

Research Article

# Influence of Language Skills on Biology Instructional Process in Secondary Schools in Kenya

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## Abstract

Biology as a core science subject enables learners to conceptualize fundamental concepts such as genetics, evolution and cellular processes that underpin all living entities. Biological knowledge is also applied in addressing global challenges in fields such as medicine, agriculture and biotechnology. However, despite its significance, there has been a dismal performance in Biology in the country and Imenti-Central Sub-county for the last five years. Student performance in the subject not only depends on content mastery but also on language proficiency. Language serves as a primary medium for communicating the subject matter making good language skills essential for comprehension and expression of Biological content. However, minimal research has been conducted on the influence of language skills on Biology instructional process thus the need to undertake this study. The study investigated the influence of language skills on Biology instructional process in secondary schools in Imenti-Central Sub-county, Meru County, Kenya. A descriptive research design was adopted for data collection and analysis. The study sampled 352 participants from a population of 2950 participants using Yamane's formula. Data was collected using questionnaires and interview schedules. Qualitative data was analyzed thematically while 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 computer software. Findings indicated that language skills had a significant influence on Biology instructional process. Students' language skills were therefore essential for effective Biology instruction. 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.

## Keywords

Biology Instructional Process, Language Skills, English Language, Language of Biology, Language of Mathematics, Public Secondary Schools

## 1. Introduction

Science education is a vital enterprise for any nation to advance industrially. It equips learners with scientific knowledge, skills and attitudes that are vital for survival and progress as an individual and society at large [1]. 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 [2]. In most countries globally, science education has evolved into a dynamic and multidisciplinary field referred to as Science, Technology, Engineering and Mathematics (STEM). In the United States of America (USA), the

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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 [3]. Within the science domain, Biology as a subject built on the foundation of biological sciences, refers to the scientific study of living organisms and their interactions with their environments [4]. The study of Biology imparts biological literacy thereby developing and enhancing the understanding of learners to apply biological knowledge and skills in a real-life situation [5]. Therefore, Biology education enables learners 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 Development and Education and (ECDE) to tertiary levels. Most education systems embed Biology education in the science curriculum in early or primary education. In New York, physical science, earth or space science and life science constitute primary school science [6]. At this level, learners are taught biological knowledge in life science where they acquire knowledge about living things and nature. Biology education during the early school years introduces learners to biological concepts and stimulates biological thinking [7]. 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. Biology exists as a distinct subject domain at the secondary school level where learners are exposed to advanced levels of biological knowledge [8]. This enables them to understand the complexity of plant, human and animal life forms. Biology education taught in secondary school equips learners with biological knowledge, skills and attitudes to solve problems that threaten human existence such as diseases and hunger [9]. This means that Biology education in secondary school level prepares learners 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 [10]. This phase is meant to ensure that the teacher is adequately prepared to meet the expectations of the instructional process. Preparation is proceeded by presentation where teachers employ various pedagogical

methods and approaches to facilitate learning [11]. At this stage, methods such as lectures, teacher demonstration, multimedia presentations and hands-on-activities are employed to facilitate knowledge transfer. The teacher also has to ensure that learners actively interact both with the content and resources. 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 [12]. As such evaluation enables teachers to determine the success and shortcoming of the instructional process which consequently reflects its effectiveness. It also provides the teacher with an opportunity to assess the effectiveness of resources selected in meeting the lesson objectives. The feedback is useful for planning areas of improvement in succeeding lessons. This means that an effective instructional process should be characterized by appropriate planning, presentation and evaluation which is in turn reflected in satisfactory performance.

An effective BIP depends on effective communication between teachers and students with language as a tool for constructing and conveying meaning of Biological concepts. Language literacy in Biology classrooms is therefore necessary to enable learners to be fully engaged in the teaching and learning process [13]. Language skills which include listening, speaking, reading and writing form the basis for intellectual growth [14]. Good language skills in reference to the Language of Instruction (LI) are therefore essential for comprehension and expression of Biological content. This means that learners' language skills determine the extent to which they comprehend the subject matter. In the context of this study, LI constitutes three aspects namely: the language used to deliver Biology content, subject-specific language which in this study refers to the Language of Biology (LB) and Mathematical concepts and skills that are incorporated in Biology instruction.

