

Utilization of instructional materials in supporting biology learning in Tanzania

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Abstract. Teachers' utilization of instructional materials during the learning endeavour is widely recognized to enhance learners' active engagement for effective learning. This paper explored the extent to which teachers utilize the instructional materials during the Biology lessons. A total of 176 students and 42 Biology teachers responded to the questionnaires and were involved in the classroom observations during data collection. Frequency means and standard deviations of the extent of utilization of instructional materials during the Biology lessons, as well as preferences, were calculated and presented in tables. Textbooks were more frequently utilized over laboratory apparatus and digital appliances such as projectors, computers, tablets, and radios. Relying solely on the utilization of mainly print instructional materials over other categories of instructional materials limits students' active interaction and thus impedes effective learning. We recommend investment in teachers' in-service training programs to enhance the utilization of a wide range of instructional materials.

Keywords: utilization, instructional materials, Biology lessons, in-service programs

1. Introduction

For efficient teaching and meaningful learning, the use of instructional materials is crucial in the educational industry [6]. Enhancing students' ability to create meaning, identify patterns, and relate to the outside world during the learning process, students have to be provided with the opportunity to interact with the instructional materials [35]. The instructional materials are used to engage learners for effective teaching that can facilitate positive student learning outcomes [10]. The effective utilization of a wide range of instructional materials enhances students' thinking, makes teaching and learning of Biology subject interesting and concrete, motivates students to be persistent in learning, and encourages participation, which enhances learning achievement [3]. Efforts to improve teaching and learning to enhance students' achievement in Biology lessons, as stated in Sustainable Development Goal-4 (SDG-4), can be achieved by maximum and rational utilization of instructional materials during the learning endeavours. Goal number four targets ensuring all girls and boys complete a free, equitable and quality education. Therefore, for the students to acquire quality education, they have to utilize the instructional materials effectively during the lessons as stipulated in the curriculum.

Instructional materials can be classified into different categories. Amos, Eghan and Oppong [3] classifies instructional materials into five categories based on their characteristics. These categories include visual aids such as chalkboards, pictorial aids such as charts and graphics, mobile aids like slides, projected aids such as posters, and audio-visual aids such as video tape recorders. The study by Effiong and Igiri [6] classifies instructional materials as print materials, such as textbooks, and

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non-print materials, such as recording videos. Teachers' ability to understand these categories and their competencies in utilising them during teaching appropriately would definitely enhance learning. The call of the education administrators to recognise the potential of each category of these instructional materials would contribute to making them available in schools.

Instructional materials are conceived as an essential ingredient in learning even for those school subjects that are perceived as difficult by students, including Biology subject [12]. Moreover, Hadiprayitno, Muhlis and Kusmiyati [10] assert that it is practically impossible for a science subject like Biology to be taught without a wide range of instructional materials. This is due to the fact that most Biology concepts are too abstract. The abstractness of such subjects causes students difficulties such as a lack of ability to create concrete constructs in their cognition systems, misunderstanding theoretical components, and difficulties in using higher-order thinking skills in the learning process [16]. The utilization of a variety of instructional materials in learning Biology would then make the lesson more concrete and encourage students to think about effective learning.

Evidence that teachers often teach without including a wide range of instructional resources that offer a practical learning opportunity for students ends up with students losing interest in Biology and consequently perceiving the subject as a difficult subject [10]. In this learning situation, students become inactive in the learning and a record of low academic achievements when come to the tests and examinations [3, 5, 8]. Both developed and emerging nations experience low academic achievement. A serious shortage of teaching and learning resources has been found across Latin America, according to a study by Willms [36], which has a negative impact on academic achievement, especially for vulnerable pupils. Additionally, Isma'il and Lukman's [12] study in Nigeria clarified why students' academic performance in the biology topic is unimpressive in both internal and external exams: they did not meet the requirements for advanced study. This state of affairs was linked to the absence of laboratory facilities. However, Akungu [1] study in Kenya claims that the academic achievement of the kids on several tests is not up to par. The performance has stayed in the mean grade D range when it comes to the accessibility, suitability, and application of instructional materials.

The item response analysis for the Biology subject across various national exams in Tanzania reveals that the majority of students have got low scores on some topics such as Transport of materials in living things in form two, Nutrition in form two, and Classification of living things in all classes from form one to form four (table 1).

Table 1

Examples of the low performed Biology topics in CSEE in Tanzania (source: [27–32]).

