	38.9	100.0
Writing Biological terms correctly	9.3	14.0	21.6	30.2	30.2	100.0
Speaking Biological content containing Biological terms fluently	16.6	11.3	20.3	25.6	25.6	100.0
Understanding Biological terms	20.9	8.0	23.3	24.3	24.3	100.0
Drawing graphs in Biology	5.0	10.0	21.6	30.6	30.6	100.0
Interpreting Biological graphs	3.3	7.3	19.9	37.2	37.2	100.0
Interpreting quantitative data	18.3	11.3	14.3	30.9	30.9	100.0
Drawing conclusions based on data	3.7	10.0	22.6	29.6	29.6	100.0

Key: No Extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

In regard to students' language skills in English language, information obtained on table 10 show that a majority of students believed that ability to: speak fluently in English (74.1%), write accurately Biological concepts in English (71.8%), understand biological content (69.8%) and read correctly biological concepts written in English (67.8%) contributed to BIP to a great and very great extent. On average, more than two thirds of students sampled (70.9%) felt that their proficiency in the English language contributed to learning of Biology to a great and a very great extent. It implies that students believed that proficiency in English language skills is an important contributor to students' success in the subject.

Data on language skills in LoB indicate that reading Biological terms correctly (66.5%), writing Biological terms correctly (55.1%), speaking Biological content containing Biological terms fluently (51.8%) and, comprehending Biological terms (47.9%) contributed to BIP to a great and very great extent. This means that more than half of the students (55.3%) believed that their language skills in regard to LoB contributed to learning of Biology to a great and very great extent. Information on STEM concepts incorporated in Biology imply that drawing Biological graphs (63.5%), interpreting Biological graphs (69.4%), interpreting quantitative data (56.1%) and drawing conclusions based on data (63.8%) contributed to BIP to a great and very great extent. This means that more than half of the students (63.2%) believed that STEM concepts incorporated in Biology contributed to a great and very great extent to BIP. Generally, descriptive information obtained from students reveal that language skills in regard to the three aspects of LoI (63.1%) contributed to BIP to a great and very great extent. Teachers' perception on the contribution of language skills to BIP was also obtained and presented in Table 11.

Table 11: Language Skills and Biology Instructional Process (Teachers of Biology)

Statement	Teachers (N=40)					
	NE%	LE %	ME%	GE %	VGE %	Total %
Reading correctly Biological concepts written in English	5.0	7.5	30.0	52.5	5.0	100.0
Writing accurately Biological concepts in English	-	2.5	25.0	45.0	27.5	100.0
Speaking fluently in English	2.5	10.0	37.5	45.0	5.0	100.0
Understanding Biological concepts presented in the English language	-	5.0	30.0	52.5	12.5	100.0
Reading Biological terms correctly	5.0	7.5	37.5	50.0	-	100.0
Writing Biological terms correctly	-	2.5	30.0	32.5	35.0	100.0
Speaking Biological content containing Biological terms fluently	7.5	12.5	27.5	47.5	5.0	100.0
Understanding Biological terms	-	-	32.5	35.0	32.5	100.0
Drawing graphs in Biology	-	2.5	17.5	77.5	2.5	100.0
Interpreting Biological graphs	-	-	27.5	55.0	17.5	100.0
Interpreting quantitative data	-	5.0	40.0	35.0	20.0	100.0
Drawing conclusions based on data	-	5.0	32.5	45.0	17.5	100.0

Key: No Extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

According to teachers, students' ability to: speak fluently in English (57.5%), write accurately Biological concepts in English (72.5%), understand biological content (50.0%) and read correctly biological concepts written in English (66.0%) contributed to BIP to a great and very great extent. This shows that teachers believed that students' proficiency in English language skills (61.2%) contributed to BIP to a great and very great extent. In regard to language skills in the LoB, reading Biological terms correctly (67.5%), writing Biological terms correctly (52.5%), speaking Biological content containing Biological terms fluently (67.5%) and comprehending Biological terms (80.0%) contributed to BIP to a great and very great extent. As such, more than half of the teachers (59.3%) pointed out that students' ability to read, write, speak and understand Biological terms contributed greatly to BIP. Teachers also felt that students' ability to draw Biological graphs (80.0%), interpret Biological graphs (72.5%), interpret quantitative data (55.0%) and draw conclusions based on data (62.5%) contributed to BIP to a great and very great extent. Findings imply that on average, more than half of the teachers (62.7%) believed that language skills contributed to BIP to a great and very great extent. Therefore, both students (63.1%) and teachers (62.7%) agreed that language skills in the three aspect of LoI contribute to BIP to a great and very great extent.

Descriptive data indicates that most students (70.9%) and teachers (63.1%) agreed that proficiency in English language contributed to BIP to a great extent or very great extent. Findings suggest that students should have good mastery of English language for effective learning in Biology. Alvermann et al. (2011) in their study established that language literacy in Biology classrooms is necessary to enable students to be fully engaged in the teaching and learning process through reading, writing, listening and speaking. According to the researchers, students' English language skills determine the extent to which they comprehend Biology subject matter.

On specific language concepts, more than half of students (55.3%) and teachers (59.3%) sampled pointed out that students' ability to read, write, speak and understand Biological terms contributed to BIP to a great and very great extent. Findings implies that students should be conversant with LoB for an effective instructional process. The findings are in line with Fang et al. (2012) who indicated that students should be

proficient in technical terms used in Biology to aid in describing, explaining and discussing scientific processes, concepts, theories and phenomena.

With regard to language of Mathematics and its contribution to BIP, a significant proportion of students (62.3%) and teachers (62.7%) felt that competency in mathematical concepts incorporated in Biology contributed greatly to BIP. Findings imply that students ought to be competent in Mathematical concepts and skills incorporated in Biology to aid in comprehending quantitative aspects of Biology. Findings therefore underscore the contribution of Mathematics to Biology instruction. The role of Mathematics in Biology was illustrated by Eastwood et al (2011) whereby nursing students in Australia exhibited errors in calculations of drug concentration. This finding is in agreement with findings by Brewer et al. (2011) who stressed the need to foster quantitative competencies in mathematical skills that aid in manipulation, analysis and interpretation of Biological data.

Data obtained from the study was cross-tabulated to establish the relationship between language skills and appropriateness of the BIP. Table 12 presents a summary of the findings.

Table 12: Language Skills and Biology Instruction (Cross-tabulation)

			Language Skills		
			Poor	Good	Total
Biology Instructional Process	Not appropriate	f	44	27	71
		%	14.6	9.0	23.6
	Highly appropriate	f	28	202	230
		%	9.3	67.1	76.4
	Total	f	72	229	301
		%	23.9	76.1	100.0

Information obtained show that a majority of the respondents (76.1%) believed that students' language skills were good compared to those who felt they were poor (23.9%). Of those who believed that students' language skills were good, more than two-thirds (67.1%) felt that language skills were highly appropriate for Biology instructional process compared to those who felt that it was not appropriate (9.0%). On the contrary, those who felt that students' language skills were poor, more (14.6%) believed that language skills are not appropriate for BIP compared to those who

believed that it was highly appropriate (9.3%). Cross-tabulation findings therefore suggests an association between language skills and BIP. Chi square analysis was used to interpret the extent to which language skills influenced BIP as presented in Table 13.