Most education systems primarily use English language as a medium of instruction, instruction of science subjects included [15]. However, adoption of English language as a medium of instruction in science poses learning difficulties to English language learners [16]. Existing literature globally and regionally illustrates challenges learners experience during the instructional process. In Sri Lanka, fluency in English language correlates positively with students' academic performance in Biology [17] implying that learners proficient in the language excel in the subject with the converse also being true. Adoption of English language as a medium of instruction in Rwanda limits participation in class discussion among learners who are yet to master the language [18]. Tawfik further adds that limited knowledge of English grammar and vocabulary affects learners' ability to effectively communicate Biological concepts orally and in written examinations [19]. Findings from existing literature therefore underscores the role played by learners' language skills in

reference to English language as medium of instruction in Biology. Challenges that learners face due to English as a LI is attributed to how and when they get introduced to the language, some learners being referred to as native language users while others as second language or non-native language users.

Language of Biology (LB) refers to domain specific language that is peculiar to Biology and aids in conceptualization of Biological concepts. It comprises specialized terminologies, vocabulary and signs used by Biologists to communicate Biological phenomena, concepts, theories and processes [20]. Learning the language of Biology and science in general provides learners with different tools to communicate scientific ideas [21]. This implies that students are expected to grasp technical terms in Biology for meaningful learning and coherent exchange of scientific information. LB also consists of Biological terms of Latin origin which learners from non-Latin linguistic backgrounds experience difficulties in understanding [19]. Students also perform poorly in Biology due to poor language skills evidenced by limited Biological vocabulary, mother tongue interference and misinterpretation of questions [22]. Misconceptions in Biology and poor output may therefore be attributed to students' poor language skills in reference to LB.

Biology entails processes and phenomena which require application of Mathematical concepts and skills. As such learner's mastery of Mathematical language and skills incorporated in Biology is essential for effective communication of Biological content. In Spain, students learning Biology related-courses demonstrate persistent weakness in answering questions that require application of mathematical skills such as calculation and graphs [23]. Brewer and Smith further underscore the importance of learners' competency in applying Mathematical tools and techniques in Biology to aid in understanding of Biological phenomena such as genetic inheritance [24]. Nursing students in Australia exhibit errors when calculating drug concentrations implying that students' competency in Mathematics contributes to interpretation of Biological phenomena that incorporates Mathematical concepts and skills [25]. Existing literature underscores the role of language proficiency in comprehending and articulating Biological concepts during instruction. However, these studies are foreign-based and may not provide the true picture of the influence of language skills on BIP in Kenyan Secondary schools particularly in Imeni-central sub-county, Meru County. This study therefore sought to establish the influence of language skills on Biology instructional process in an attempt to contribute in providing the Kenyan picture.

## 2. Literature Review

Language is a medium through which organized refined thoughts are expressed to facilitate transmission of the intended message to the recipient [26]. 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 [14]. 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 [13]. 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 Imeni-Central schools. In this context, the focus is on learner's language skills in reference to the language of instruction in Biology.

The LI 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), a majority of learners are taught using a second language due to the global mobility of students and international migration [27]. 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 [15]. However, students whose first language differs from the LI face difficulties in science subjects [28]. 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. LB is composed of specialized terminology, vocabulary and communication conventions used by Biologists to describe, explain and discuss scientific processes, concepts, theories and phenomena [29]. The specialized vocabulary and technical terms used by scientists and experts in the field of Biology is often in the form of scientific English [30]. LB also includes technical terms of Latin origin which may present a challenge for students, especially those from non-Latin linguistic backgrounds [19]. Existing literature indicate that scientific English commonly incorporates both standard and technical terms of Latin origin that Biology learners ought to master during the instructional process. Learners' proficiency in LB is therefore essential for effective teacher-student interactions and peer discussions, allowing for precise and coherent exchange of biological

information during the instructional process.