Year	Topic examined	Students scored 30% and above	Students scored below 30%
2015	Transport of materials in living things	08.40%	91.60%
2017	Reproduction	04.51%	95.49%
2018	Classification of living things	11.90%	88.10%
2019	Transport of materials in living things	04.80%	95.20%
2020	Classification of living things	01.30%	98.70%
2021	Nutrition	07.87%	92.13%

The more students score less than 30% in a given question on a range of topics for six consecutive years. Though the topics seemed important for social and economic development, students' scores indicate that they are not learning despite their attendance in class. The concepts behind tested topics seemed to be difficult and

challenging for the students to comprehend (table 1). This record of poor academic attainment in Biology is caused by many factors, including the inappropriate utilization of instructional materials [16]. Candidate Item Response Analysis (CIRA) done by the National Examination Council of Tanzania (NECTA) recommends a wide range of instructional materials during the teaching of Biology to make topics interesting and more concrete and engage students in the thinking process [31]. The type and the extent of the utilization of the instructional materials would otherwise enhance the availability, monitoring, and support of teachers from the school administrators and other educational stakeholders.

Different initiatives have been established to ensure that the instructional materials for teaching and learning Biology subject are available and utilized in schools. The initiatives include the establishment of the Tanzania Institute of Education (TIE) under Act No. 13 of 1975 (CAP 142 R.E. 2002) to develop and make available instructional materials in schools. The TIE is also responsible for conducting in-service teacher education in the country. The Instructional materials that include textbooks have been supplied in schools TIE [26], and different in-service training programmes have been implemented by TIE [32]. Moreover, some researchers have developed different textbooks, such as language-supportive textbooks, to ensure meaningful learning of Biology subject [9].

Furthermore, the initiatives to establish science laboratories in each school in the country to ensure that students learn through hands-on activities to deepen their understanding of biology concepts have been documented. Evidence shows that between 2018 and 2019, the government built 165 science laboratories in different schools in order to improve academic performance [32]. Supporting teachers with digital devices, the Government of Tanzania decided to supply tablets for every teacher in all schools countrywide to ensure that even digital instructional materials are integrated into learning. Therefore, both digital and non-digital instructional materials are conceived as imperative in the teaching and learning process to ensure students' effective learning. This calls for research to be conducted in schools to establish the extent to which these instructional materials are utilized in teaching and learning Biology lessons.

Evidently, the underutilization of instructional materials is hypothesised to be linked to such low achievement as envisaged in table 1. The Candidates' Item Response Analysis (CIRA) that Biology teachers have to use various instructional materials for meaningful learning and to boost student performance for such topics with low performance [28]. The academic performance in Biology, specifically in some topics such as nutrition, classification, and the transport of materials in living things, is not encouraging, and this gives the impression that Biology is a challenging subject. Umuhoza and Uworwabayeho [34] insist that the students who learn by interacting with appropriate instructional materials perform better than those who taught without teaching aids. Therefore, it is imperative to study the extent of the utilization of instructional materials in teaching and learning Biology lessons.

2. Literature review

2.1. Instructional materials and its implication in teaching and learning

Instructional materials are print and non-print items that are utilized by the teacher as part of the instructional process to make the learning more interesting, enjoyable, memorable, and concrete [3, 6, 10]. Also, instructional materials can be defined as educational tools that are utilised to simplify teaching content, making learning more concrete and less abstract [3, 33]. These materials are crucial in the teaching and learning process of Biology for students to acquire basic science skills such as

observation, measurement, and experimentation. Biology teachers also use these instructional materials for demonstration and lesson organisation for effective teaching and meaningful learning [3].

According to Amos, Eghan and Oppong [3], when a good teacher plans a lesson, they choose, modify, and employ different instructional materials that align with students' needs and levels. These instructional materials motivate the students to learn, help in students' language development, make the lesson interesting and enjoyable, and boost the memory level of the students by making them reason critically in the learning process, which results in improved performance [3, 6, 8, 16]. Also, these instructional materials give the students a chance to use more than one sense organ, which makes them learn easily and quickly and makes them more active and engaged in the learning process, resulting in everlasting learning [3, 16]. Nevertheless, instructional material helps to change the concepts from abstract to concrete and makes students curious, so students learn more easily and understand the subject matter more quickly.

2.2. Classification of instructional materials

The educational industry comprises a lot of instructional materials that are critical to the facilitation of the learning process. To ease the identification of those instructional materials, researchers have categorized them into different classes. Most of the researchers categorize these instructional materials according to their perspectives. Ordu [21] classified instructional materials into two categories according to time periods. Conventional or traditional instructional materials. These materials include chalk and a blackboard. Another category is non-conventional or modern instructional materials, which include computers, television or radio, interactive whiteboards, and multimedia.