Table 13: Language Skills and Biology Instruction (Chi-Square Test)

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	CC
Pearson Chi-Square	73.928[a]	1	0.000			0.444
Continuity Correction[b]	71.217	1	0.000			
Likelihood Ratio	66.506	1	0.000			
Fisher's Exact Test				0.000	0.000	
Linear-by-Linear Association	73.682	1	0.000			
N of Valid Cases	301					

Chi square results $x^2(1) = 73.928$, $p<0.001$ shows that there exists a statistically significant influence of language skills on BIP. Contingency coefficient measure of association attributed 44.4% of the total variance in BIP to students' language skills. Findings mean that student' language skills significantly influenced Biology instructional process, language skills contributing to 44% of total variance in BIP. This led to the rejection of the first hypothesis, H_O1 which stated that there is no statistically significant influence of students' language skills on Biology instructional process in Imenti-Central sub-county, Meru County. Findings show that a student's language skills significantly influence BIP implying that students with good language skills would contribute positively thus promote the process while those with inferior language skills would contribute in the reverse. A study in North-America by Tawfik (2017) denoted the need for students' language proficiency to enhance learning of Biology at the presentation and evaluation stage. Related findings of a Nigerian study undertaken by Oyekan (2015) indicated that poor language skills evidenced by limited Biological vocabulary, mother tongue interference and misinterpretation of questions led to poor performance which negatively influenced BIP.

Qualitative data obtained from Biology HoS highlighted the key role played by language skills in regard to Biology instruction. Interviewee R observed that;

Students experience difficulties in writing Biological terms accurately in examination leading to poor performance.

Interviewee V indicated that;

Poor language skills in English language limits students' understanding and ability to express themselves during discussions. It also limits students' ability to answer questions orally and in written form especially when writing essays in Biology. For instance, a student once wrote 'blood goes' instead of 'blood flows'.

A similar observation was made by interviewee W who noted that;

Students experience difficulties in expressing themselves fluently in English language since they hardly speak in English. Most students do not attempt application or analysis questions due to poor comprehension of English language. For instance, majority of the students can draw Biological graphs accurately but cannot interpret them due to poor language skills.

A majority of interviewees were in agreement that proficiency in all aspects of language skills are vital for effective Biology instruction. This meant that the effectiveness of BIP could be attributed to students' language skills in reference to English language, LoB and Mathematical language. The qualitative findings are in agreement with Ferreira (2011) who revealed that students found biological terms unfamiliar which made it difficult to master and comprehend the terminologies. Hakorimana et al (2020) aver that poor language skills in reference to English language hindered students' participation in classroom discussions. In Kenya, Karwitha (2016) indicated the importance of literacy and numeracy skills in Biology. Generally, the scholars underscore the importance of good language skills in the three aspects of LoI for effective BIP.

4.4.2 Attitude and Biology Instructional Process

In the second objective, the researcher sought to establish the influence of attitude on Biology instructional process in Imenti-Central sub-county, Meru County. Students and teachers were provided with statements on attitude. Table 14 presents a summary of data obtained from students. Information obtained reveal that majority of the students perceived Biology as an easy subject (73.1%), their future career depended on Biology knowledge (78.4%) and they enjoyed Biology lesson (63.8%) to a great and very great extent. A significant proportion of the students (59.5%) selected Biology because it was

an easier alternative among other optional science subjects. However, less than half of the students (47.2%) frequently studied Biology on their own and less than half of the sampled students (47.5%) believed they can perform well in Biology to a great and very great extent. This means that, on average, (55.57%) of the students had a positive attitude toward Biology.

Table 14: Attitude and Biology Instructional Process (Students)

Statement	Students (N=301)					
	NE%	LE %	ME%	GE %	VGE %	Total %
Biology is an easy subject	1.7	6.3	18.9	39.2	33.9	100.0
My future career depends on Biology knowledge.	3.7	4.7	13.3	35.5	42.9	100.0
Biology knowledge improves the quality of our lives	4.3	8.0	25.2	33.6	28.9	100.0
I enjoy Biology lessons	6.0	10.3	19.9	31.2	32.6	100.0
I selected Biology because it is an easier alternative among optional science subject	9.0	11.0	20.6	28.9	30.6	100.0
I frequently study Biology on my own	22.9	13.0	16.9	20.6	26.6	100.0
I can perform well in Biology	25.6	11.0	15.9	21.9	25.6	100.0
I fail Biology because I have a negative toward Biology	6.3	11.6	20.9	30.6	30.6	100.0
Our teacher enjoys teaching us Biology	6.6	9.0	19.6	28.9	35.9	100.0
Our Biology teacher believes we can perform well in Biology	27.6	11.0	20.6	17.9	22.9	100.0
I like my Biology teacher	9.3	9.6	20.9	34.6	25.6	100.0
I like how our Biology teacher teaches us	9.6	10.0	23.3	35.9	21.3	100.0
Our Biology teachers speaks negatively about aspirations of students who perform poorly in Biology	6.0	11.3	19.9	30.2	32.6	100.0
Our Biology teacher encourages us to develop a positive attitude toward Biology	5.0	12.0	31.2	26.6	25.2	100.0
Our Biology teacher guides us on how to improve our performance in Biology	2.3	5.6	19.3	40.2	32.6	100.0

Key: No Extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

Information on students' attitude toward their Biology teacher reveal that students liked their Biology teacher (60.2%) and liked how they were taught Biology (57.2%). Students also felt that their Biology: teacher enjoyed teaching them Biology (64.8%), believed they could perform well in Biology (40.8%), spoke negatively about

aspirations of students who performed poorly in Biology (62.8%), encouraged them to develop a positive attitude toward Biology (51.8%) and guided them on how to improve performance in Biology (72.8%) to a great and very great extent. This implies that, besides students believing less than half of their teachers (40.8%) believed that students can perform well in Biology, more than half of the students (58.6%) had a positive attitude toward their Biology teachers.

Data on attitude was also sought from teachers and the information obtained is presented in Table 15.

Table 15: Attitude and Biology Instructional Process (Teachers)

Statement: My students;	Teachers (N=40)					
	NE	LE	ME	GE	VGE	Total
Performance in Biology meets my expectations	30.0	17.5	22.5	27.5	2.5	100.0
Can integrate knowledge from different areas of Biology	-	32.5	22.5	35.0	10.0	100.0
Are competent in conducting Biology experiments	-	20.5	30.5	22.5	26.5	100.0
Are self-motivated to learn Biology	5.0	22.5	22.5	22.5	27.5	100.0
Analyze Biological data effectively	10.5	30.5	24.5	20.0	15.0	100.0
Can explain complex Biological effectively	9.0	11.5	30.5	36.5	12.5	100.0
Are able to apply Biological knowledge in real-life situations	5.0	25.0	20.0	37.5	12.5	100.0
Have the potential to excel in Biology.	-	2.5	27.5	65.0	5.0	100.0
Enjoy Biology lessons	-	-	55.0	35.0	10.0	100.0
Select Biology because it is an easier alternative among optional science subject	-	-	20.0	42.5	37.5	100.0
Believe Biology is an easy subject	3.0	22.5	31.0	22.0	21.5	100.0
Believe Biology is relevant to their lives	-	10.0	32.5	42.5	15.5	100.0
Are always curious about biological concepts and phenomena	-	12.5	35.0	45.0	7.5	100.0
Attitude towards Biology is influenced by their peers	5.0	5.0	30.0	42.5	17.5	100.0
Fail Biology because they have a negative attitude towards Biology	5.0	12.5	37.5	20.0	25.0	100.0

Key: No Extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

Information obtained from teachers indicate that only a third of the teachers (30.0%) believed that students' performance in Biology met expectations to a great and very great extent. This indicates a gap between teacher's expectations and the actual students' performance. Teachers also felt that students; could integrate knowledge across different areas in Biology (45.0%), were competent in conducting experiments (49%), were self-motivated to learn Biology (50.0%), analyzed Biological data effectively (34.5%), explained Biological complex concepts effectively (49.0%) and applied Biological knowledge in real-life situations (50.0%) to a great and very great extent. Students' ability to meet performance expectations and analyze Biological data stood out as key areas of concern with less than half of the teachers expressing confidence in these areas. Findings indicate that teachers had low confidence (43.9%) in students' abilities across various aspects of Biology. However, despite the low levels of confidence, majority of teachers felt that students had the potential to excel in Biology (70.0%). Data therefore suggests the need for targeted improvements in teaching methods and student support to meet the projected expectations.