Instruction in Biology also integrates concepts and skills from other STEM disciplines such as Mathematics and Chemistry. For instance, Biology consists of quantitative data in fields such as genetics and ecology, whose analysis and interpretation require the application of mathematical skills and concepts [31]. This means that Mathematical tools and techniques enable students to make sense of complex biological phenomena such as population dynamics and genetic inheritance [24]. 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 students struggle with the mathematical components of Biology, it may limit their understanding and engagement with the subject. Relevant skills from fields such as mathematics, computer science and chemistry are therefore vital for understanding and manipulating biological data. Overall, proficiency in the three aspects of LI cannot be overlooked since they contribute to the learning of Biology. In this light, this study focused on the relationship between learners' language skills in the three aspects of LI 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 carried out a study on the integration of language and content in Biology classrooms for non-native English speakers in North America [19]. 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 learners' 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 have many scientific vocabularies that are difficult to understand. The study revealed that English language learners 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.

Hadi-Tabassum underscored the role of language proficiency among English language learners in science classrooms [32]. The study pointed out that English language learners experienced difficulties in grasping complex scientific concepts where technical vocabulary, abstract concepts and complex sentence structures were prevalent. According to the study learning difficulties were as a result of limited English vocabulary and language barrier. In response to the findings, the study advocated incorporation of visual aids to address learning needs among English language learners. The study further recommended adoption of instructional approaches that integrate language and content learning to

ensure that language barriers do not impede students' comprehension and engagement with scientific concepts. Findings of the study highlight language proficiency as fundamental concept of effective instruction in science classrooms. Study finding forms the basis to explore language skills and Biology instruction in Kenyan Secondary schools since English language which is used as a medium of instruction is a second language among majority of students [33].

To remedy poor performance, Thayamathy evaluated factors affecting the academic performance of undergraduate students in the faculty of Science Eastern University, Sri Lanka [17]. 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 provide an insight into how proficiency in language of instruction affects students' performance in Science subjects. However, it mainly focused on student performance and not the instructional 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.

In Spain, Llamas studied the relationship between Mathematical concepts and skills and learning of Biology-related courses at the tertiary level [23]. 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 who pointed out that nursing students in Australia exhibited mathematical errors in calculating drug concentrations [25]. 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 and Eastwood focused on Mathematical skills and Biology instruction at the University level, there is a need to focus on learners' proficiency in Mathematical language skills incorporated in secondary school Biology.

Oyekan studied teachers' perception of the relationship between language competency and academic performance in Biology among Senior School Certificate students in Nigeria [22]. The 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. Findings showed that proficiency in the language of instruction enhanced understanding of concepts and promoted communication and presentation skills in the description and application of Biological concepts day to day life. Findings further revealed that poor language skills negatively influenced learners' motivation to learn Biology. Though providing useful findings,



this study mainly focused on 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.

In South Africa, Ferreira adopted a qualitative research design to investigate the influence of the English language in teaching life sciences in [34]. Findings revealed that learners with low comprehension of the English language failed to grasp biological concepts being taught. This shows that the use of the English language as a medium of instruction may create challenges for non-native English speakers. Learners 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 that does not provide statistical representation. This study sought to supplement the qualitative data findings by incorporating quantitative research design to generate quantitative data that established the degree of the influence of the language skills on Biology instructional process.

In the East African context, Ahmed conducted a case study to determine problems faced by high school students when learning speaking skills in Sudan [35]. 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, learners 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. Findings underscore the need for learners' competency in writing, listening, speaking and reading domains in reference to the language of instruction for effective instruction in Biology.

Hakorimana studied relationship between English language skills and academic performance of students in public secondary schools in Rwanda [18]. Data analysis gave a correlation coefficient of 0.874 which revealed a positive relationship between learners' proficiency in English as the LI and student academic performance. The study revealed that instruction in the English language was difficult for some students who had 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 highlight the importance of learners' proficiency in the language used as a medium of instruction. As such poor language skills in the LI 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 learners predominantly communicate using their mother tongue before they start schooling [33]. This means that English language is a second language that most learners mainly encounter in a school setup. Learners at the primary and secondary school levels in Kenya demonstrate poor mastery of English language which hinders effective learning [36]. This shows that proficiency in the language of instruction is required for subject matter conception in all education levels. Karwitha studied the relationship between literacy and numeracy and achievement in Science Subjects in Kenya Certificate of Secondary Education (KCSE) [26]. Numeracy skills were reflected by performance in Mathematics while literacy skills were reflected by Kiswahili and English grades in KCSE. Data analysis revealed that numeracy and literacy skills have 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 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 in Mombasa County, Kenya [37]. The study focused on language skills in English as the language of instruction and learner's proficiency in language of Mathematics. Findings revealed that learners' ability to read, write, listen and speak predicted their ability to master the language of Mathematics. Learners 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 learners must be proficient in the language of instruction to understand subject-specific language which ultimately enhances their 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, the current study focused on the relationship between proficiency in the language of instruction and Biology instructional process in Imenti-Central, Meru County.