Findings on teachers' perception of students' attitude towards Biology indicate that less than half of students enjoyed Biology lessons (45.0%) to a great and very great extent. This suggests that there may be factors within the instructional process that fail to engage a significant portion of the students during the presentation stage. A majority of the students (80.0%) selected Biology because it was an easier alternative among optional science subjects suggesting that students may not be motivated by genuine interest but rather by the ease of Biology compared to other optional science subjects. Despite, selecting Biology as an easier alternative among optional science subjects, less than half of the teachers (43.5%) pointed out that students believed Biology is an easy subject. This may reflect the actual difficulty level of Biology or students' struggles in understanding concepts. According to teachers, more than half of the students (58.0%) believed Biology is relevant to their lives which suggests students' appreciation of practical applications of Biology. More than half of the students (52.5%) were always curious to learn biological concepts and phenomena which indicated moderate levels of interest in Biology. According to a majority of teachers, students' attitude toward Biology was influenced by their peers (60.0%) and that they failed Biology because they had a negative attitude towards Biology (64.2%). This pointed out the role of peer influence in determining and

shaping attitude and the need address attitude-related issues to improve academic performance in Biology. On average, data suggested that more than half of teachers (54.8%) perceived students to have a positive attitude towards Biology.

Descriptive findings revealed that more than half of the teachers (54.8%) believed that students had a positive attitude towards Biology. Similarly, more than half of the students (58.6%) felt that they had a positive attitude towards Biology. On average, more than half of the students (56.7%) had a positive attitude towards Biology. Findings of this study are consistent with Hinneh (2017) who posits that senior secondary school students had a positive attitude towards practical work in Biology irrespective of age and gender. Similarly, Baraiywo (2019) observed that a majority of the students (80.27%) had a positive attitude towards Biology in Nandi County, Kenya. Despite more than half of the sampled students (56.7%) having a positive attitude towards Biology, a significant proportion of the students (43.3%) have a negative attitude towards Biology which may impact the instructional process negatively. Findings therefore corroborate with Cimer (2012) who posits that Students' negative attitude toward Biology hindered effective learning in Turkish secondary schools. Similar observation was made Ahmad et al. (2022) who indicated that students' attitude had a positive correlation to academic achievement among secondary school students in Pakistan.

A majority of teachers (70.0%) also believed that students had the potential to excel in Biology. However, teachers portrayed low expectation (43.9%) in regard to students' ability in Biology which may impact teacher's performance in regard to the instructional process. Additionally, less than half of the students (40.8%) pointed out that teachers believed in their ability to perform well in Biology implying a negative perception of students' ability in Biology. Findings imply that teachers' low expectation of their students' ability in Biology which may impacts the BIP negatively in regard to activities at each stage of the instructional process. Findings are therefore consistent with findings of Rubie-Davies et al. (2015) who indicated that students' outcome improved when taught be teachers with high-expectations as compared to teachers with low expectations.

Data obtained from the study was cross-tabulated to gauge respondents' perception of attitude and appropriateness of BIP. Table 16 presents the findings.

Table 16: Attitude and Biology Instruction (Cross tabulation)

			Attitude towards Biology		
			Negative	Positive	Total
Biology Instructional Process	Less appropriate	f	54	17	71
		%	17.9	5.6	23.6
	Highly appropriate	f	57	173	230
		%	18.9	57.5	76.4
	Total	f	111	190	301
		%	36.9	63.1	100.0

Findings indicate that more than half of the sampled respondents (63.1%) had a positive attitude towards BIP while (36.9%) had negative attitude towards BIP. A significant proportion of those with positive attitude (57.5%) regarded BIP as highly appropriate compared to those who regarded BIP as less appropriate (5.6%). Of those with negative attitude, (18.9%) felt that BIP was highly appropriate compared to those who felt that it was less appropriate (17.9%). Findings suggest an association between attitude towards Biology and perception of the instructional process, with students who have a positive attitude also perceiving the instructional process more positively. This observation was interpreted using chi-square analysis as presented in Table 17.

Table 17: Attitude and Biology Instruction (Chi-Square Test)

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	CC
Pearson Chi-Square	61.273[a]	1	0.000			0.411
Continuity Correction[b]	59.090	1	0.000			
Likelihood Ratio	60.565	1	0.000			
Fisher's Exact Test				0.000	0.000	
Linear-by-Linear Association	61.069	1	0.000			
N of Valid Cases	301					

Chi square results $x^2(1) = 61.27$, $p<0.001$ show that there exists a statistically significant influence of attitude on BIP. A Contingency Coefficient measure of association attributed 41.1% of the total variance in the outcome of BIP to students' attitude. This led to rejection of the second hypothesis, H_O2 which stated that there is no statistically

significant influence of attitude on Biology instructional process in Imenti-Central sub-county, Meru County. Inferential findings show that students' attitude significantly influences the BIP implying that students with a positive attitude would enhance the effectiveness of BIP while those with negative attitude would be of detrimental effect to an effective instructional process. Inferential findings therefore corroborates with Baraiywo (2019) who indicated that students with a positive attitude performed better than their counterparts with a negative attitude. Consistent with these findings, Kiilu et al. (2022) in a study on challenges facing performance of Biology whereby negative attitude of students towards Biology led to poor performance in Biology.

Qualitative data was sought from Biology HoS on students' attitude towards Biology. In response, Interviewee R observed that;

> *Students have a positive attitude towards Biology. However, students' poor performance in Biology demotivates students to learn Biology. Students choose Biology as an easier optional science subject but still complain that Biology is complex due to too many biological terms in topics such as; Reception, Response and Co-ordination and Support and Movement in Plants and Animals.*

Interviewee S stated that;

> *The negative attitude towards Biology among students is associated to complex Biological terms, strict marking in regard to spelling and language coherency.*

A majority of interviewees pointed out that a majority students had a positive attitude towards Biology. However, the motivation to learn declined due to persistent poor performance in Biology. According to most interviewees, students' negative attitude was attributed to too many complex biological terms, a shift in examination criteria that mainly focused on analysis and application questions and strict marking of Biology examinations. Qualitative findings imply that the Biology curriculum and assessment and evaluation procedures contribute to negative attitude towards Biology. The study findings corroborate with Cimer (2012) who indicated that negative attitudes among students were attributed to the theoretical nature of Biology. Students felt that teachers focused more on theoretical aspects making Biology abstract in nature and hard to understand complex concepts and difficult topics.

4.4.3 Utilization of Instructional Resources and Biology Instructional Process

The third objective was to establish the influence of utilization of instructional resources on Biology instructional process in Imenti-Central sub-county, Meru County. Teachers and students were provided with 19 statements on utilization of IR. Findings from Biology students are presented in Table 18.

Table 18: Use of Instructional Resources and Biology Instructional Process (Students)

Instructional Resource	Students (N=301)					
	NE%	LE %	ME%	GE %	VGE %	Total %
Computers	6.3	10.0	21.9	37.5	24.3	100.0
Projectors	3.3	13.3	29.9	27.9	25.6	100.0
Laboratory apparatus e.g. microscopes	4.0	11.6	23.6	34.9	25.9	100.0
Laboratory reagents	3.0	15.3	24.3	33.9	23.6	100.0
Real objects	6.0	15.9	28.2	28.9	20.9	100.0
Charts	11.0	12.6	32.2	26.2	17.9	100.0
Models	13.3	14.6	22.9	26.2	22.9	100.0
Educational websites	20.9	17.3	25.9	22.3	13.6	100.0
Educational You-tube channels	13.6	13.6	25.9	26.2	20.6	100.0
Resource persons e.g. doctors	16.6	10.0	25.2	21.6	26.6	100.0
Agricultural shows	3.0	13.0	22.6	29.2	31.9	100.0
Forests	2.0	10.6	15.6	35.9	35.9	100.0
Rivers/swamps to study ecology	5.6	9.0	27.6	22.6	35.2	100.0
Cultural artifacts e.g. bones, animal skin	2.0	5.3	20.3	33.9	38.5	100.0
Teacher-made charts	4.7	15.3	25.2	28.6	26.2	100.0
Teacher-prepared videos	7.6	15.3	26.2	28.2	22.6	100.0
Teacher-prepared models	16.6	9.6	27.6	26.9	19.3	100.0
Drawings	10.3	10.0	26.2	28.9	24.6	100.0
Teacher prepared photographs	28.2	27.6	19.6	12.3	12.3	100.0

Key: No Extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

Information obtained from students on utilization of conventional IR indicated that computers (61.8%) were the most preferred IR for teaching and learning Biology followed by laboratory apparatus (60.8%), laboratory reagents (57.5%) and, projectors (53.5%). Other conventional IR such as real objects (49.9%), charts (44.1%), models (49.1%), educational You-tube channels (46.8%) were moderately utilized. Educational websites (35.9%) were fairly used to a great and very great extent. On average, conventional IR were moderately used (51.0%) in the learning of Biology. Community resources such as cultural artifacts like bones (72.4%), forests (71.8%), agricultural

shows (61.1%) and rivers (57.8%) were among the most commonly used community resources in learning of Biology.

Resource persons such as doctors (48.2%) were moderately used to a great and very great extent. Findings on improvised resources show that teacher made charts (54.5%), videos (50.8%), drawings (53.5%) and models (46.2%) were utilized to a great extent and very great extent. Teacher-prepared photographs (24.6%) were minimally used to a great extent and very great extent. Generally, community resources were the most utilized (62.3%) followed by conventional resources (51.0%) and improvised resources (46.0%). On average, IR were used moderately (53.1%) to learn Biology.

Information on utilization of IR was also sought from Biology teachers and findings are presented in Table 19.

Table 19: Use of Instructional Resources in Biology Instructional Process (Teachers)

Instructional Resource	Teachers (N=40)					
	NE%	LE %	ME%	GE %	VGE %	Total %
Computers	5.0	20.0	17.5	35.0	22.5	100.0
Projectors	27.5	12.5	30.0	22.5	7.5	100.0
Laboratory apparatus e.g. microscopes	-	2.5	10.0	47.5	40.0	100.0
Laboratory reagents	-	-	7.5	55.0	37.5	100.0
Real objects	-	12.5	62.5	20.0	5.0	100.0
Charts	-	10.0	42.5	45.0	2.5	100.0
Models	10.0	37.5	35.0	12.5	5.0	100.0
Educational websites	5.0	25.0	45.0	22.5	2.5	100.0
Educational You-tube channels	10.0	37.5	40.0	7.5	5.0	100.0
Resource persons e.g. doctors	77.5	17.5	5.0	-	-	100.0
Agricultural shows	50.0	47.5	-	2.5	-	100.0
Forests	42.5	47.5	7.5	2.5	-	100.0
Rivers/swamps to study ecology	40.0	45.0	15.0	-	-	100.0
Cultural artifacts e.g. bones, animal skin	40.0	7.5	27.5	22.5	2.5	100.0
Teacher-made charts	-	-	32.5	55.0	12.5	100.0
Teacher-prepared videos	5.0	37.5	30.0	22.5	5.0	100.0
Teacher-prepared models	25.0	17.5	37.5	17.5	2.5	100.0
Drawings	-	10.0	22.5	55.0	12.5	100.0
Teacher prepared photographs	7.5	32.5	32.5	25.0	2.5	100.0

Key: No Extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

According to teachers, laboratory reagents (92.5%) were the most integrated conventional IR followed by laboratory apparatus (87.5%). Other fairly integrated resources included computers (57.5%) and charts (47.5%). However, resources such as educational You-tube channels (12.5%), educational websites (25.0%) and charts (25%) were integrated at relatively low rate to a great and very great extent. Similarly, community resources (6.0%) were minimally integrated in the teaching and learning of Biology. Information on improvised resources indicate that teacher-prepared drawings (67.5%) and charts (67.5%) were most adopted to teach and learn Biology while teacher-prepared photographs (27.5%), videos (27.5%) and models (20.0%) were minimally integrated in a great and very great extent. On average, teachers mainly integrated conventional resources (43.9%) and improvised resources (42.0%) in the teaching and learning of Biology. Findings therefore imply minimal utilization of community resources which make learning real as they enable students to connect what they learn in class with real-life situations.

Descriptive findings indicated that conventional resources were the most utilized (47.5%), followed by improvised resources (44.0%) and lastly community resources (34.5%). On average less than half of the teachers (41.9%) utilized IR to a great and very great extent. Findings imply underutilization of IR in Biology instruction. The findings are in agreement with Mukagihana et al. (2020) who indicated that despite adequate IR in Rwandan Universities, only 7.3% of Biology lectures were taught using IR which meant that IR were underutilized by lecturers. Similar observations were made by in Kenya by Wambui (2013) who observed that instructional materials were not effectively utilized because of various challenges like: overcrowded classrooms, inadequate infrastructure in early childhood education centers, language barriers, negative teacher attitudes and insufficient professional skills among teachers.

Data on utilization of IR was cross-tabulated respondents' conception of appropriateness of Biology instructional process as presented in Table 20. Cross-tabulation results indicate that more than half of the teachers highly utilized IR (54.2%) compared to those who utilized IR minimally (45.8%). Twice as much as those who utilized IR highly (49.8%) believed that BIP was highly appropriate compared to those whose utilization was low (26.6%). Five times as those who had recorded low

utilization of IR (19.3%) felt that BIP was less appropriate as compared to those who had high utilization (4.3%).

Table 20: Utilization of Instructional Resources and Biology Instruction

			Utilization of instructional Resources		
			Low	High	Total
Biology Instructional Process	Less appropriate	f	58	13	71
		%	19.3	4.3	23.6
	Highly appropriate	f	80	150	230
		%	26.6	49.8	76.4
	Total	f	138	163	301
		%	45.8	54.2	100.0

Cross-tabulation data suggests an association between increased utilization of IR and effectiveness of BIP. Chi square analysis was used to establish the degree of influence of utilization of instructional resources and BIP as presented in Table 21.

Table 21: Utilization of Instructional and Biology Instruction (Chi-Square Test)

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	CC
Pearson Chi-Square	48.081[a]	1	0.000			0.371
Continuity Correction[b]	46.210	1	0.000			
Likelihood Ratio	50.394	1	0.000			
Fisher's Exact Test				0.000	0.000	
Linear-by-Linear Association	47.921	1	0.000			
N of Valid Cases	301					

Chi square results $x^2(1) = 48.081$, $p<0.001$ shows that there exists a significant influence of utilization of instructional resources on BIP. A Contingency coefficient measure of association attributed of 37.1% of the total variance in the outcome of BIP could be attributed to utilization of instructional resources. This led to the rejection of the third hypothesis H_O3, which stated that there is no statistically significant influence of utilization of instructional resources on Biology instructional process in Imenti-Central sub-county, Meru County. Inferential findings shows a significant influence of utilization of IR and BIP implying that incorporation of IR as aids to teaching and

learning promotes the effectiveness of BIP while non-utilization or under-utilization of IR hinder effective instructional process since IR acts as aids to teaching and learning. Findings are consistent with Kimeu et al. (2016) who averred that IR facilitate conception and understanding of the subject matter by breaking down complex concepts into manageable and understandable units. Okeze (2022) also underscored the role of IR such as textbooks, diagrams, charts and digital media such as slide in providing multiple representations which facilitated understanding of complex and abstract concepts.