### 3. Theoretical Framework

The study was anchored on Lev Vygotsky's (1979) Social cultural theory which 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 learners' cognitive development is not a solely innate process, rather, it is influenced by their social and cultural environments [38]. Two concepts were put forth to explain the Social Cultural theory: Zone of Proximal Development (ZPD) and Scaffolding. ZPD refers to the gap between learners' 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 learners are challenged to work on their ZPD. Scaffolding on the other hand refers to the support and guidance provided to aid learners in actualizing their potential in their ZPD. This support is gradually reduced as learners 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 [39]. Language serves as a primary tool in the scaffolding process by enabling learners 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. Language is therefore a vital tool through which cognition is developed, culture is transmitted and social interactions are mediated.

Vygotsky's Social cultural theory was adopted in the context of this study to provide a comprehensive framework for understanding and analyzing language skills in reference to Biology instruction. This theory underscores the role of language in cognitive development. Language mediates learning during the instructional process by facilitating communication, clarification of complex concepts and enabling students to articulate their understanding [32]. Language skills play a vital role in navigating students' ZPD. During presentation stage, Biology teachers use language to facilitate learning to enable students actualize their potential in their ZPD. This may be through explaining Biological concepts in simpler forms, using analogies or engaging in dialogue to aid in conception of subject matter [40]. Besides language acting as a communication tool, it also shapes students' thought process. During assessment, language skills particularly writing enable students to articulate concepts being assessed to provide information on the extent to which students have actualized their potentials with their ZPD. Speaking, listening, reading and writing enable students to organize their thoughts, make sense of complex information and develop a deeper understanding of subject matter [41]. This shows that students' language skills in reference to the language of instruction influences comprehension and engagement with the subject

matter consequently facilitating or hindering learning. Vygotsky's Social cultural theory highlights language as a fundamental part of the instructional process which provided a framework to establish how the language skills influenced the Biology instructional process.

## 4. Methodology

The study adopted a descriptive survey design to explore the existing state of learners' language skills, regarding Biology instructional process. The study population comprised 95 Biology teachers, 2806 form three Biology students and 49 Biology Heads of Subject (HOS) from 49 public secondary schools in Imenti-Central. A sample of 352 respondents was obtained from the target population using Yamane's formula. The sample comprised 302 form three Biology students, 8 Biology HOS and 40 Biology teachers. Data was collected using questionnaires and interview schedule. Interview schedule gathered qualitative data from Biology HOS while questionnaires collected quantitative data from Biology teachers and students. Qualitative data was analyzed thematically as per the study objectives while 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 (SPSS) version 26 computer software.

### 4.1. Research Hypothesis

The study was guided by the following hypothesis:

H<sub>01</sub>: There is no statistically significant influence of learners' language skills on Biology instructional process in Imenti-Central sub-county, Meru County.

### 4.2. Study Variables

The following variables were utilized in the study: the extent to which language skills contributed to Biology instruction was assessed using a set of twelve Likert scaled statements where 1=No extent, 2=Little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent. Reliability of questionnaire items was tested using Cronbach's alpha. The variable obtained a reliability index of 0.701 which was within the acceptable threshold and therefore all the variable elements were adopted for further analysis.

## 5. Results and Discussion

This study sought to determine the influence of learners' 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 Mathematical skills incorporated in Biology instruction. Findings obtained from students are summarized in Table 1.

**Table 1.** 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 from students show that a majority of students (74.1%) believe in their ability to speak fluently in English, their ability to write accurately Biological concepts in English (71.8%), ability to understand biological content (69.8%) and read correctly biological concepts written in English (67.8%) contribute 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 contributes to learning of Biology to a great and a very great extent. It implies that students believe that proficiency in English language skills is an important contributor to students' success in the subject.