Qualitative data on utilization of instructional resources was sought from Biology HoS. In response, interviewee R indicated that;

> *Teachers mainly use conventional resources such as charts, laboratory apparatus and reagents since they are readily available. ICT resources such as phones are also used to access You-tube and educational websites in google during lesson preparation. Community resources are hardly used due to time constraints.*

Interviewee W observed that;

> *Laboratory reagents, apparatus, charts, realia, teacher-made charts and diagrams are highly utilized during the instructional process. ICT resources such as computers are hardly used since they are scarce. Nearby river is used to teach ecology and the school man-made forest is used as source of specimen for use in topics such as classification, reproduction and ecology.*

Similar observations were made by a majority of interviewees who pointed out that conventional resources were the most utilized IR, followed by improvised resources. Community resources were hardly used by teachers due to time and financial constraints. Qualitative findings corroborate with findings of Arum (2015) who indicated that conventional resources such textbooks, charts and whiteboards were the most commonly utilized resources while dissecting kits, computers, projectors and school botanical gardens were hardly used in most Biology lessons. Findings on limited use of community resources are in agreement with Kerubo (2015) who indicated that community resources were hardly utilized during the instructional process due to time and financial constraints. On the contrary, Kabesa et al. (2019) observed that community resources were effectively utilized to develop science process skills in

Biology. According to the researcher, school grounds, objects and specimens, museums, parks, botanical gardens, zoos and resource persons were frequently used to enhance acquisition of science process skills in instruction of Biology.

4.4.4 Institutional Support and Biology Instructional Process

The fourth objective focused on determining the influence of institutional support on Biology instructional process in Imenti-Central sub-county, Meru County. Biology teachers and students were provided with a set of Likert-scaled statements to gauge the extent to which various aspect of institutional support contributed to BIP. Table 22 presents a summary of data obtained from students.

Table 22: Institutional Support and Biology Instructional Process

Statement	Students (N=301)					
	NE%	LE %	ME%	GE %	VGE %	Total %
Remedial practical lessons	24.6	9.6	8.6	10.0	47.2	100.0
Remedial theory lessons	20.9	8.0	8.3	13.6	49.2	100.0
Field trips	34.9	13.6	16.3	17.6	17.6	100.0
Talks from Biology experts e.g. examiners	38.5	12.6	11.0	25.9	12.0	100.0
Rewarding top performers in Biology	29.6	10.6	9.0	10.0	40.9	100.0

Key: No Extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

Information obtained from students on institutional support in the form of academic support programs in Biology indicated that remedial theory lessons (62.8%), remedial practical lessons (57.2%) contributed to BIP to a great and very great extent. Half of the students felt that rewarding top performers in Biology (50.9%) contributed to BIP to a great and very great extent which is consistent with the findings of Geofrey (2014). According to the researcher, majority of the students embraced rewarding culture and viewed it as a motivation to work harder. One third of the students felt that talks from Biology experts such as examiners (37.2%) and field trips to wild reserves (35.2%) contributed minimally to BIP to a great and very great extent. This indicates a higher preference of remedial theory, remedial practical lessons and rewarding of top achievers in enhancing the effectiveness of BIP.

Table 23 presents findings on the contribution of Institutional Support programs in Biology as obtained from teachers.

Table 23: Institutional Support and Biology Instructional Process

Statement	Teachers (N=40)					
	NE%	LE %	ME%	GE %	VGE %	Total %
Mentorship programs	20.0	35.0	27.5	12.5	5.0	100.0
Peer Observation and Feedback	10.0	35.0	25.0	25.0	5.0	100.0
ICT Training	20.0	37.5	35.0	7.5	-	100.0
Assessment and Evaluation Workshops	7.5	35.0	35.0	17.5	5.0	100.0
Remedial practical lessons	-	-	10.0	45.0	45.0	100.0
Remedial theory lessons	-	-	5.0	60.0	35.0	100.0
Field trips	20.0	30.0	22.5	22.5	5.0	100.0
Talks from Biology experts	2.5	27.5	35.0	25.0	10.0	100.0
Rewarding top achievers in Biology	2.5	17.5	55.0	22.5	2.5	100.0
Rewarding teachers for students' good performance in Biology	10.0	22.5	27.5	30.0	10.0	100.0

Key: No Extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

Data obtained from teachers show that mentorship programs (17.5%), peer observation and feedback (30.0%), ICT training (7.5%) and assessment and evaluation workshops (22.5%) contributed to BIP to a great and very great extent. On average, teachers PD activities (19.4%) had contributed minimally to BIP. Teachers confirmed students' observation on academic support programs in Biology whereby remedial theory lessons (95.0%), remedial practical lessons (90.0%) had the greatest contribution to BIP to a great and very great extent. Other programs that fairly contributed to BIP to a great and very great extent included rewarding teachers for students' good performance in Biology (40.0%) and talks from Biology experts (35.0%). The remaining activities, that is, field trips (27.5%) and rewarding top achievers in Biology (25.0%) though adopted, did not contribute to a BIP to a great and very great extent. On average, teachers felt that academic support programs in Biology (52.1%) contributed to BIP to a great and very great extent compared to teacher PD activities (19.4%). Findings suggest that academic support programs in Biology contributed greatly to BIP compared to teacher PD programs.

Findings from both teachers and students point out the great contribution of academic support programs, specifically remedial theory and remedial practical lessons in the teaching and learning of Biology. On average, more than half of the sampled teachers and students (50.5%) felt that academic programs contributed to BIP to a great and very great extent. Remedial theory lessons (78.9%) and remedial practical lessons 73.6%) had the greatest contribution. Findings are consistent with Munene et al. (2017) who indicated that teachers embraced remedial teaching as both a means of covering the syllabus on time and improving pupils' academic performance. The researcher further highlighted the importance of academic support programs such as remedial teaching and the need to establish clear guidelines on when such programs should be conducted to meet the needs of both students and teachers. Professional development programs, though essential in enhancing teacher effectiveness, had minimal contributions (19.4%) to BIP. This is contrary to the findings of Omeodu (2023) whereby teachers and principals agreed that teacher professional development was essential for a teacher. Data on institutional support was cross-tabulated to gauge the extent of institutional support on appropriateness of BIP. Table 24 presents the results.

Table 24: Institutional Support and Biology Instruction

			Institutional Support		
			Below average	Above average	Total
Biology Instructional Process	Less appropriate	f	34	37	71
		%	11.3	12.3	23.6
	Highly appropriate	f	112	118	230
		%	37.2	39.2	76.4
	Total	f	146	155	301
		%	48.5	51.5	100.0

Cross-tabulated information on Table 24 shows that majority of the respondents (76.4%) perceived BIP as highly appropriate compared to a smaller proportion (23.6%) who viewed it as less appropriate. Among those who perceived BIP as highly appropriate, more than half (51.3%) were from institutions with above average IS compared to those who were from schools with below average IS (48.7%). Among those who found BIP less appropriate, more than half (52.1%) were from schools with above average IS while an almost equal proportion (47.9%) was from schools with below average IS. Findings indicated that institutional support levels are skewed

towards being above average. However, the perception of the appropriateness of BIP is largely favorable regardless of the levels of IS. Data from students was further subjected to chi-square analysis to establish the degree of influence of IS on BIP and the findings presented in Table 25.

Table 25: Language Skills and Biology Instruction (Chi-Square Test)

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	CC
Pearson Chi-Square	0.014[a]	1	0.905			0.007
Continuity Correction[b]	0.000	1	1.000			
Likelihood Ratio	0.014	1	0.905			
Fisher's Exact Test				1.000	0.000	
Linear-by-Linear Association	0.014	1	0.905			
N of Valid Cases	301					

Chi square results $x^2(1) = 0.014$, $p<0.905$ showed that there was no significant influence of institutional support on BIP. A Contingency coefficient measure of association of 0.007% illustrates a very weak association between institutional support and BIP. The findings therefore led to acceptance of the fourth hypothesis, H_O4 which stated that there is no statistically significant influence of institutional support on Biology instructional process in Imenti- Central sub-county, Meru County. Findings suggested that the effectiveness of BIP was independent of the presence and extent of IS in Biology teacher PD and academic support programs in Biology. Inferential findings were contrary to findings of Sukandar (2018) who indicated that professional development programs and academic support programs enhanced the teaching and learning process. Study findings were also contrary to findings of Gonzalez et al. (2019) who indicated that IS in the form of mentorship programs in Biology fostered a sense of belonging which reduced feelings of isolation among teachers which helped in retention of experienced teachers.

Qualitative information was sought from Biology HoS on various aspects of institutional support in their respective schools. In response, interviewee T indicated that;

There are hardly any teacher PD activities or programs which limits teachers' effectiveness in terms of trends in teaching methodologies, assessment and evaluation. However, the school administration supports remedial teaching and rewarding of students who perform well in end of term examinations.

Observation made by interviewee T is in agreement with findings obtained from interviewees P, U, V and W. These findings reveal that most sampled schools hardly organized for teacher PD apart from peer observation and feedback. This underscores the importance of PD programs in enhancing teacher effectiveness. On the contrary in a study conducted by Omeodu (2023), teachers and principals underscored the role of teacher professional development in enhancing teacher effectiveness. According to the researcher, constant planning, supervision and encouragement of professional development by principals had a positive impact on Biology teachers' performance. Qualitative findings revealed that the school administration supported and embraced rewarding top achievers in Biology to motivate students to work harder. This is in agreement with findings of Chen (2023) who indicated that rewarding students acts as a reinforcement for their efforts and achievements, thereby reinforcing desirable behaviors and academic achievements.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study sought to establish the influence of language skills, attitude, utilization of IR and institutional support on BIP in Imenti-Central sub-county, Meru County. The study employed a descriptive survey research design to obtain relevant information on the dynamics of Biology instruction in regard to the selected factors. The study population included 2806 form three Biology students, 95 Biology teachers and 8 Biology HoS. Data was collected from 301 students, 40 Biology teachers and 8 Biology HoS. Data obtained from Biology HoS was analyzed qualitatively through thematic analysis as per the study objectives. Quantitative data collected from Biology teachers and students was analyzed descriptively using frequencies and percentages and inferentially using Chi-square analysis statistics. Data related to BIP indicates that at the preparation stage, a majority of the teachers; identified learning objectives, selected relevant and appropriate content, identified suitable instructional methods to deliver the content, sourced for relevant IR and chose appropriate assessment method. Therefore, findings implied that a majority of the Biology teachers adequately prepared for Biology lessons. During lesson delivery, more than two thirds of the teachers engaged students throughout the lesson, guided students in handling and manipulation of materials, gave students opportunities to ask questions and facilitated collaborative and cooperative learning activities such as group discussions. Findings implied that a majority of Biology teachers adopted a learner-centered teaching approach that engaged students actively at the presentation stage. However, at the evaluation stage, only a small proportion of the teachers conducted formative evaluation effectively.

Descriptive data on the influence of language skills on BIP indicated that students' language skill in reference to English language and language of Biology contributed greatly to the effectiveness of BIP. Similarly, students' proficiency in mathematical concepts incorporated in Biology determined the extent to which students made sense of quantitative data in Biology. Qualitative findings highlighted challenges experienced by students with poor language skills which impacted their ability to write, speak and comprehend Biological terms and concepts. According to Biology HoS, poor language skills in reference to English language, LoB and mathematical language limited

students' ability to express themselves coherently orally and in written form. Cross-tabulated findings indicated a positive relationship between language skills and BIP. As such, a majority of students with language skills considered BIP as highly appropriate. Inferential relationship indicated a significant influence of language skills on BIP, with language skills contributing significantly to the effectiveness of BIP.

Relative to the influence of attitude on BIP, descriptive findings indicated that despite a majority of teachers believing that students had potential to excel in Biology, most teachers had low expectations of students' ability in Biology. Data on students' attitude towards Biology indicated that more than half of the students had a positive attitude towards Biology. However, a significant proportion of the students had a negative attitude toward Biology. Qualitative findings attributed the negative attitude among students to too many complex biological terms and strict marking criteria in Biology examinations that led to a demotivating cycle of poor performance. Cross-tabulated information illustrated a positive relationship between attitude and BIP. Specifically, among the students with positive attitude towards Biology, a majority regarded BIP as highly appropriate. Inferentially, attitude of students towards Biology had a statistically significant influence on BIP. Contingency coefficient measure of association indicated that effectiveness of BIP outcomes could be attributed to the attitude of students.

Data on utilization of IR pointed out that laboratory apparatus, laboratory reagents and computers were the most utilized conventional resources. Teacher-prepared resources such as charts and drawings were moderately used. Conventional resources were the most utilized, followed by improvised resources and lastly community resources. Biology HoS attributed minimal use of community resources on time and financial constraints. Descriptive analysis generally revealed that IR were underutilized as only less than half of the teachers utilized IR to a great and very great extent. Cross-tabulated data indicated a significant positive association between higher utilization of instructional resources and the appropriateness of BIP. Inferential findings further illustrated a significant influence of utilization of IR on BIP.

Data relative to institutional support illustrated that academic support programs in Biology particularly remedial theory lessons and practical lessons greatly contributed

to BIP. Students and teachers embraced the culture of rewards as means of recognizing teachers' and students' effort and further motivating them to engage more in the teaching and learning process. Information on PD of Biology teachers revealed that a majority of teachers in county and sub-county schools hardly participated in PD programs besides peer observation and feedback. Descriptive findings further illustrated minimal contribution of PD on BIP. The extent of IS was slightly skewed towards being above average. However, cross-tabulated findings indicated that BIP was appropriate irrespective of levels of IS. Inferentially, there was no statistical significant influence of IS on BIP.

5.2 Conclusion

The first study objective focused on the influence of language skills on BIP. Descriptive and qualitative findings illustrated a positive conception of good language skills in Biology instruction. Inferential analysis revealed that language skills significantly influenced BIP. From the findings it can be deduced that language skills of students play a critical role in effective Biology instruction.

The second objective established the influence of attitude on BIP. Descriptive findings pointed out that students exhibited both positive and negative attitude in different but significant proportions. Cross-tabulation analysis revealed a positive relationship between positive attitude and effectiveness of BIP. Inferential analysis based on Chi-square test indicated a significant influence of attitude on BIP. It can therefore be deduced that students portrayed mixed attitudes towards Biology which hindered effectiveness of BIP since attitude had a significant influence on BIP. Attitude therefore had a significant influence on BIP.

The third objective sought to establish the influence of utilization of instructional resources on BIP. Findings illustrated low levels of utilization of IR in Biology instruction. Based on categories, conventional resources were the most utilized, followed by improvised resources. Community resources were hardly incorporated in Biology instruction due to time and financial constraints. Utilization of IR was positively associated with effectiveness instructional process. This suggests that increased use of instructional resources enhances the effectiveness of Biology

instruction. Inferential analysis further indicated a significant influence of utilization of IR on BIP. It can therefore be concluded that utilization of IR has a significant influence on BIP.

The fourth objective focused on determining the influence of institutional support on BIP. Findings relative to the objective indicated that most school administrators supported BIP through academic programs in Biology in the form of remedial theory and practical lessons. Teachers hardly participated in teacher PD activities that are usually designed to enhance teacher effectiveness. Consequently, teacher participation in PD activities and programs had minimal contribution to BIP. Besides IS in most schools being considered as above average, inferential analysis indicated that IS has no significant influence on BIP. It can therefore be concluded that IS has no significant influence on BIP.

5.3 Recommendations of the Study

The findings of this study indicated that besides IS all other selected factors which included language skills, attitude and utilization of IR influence BIP. Findings further illustrated a positive association between the selected factors and effectiveness of BIP. Based on the findings, the study makes the following recommendations.

i. Biology teachers should partner with English language teachers and devise a plan to integrate language development activities to improve language skills of students.
ii. Biology teachers should use varied teaching methods to demystify complex Biological terms and concepts to enhance learning.
iii. Biology teachers should enhance utilization of both conventional and improvised resources to enhance lesson delivery and overall effectiveness of the BIP. Biology teachers should also incorporate community resources where feasible to provide students with real-world learning experiences.
iv. The Ministry of Education in conjunction with School administration should facilitate regular and comprehensive teacher PD programs for Biology teachers. The school administration should also establish mechanisms to monitor implementation of recommended practices of formative evaluation in Biology

and sensitize Biology teachers on the importance of conducting formative evaluation.