Data on language skills in LB 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%) believe that their language skills in regard to LB contributes to their learning of Biology to a great and very great extent. Information on Mathematical concepts and skills 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%) believe that Mathematical concepts and skills incorporated in Biology contribute 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 LI (63.1%) contribute 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 2.

**Table 2.** 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

Statement	Teachers (N=40)					
	NE %	LE %	ME %	GE %	VGE %	Total %
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%) contribute to BIP to a great and very great extent. This shows that teachers believe that students' proficiency in English language skills (61.2%) contribute to BIP to a great and very great extent. In regard to language skills in the LB, 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%) point out that students' ability to read, write, speak and understand Biological terms contributes 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 LI contribute to BIP to a great and very great extent. Descriptive data indicates that most students (70.9%) and teachers (63.1%) agree that proficiency in English language contributes to BIP to a great extent or very great extent. It implies that they believe that proficiency in English language is an important contributor to students' success in the subject. Findings suggest that students should have good mastery of English language for effective learning in Biology because language literacy in Biology classrooms is necessary to enable learners to be fully engaged in the

teaching and learning process through reading, writing, listening and speaking [13]. According to the researchers, learners' 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 contributes to BIP to a great and very great extent. Findings implies that students should be conversant with LB for an effective instructional process. The findings are in line with Fang who indicated that learners should be proficient in technical terms used in Biology to aid in describing, explaining and discussing scientific processes, concepts, theories and phenomena [29]. 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 and skills incorporated in Biology contributes greatly to BIP. Findings suggest 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 nursing students in Australia who exhibited errors in calculations of drug concentration [25]. This finding is in agreement with findings by Brewer who stressed the need to foster quantitative competencies in mathematical skills that aid in manipulation, analysis and interpretation of Biological data [24].

Data obtained from the study was cross-tabulated to establish the relationship between language skills and appropriateness of the BIP. Table 3 presents a summary of the findings.



**Table 3.** 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

Cross-tabulated information 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' lan-

guage 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 therefore suggests that there is 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 4.

**Table 4.** 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 <sup>a</sup>	1	0.000			0.444
Continuity Correction <sup>b</sup>	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  $\chi^2(1) = 73.928$ ,  $p < 0.001$  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 influences Biology instructional process with language skills contributing to 44% of total variance in BIP. This led to the rejection of the hypothesis,  $H_01$  which stated that there is no statistically significant influence of learners' language skills on Biology instructional process in Imenti-Central sub-county, Meru County. Findings show that a student's language skills significantly influence Biology instructional process implying that students with good language skills would contribute posi-

tively thus promote the process while those with inferior language skills would contribute in the reverse. A study in North-America denoted the need for students' language proficiency to enhance learning of Biology at the presentation and evaluation stage [19]. Related findings of a Nigerian study undertaken by Oyekan 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 [22].

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, LB and Mathematical language. The qualitative findings are in agreement with Ferreira who revealed that learners found biological terms unfamiliar which made it difficult to master and comprehend the terminologies [34]. Poor language skills in reference to English language hindered learners' participation in classroom discussions [18]. In Kenya, Karwitha indicated the importance of literacy skills in Biology [26]. Generally, the scholars underscore the importance of good language skills in the three aspects of LI for effective BIP.

## 6. Conclusion and Recommendations

The study sought to establish 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 students' language skills play a critical role in effective Biology instruction. It illustrated that language skills influence BIP. It also illustrated a positive association between the language skills and effectiveness of BIP. Based on the findings, the study makes the following recommendations.

Biology teachers should partner with English language teachers and devise a plan to integrate language development activities to improve students' language skills.

Biology teachers should use varied teaching methods to demystify complex Biological terms and concepts making them easier to understand.

## Abbreviations

BIP	Biology Instructional Process
ECDE	Early Childhood Development and Education

	Centre
GPA	Grade Point Average
HOS	Head of Subject
KCSE	Kenya Certificate of Secondary Education
LB	Language of Biology
LI	Language of Instruction
SPSS	Statistical Package for the Social Sciences
STEM	Science, Technology, Engineering and Mathematics
UNICEF	United Nations Children's Funds Report
USA	United States of America
ZPD	Zone of Proximal Development

## Conflicts of Interest

The authors declare no conflicts of interest.

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