5.4 Suggestions for Further Studies

Based on the findings from this study, several suggestions for further research on Biology instructional process include:

i. The current study found out that Biology teachers underutilized IR in Biology instruction. Future studies should investigate barriers to the utilization of instructional resources.

ii. Future studies should investigate teachers' perceptions and practices regarding formative evaluations and how they can be supported to enhance their assessment strategies.

iii. Conducting comparative studies in different regions to determine whether similar patterns exist between the influence of selected factors on BIP to identify region-specific challenges and solutions.

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APPENDICES

Appendix I: Consent Form

Dear Respondent,

Re: Consent Form

I am a student at Chuka University taking a Master's degree in Science Education. I intend to carry out research as one of the requirements for the award of a degree in Masters of Education in Science Education. My research topic is; **Influence of Selected Factors on Biology Instructional Process in Secondary Schools in Imenti-Central Sub-County, Meru County, Kenya**

This research has been approved by Chuka University Ethics Review Board ensuring that it meets ethical standards and poses no danger to you. Your identity will remain anonymous if you choose to participate in this study and the information obtained will remain confidential and will only be used for this study.

You are kindly requested to participate in this study. Kindly note that your involvement in this study is voluntary and you have the liberty to withdraw at any stage in the course of the study without any obligation. If you agree to participate, please indicate your consent by signing in the space provided.

Your cooperation is greatly appreciated.

Yours faithfully,
Mukiri Naomi.
(Researcher)

Sign ……Date …….

Appendix II: Questionnaire for Biology Teachers.

The following questions intend to obtain information on factors that influence the teaching and learning of Biology in your school. Please provide honest responses to all the questions. Your willingness and cooperation to participate in this exercise is highly appreciated.

Section I: Background Information

1. Indicate your response by a tick (√) against the appropriate box.
2. What is your Gender? Male **[ ]** Female **[ ]**
3. What is your age? Below 30 years **[ ]** 30 – 50 years **[ ]** Above 50 years **[ ]**
4. What is your highest level of education?

   Diploma **[ ]** Degree **[ ]** Master's **[ ]** PhD **[ ]**

   Others, Specify_____
5. What is the category of your school based on:
   - **a)** Classification: County **[ ]** Sub-county **[ ]**
   - **b)** Accommodation: Day **[ ]** Boarding **[ ]** Day & Boarding **[ ]**
   - **c)** Gender: Boys only **[ ]** Girls only **[ ]** Mixed **[ ]**
6. How many years have you taught Biology? Below 5 years **[ ]** 5-10 years **[ ]** above 10 years **[ ]**
7. Have you attended any refresher courses in Biology teaching? ____ if yes, which one___ if no, why

   _____

Section II: Biology Instruction

Biology instructional process is characterized by preparation, presentation and evaluation. On a scale of 1 to 5, indicate using a tick (√) to show the extent to which you undertake each of the following activities during the instructional process. Key: 1=Never, 2= Rarely, 3=Sometimes, 4= Often, 5= Always

Biology instructional process activities					
During Preparation of Biology lessons: I:	**5**	**4**	**3**	**2**	**1**
Identify learning objectives					
Select relevant and appropriate content					
Source for relevant instructional resources					
Identify suitable instructional methods to deliver the content					
Choose an appropriate assessment method					
During presentation, I:	**5**	**4**	**3**	**2**	**1**
Engage students actively throughout the lesson					

Guide students in handling and manipulation of materials					
Facilitate students in undertaking group activities such as discussions					
Give students opportunities to ask questions and seek clarification					
To evaluate learning, I:	**5**	**4**	**3**	**2**	**1**
Give assignments daily					
Organize Biology practicals weekly.					
Mark and return assignments promptly					
Facilitate correction of assignments.					

Section III: Language Skills

On a scale of 1 to 5, indicate using a tick (√) the extent to which the following aspects of the language skills contribute to Biology instruction as per the following statements. Key; 1=No extent, 2= Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent.

English Language; the ability of learners to:	**5**	**4**	**3**	**2**	**1**
Read correctly Biological concepts written in English					
Write accurately Biological concepts in English					
Speak fluently in English					
Comprehend Biological content presented in the English language					
Language of Biology; the ability of learners to	**5**	**4**	**3**	**2**	**1**
Read Biological terms correctly					
Write Biological terms correctly					
Speak Biological content containing Biological terms fluently					
Comprehend Biological terms					
Indicate the extent to which students' proficiency in the following aspects of Mathematical concepts and skills contributes to Biology instruction	**5**	**4**	**3**	**2**	**1**
Drawing Biological graphs					
Interpreting Biological graphs					
Interpreting quantitative data					
Drawing conclusions based on data					

Section IV: Attitude

On a scale of 1 to 5, indicate using a tick (√) the extent to which you agree with the following statements. Key: 1=No extent, 2= Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent.

Statements : my students ;	**5**	**4**	**3**	**2**	**1**
Performance in Biology meets my expectations					
Can integrate knowledge from different areas of Biology					
Competent in conducting Biology experiments					
Self-motivated to learn Biology					
Analyze Biological data effectively					

Can explain complex Biological effectively					
Are able to apply Biological knowledge in real-life situations					
Have the potential to excel in Biology.					
Enjoy Biology lessons					
Select Biology because it is an easier alternative among optional science subject					
Believe Biology is a difficult subject					
Believe Biology is relevant to their lives					
Are always curious about biological concepts and phenomena					
Attitude towards Biology is influenced by their peers					
Fail Biology because they have a negative toward Biology					

Section V: Utilization of instructional resources

On a scale of 1 to 5, indicate using a tick (√) the extent to which you use the following instructional resources in Biology instructional process. Key: 1=No extent, 2=Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent.

Statements					
Conventional Resources	**5**	**4**	**3**	**2**	**1**
Computers					
Projectors					
Laboratory apparatus e.g. microscopes					
Laboratory reagents					
Real objects					
Charts					
Models					
Educational websites					
Educational You-tube channels					
Community Resources	**5**	**4**	**3**	**2**	**1**
Resource persons e.g. doctors					
Agricultural shows to study genetics					
Forests to Study Ecology					
Rivers/swamps to study ecology					
Cultural artifacts e.g. bones, animal skin					
Improvised Resources	**5**	**4**	**3**	**2**	**1**
Teacher-made charts					
Teacher-prepared videos					
Teacher-prepared models					
Drawings					
Teacher prepared photographs					

Section VI: Institutional Support

On a scale of 1 to 5, indicate using a tick (√) the extent to which the following aspects of institutional support contribute to Biology instruction in your school. Key: 1=No extent, 2=Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent.

Statements					
Teacher Professional Development activities	**5**	**4**	**3**	**2**	**1**
Mentorship programs					
Peer Observation and Feedback					
ICT Training					
Assessment and Evaluation Workshops					
Academic Support Programs in Biology.	**5**	**4**	**3**	**2**	**1**
Remedial practical lessons					
Remedial theory lessons					
Field trips to wildlife reserves					
Talks from Biology experts					
Rewarding top achievers in Biology					
Rewarding teachers for students' good performance in Biology					

Appendix III: Students' Questionnaire

The following questions intend to obtain information on factors that influence the teaching and learning of Biology in your school. Please provide honest responses to all the questions. Your willingness and cooperation to participate in this exercise is highly appreciated.

Section I: Demographic Information

Please tick where appropriate

1. What is your Gender? Male **[ ]** Female **[ ]**
2. What is your age? _____
3. What is the category of your school based on:
    a) Classification; County **[ ]** Sub-county **[ ]**
    b) Accommodation: Day **[ ]** Boarding **[ ]** Day & Boarding **[ ]**
    c) Gender: Boys only **[ ]** Girls only **[ ]** Mixed **[ ]**
4. What was your KCPE grade/marks in the Science subject in primary school? _____
5. What was your grade in Biology in the last end-of-term examination? _____

Section II: Biology Instruction

On a scale of 1 to 5, indicate using a tick (√) the extent to which Biology Teacher conducts the following activities. Key: 1=Never, 2= Rarely, 3=Sometimes, 4= Often, 5= Always

Biology instructional process activities	**5**	**4**	**3**	**2**	**1**
During Biology lessons, our Biology teacher;					
Encourages active participation throughout the lesson					
Guides us on handling and manipulation of learning materials					
Monitors group activities we undertake					
Gives us opportunities to ask questions and seek clarification					
Evaluation; our Biology teacher					
Gives us assignments daily					
Organizes Biology practicals weekly.					
Marks and returns assignments promptly					
Facilitates correction of assignments.					

Section III: Language Skills

On a scale of 1 to 5, indicate using a tick (√) the extent to which the following aspects of the language skills contribute to Biology instruction as per the following statements. Key: 1=No extent, 2=Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent.

English Language; my ability to;	**5**	**4**	**3**	**2**	**1**
Read correctly Biological concepts written in English					
Write accurately Biological concepts in English					
Speak fluently in English					
Understand Biological content presented in the English language			`		
Language of Biology; my ability to;	**5**	**4**	**3**	**2**	**1**
Read Biological terms correctly					
Write Biological terms correctly					
Speak Biological content containing Biological terms fluently					
Comprehend Biological terms					
Indicate the extent to which your ability in the following aspects of Mathematical concepts and skills contributes to Biology instruction	**5**	**4**	**3**	**2**	**1**
Drawing Biological graphs					
Interpreting Biological graphs					
Interpreting quantitative data					
Drawing conclusions based on data					

Section IV: Attitude

On a scale of 1 to 5, indicate using a tick (√) the extent to which you agree with the following statements. Key: 1=No extent, 2=Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent.

Statements	**5**	**4**	**3**	**2**	**1**
Biology is an easy subject					
My future career depends on Biology knowledge.					
Biology knowledge improves the quality of our lives					
I enjoy Biology lessons					
I selected Biology because it is an easier alternative among optional science subject					
I frequently study Biology on my own					
I can perform well in Biology					
I fail Biology because I have a negative attitude toward Biology					
Our teacher enjoys teaching us Biology					
Our Biology teacher believes we can perform well in Biology					

I like my Biology teacher					
I like how our Biology teacher teaches us					
Our Biology teacher speaks negatively about aspirations of students who perform poorly in Biology					
Our Biology teacher encourages us to develop a positive attitude toward Biology					
Our Biology teacher guides us on how to improve our performance in Biology					

Section V: Utilization of instructional resources

On a scale of 1 to 5, indicate using a tick (√) the extent to which your Biology teacher uses the following instructional resources during Biology lessons. Key: 1=No extent, 2=Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent.

Conventional Resources	**5**	**4**	**3**	**2**	**1**
Computers					
Projectors					
Laboratory apparatus e.g. microscopes					
Laboratory reagents					
Real objects					
Charts					
Models					
Educational websites					
You-tube to learn Biology					
Community Resources	**5**	**4**	**3**	**2**	**1**
Resource persons e.g. doctors					
Agricultural shows to study genetics					
Forests to Study Ecology					
Rivers/swamps to study ecology					
Cultural artifacts e.g. bones, animal skin					
Improvised Resources	**5**	**4**	**3**	**2**	**1**
Teacher-made charts					
Teacher-prepared videos					
Teacher-prepared models					
Drawings					
Teacher prepared photographs					

Section VI: Institutional Support

On a scale of 1 to 5, indicate using a tick (√) the extent to which the following academic support programs contribute to the learning of Biology in your school. Key: 1=No extent, 2=Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent.

Academic Support Programs in Biology.	**5**	**4**	**3**	**2**	**1**
Remedial practical lessons					

Remedial theory lessons					
Field trips to wildlife reserves					
Talks from Biology experts e.g. examiners					
Rewarding top performers in Biology					

Appendix IV: Interview Schedule for Biology Head of Subject

Instructions: This interview schedule seeks your view on the influence of the selected factors on Biology instructional process. Please provide honest responses based on your experience and insight as a Biology Head of Subject. Your response is highly valued and it will be kept confidential and anonymous.

1. How many years have you been acting as Biology Head of Subject? _____

2. What is the trend of performance in Biology in KCSE at your school in the last five years? [Probe for factors contributing to this trend of performance].

_____

3. How do Biology teachers conduct lesson preparation, presentation and evaluation? (Probe for activities that take place during preparation presentation and evaluation).

_____

4. How does learner's language skill in reference to LoI influence Biology instruction? [Probe for students' understanding, engagement and performance].

_____

5. How does the attitude of Biology teachers and students influence Biology instructional process?

_____

6. Do teachers incorporate instructional resources in the teaching and learning process? [Probe for resources frequently used conventional resources, improvised resources and community resources].

_____

7. How does institutional support influence the teaching and learning of Biology? [Probe for leadership style and academic support programs]

_____

8. What should the following stakeholders do to enhance the performance of Biology?

School administration_____

Teachers_____

Students_____

Appendix V: Research Approval Letter

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

OFFICE OF THE DIRECTOR
BOARD OF POSTGRADUATE STUDIES

Telephones: 020-2310512/18
Direct Line: 020-268 7625
postgraduate@chuka.ac.ke
P. O. Box 109-60400, Chuka
Website: www.chuka.ac.ke

REF: EM13/51314/21

4th April, 2024

Director
National Commission for Science Technology and Innovation
Off Waiyaki Way, Upper Kabete
P O Box 30623, 00100
Nairobi.

Dear Sir / Madam,

MUKIRI NAOMI

The above-named person is a *bona fide* student of Chuka University pursuing MED in Science Education proposal titled**: Influence of Selected Factors on Biology Instructional Process in Secondary Schools in Imenti-Central Sub-County, Meru County, Kenya**

Ms. Mukiri has defended at the Faculty level and is now expected to conduct research.
Any assistance accorded will be highly appreciated.

Yours sincerely,

04 APR 2024

Prof. Moses Muraya, Ph.D.

DIRECTOR
BOARD OF POSTGRADUATE STUDIES

Appendix VI: Ethics Review Board Approval Letter

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

CHUKA UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE

Telephones: 020-2310512/18
Direct Line: 0772894438
Email: info@chuka.ac.ke,
P. O. Box 109-60400, Chuka
Website: www.chuka.ac.ke

19th March, 2024

REF: CUIERC/ NACOSTI/480
TO: **Naomi Mukiri**

RE: Influence of Selected factors on Biology Instructional Process in Secondary Schools in Imenti-Central Sub-County, Meru County, Kenya

This is to inform you that *Chuka University IERC* has reviewed and approved your above research proposal. Your application approval number is *NACOSTI/NBC/AC-0812.* The approval period is 19th March, 2024 – 19th March, 2025.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by *Chuka University IERC.*
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *Chuka University IERC* within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to *Chuka University IERC* within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to *Chuka University IERC.*

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

Dr. Benjamin Kanga
SECRETARY

Appendix VII: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **303993**

Date of Issue: **13/April/2024**

RESEARCH LICENSE

This is to Certify that Ms.. MUKIRI NAOMI NAOMI of Chuka University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Meru on the topic: INFLUENCE OF SELECTED FACTORS ON BIOLOGY INSTRUCTIONAL PROCESS IN SECONDARY SCHOOLS IN IMENTI-CENTRAL SUB-COUNTY, MERU COUNTY, KENYA for the period ending : 13/April/2025.

License No: **NACOSTI/P/24/34582**

303993

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