Ordu [21] classified them further into five categories based on the sense organ involved. These categories include audio-visual aids, which involve the senses of hearing and sight. The instructional materials involved in this category include DVDs. Visual aids include instructional materials that involve the sense of sight. These include illustrations, textbooks, and magazines. Audio aids, which involve the sense of hearing. These instructional materials include sound recordings from CDs. Another category is projected aid. These are the instructional materials that can be projected on the screen to give an enlarged image of the materials. These materials include PPT, slides, film strips, overhead projectors, and TV/VCR. The last category was non-projected aid. These are instructional materials that do not need a projection screen; rather, they are simply shown, hung, or touched. These materials include chalkboards, whiteboards, charts, posters, pictorial materials, and models.

Amos, Eghan and Oppong [3] classified instructional materials into five categories based on their characteristics, which are: visual aids such as chalkboards; pictorial aids such as charts and graphics; mobile aids like slides; projected aids such as posters; and audio-visual aids such as video tape recorders. They further categorise audio, visual, and audio-visual aids into six classes. These include realia, such as artefacts, plants, and animals, and graphic materials, such as drawings, charts, graphs, and posters. Another class is mock-ups and models, audio materials, overhead projectors, and film and video projectors. Effiong and Igiri [6] classified instructional materials as print materials, such as textbooks, and non-print materials, such as recording videos.

This study categorized instructional materials into three classes which are digital instructional materials, printed instructional materials, and laboratory instructional materials. These classes were adopted and modified from the studies of Amos, Eghan and Oppong [3] and Effiong and Igiri [6] using the standardized instructional materials from the Tanzania ordinary-level Biology syllabus of 2010. In this study, the audio,

visual and audio-visual materials are classified as digital instructional materials, such as projectors, radio, television, educational slides, computers and tablets. Since we are in a digital era, the utilization of digital materials is very important in the education sector as it influences student academic performance. The study by Kalogiannakis et al. [13] revealed that the application of tablets in the teaching and learning process results in improved academic performance, though it has no significant difference with the utilization of computers. Also, the study by Montrieux et al. [19] and Algoufi [2] shows that the use of tablets has an impact on both teaching and learning practices as they provide an interactive learning environment and make the materials quickly available. All this shows is that the digital appliance has significant effects on students' academic achievement.

Realia materials are real things that have not been altered [3]. In this study, most of these realia materials are laboratory equipment and are classified as laboratory instructional materials. Examples Biology laboratory, test tube holders, beakers, droppers, petri dishes, mortars and pestles, tripod stands, Bunsen burners, funnels, plant presses, measuring cylinders, sweep nets, pooters, spatulas, watch glasses, rat hooks, potometers, and clinostats. According to Pareek [22], the academic achievement of the students is affected by the utilization of the laboratory as the laboratory activities motivate students to learn more about biology. Therefore, underutilization of laboratory facilities results to poor academic performance by students in biology subject. The last category is Printed instructional materials. These are the hardcopy materials that have been printed. Examples are magazines, practical manuals, and Biology textbooks.

2.3. Utilization of instructional materials

Effective Biology classrooms need students who are active in learning, able to integrate the experiences from the environment with the new knowledge, able to locate information-rich sources and remain connected with the sources, and aware of instructional objectives [35]. It needs a teacher who can facilitate the learning process and be able to plan and design the activities of the students that are practical and visual in nature [25]. For effective teaching and meaningful learning, instructional materials should be utilized as part and parcel of the learning process.

Evidence shows that Biology teachers are not always utilizing the instructional materials to facilitate the learning process [15]. Some of the instructional materials are available for teaching and learning Biology subject, but they are utilized in a minimum way [10]. Teachers practising the lecture method with no visual aids or demonstrations when teaching their students [10]. As a result, it leads to misunderstandings, loss of information, and poor retention, which eventually lead to poor performance by students in Biology subject [10, 15, 20]. Studies conducted by Amos, Eghan and Oppong [3], Effiong and Igiri [6], and Filgona et al. [8] revealed that teachers are not conducting practicals; they present their lessons in abstract form, which makes the students perceive Biology subject as a difficult subject. According to Pareek [22], argued that science subjects such as biology cannot show their excellence until it is related to practical work. However, the study revealed that students were not conducting experiments, and there was no practical assessment. However, the study conducted by Kamba, Libata and Usman [14] revealed that lack of in-service training and experience in using laboratory equipment hinders the utilization of instructional materials. Professional training for Biology teachers is a strategically important link in teaching biology subjects [18].

The extent of utilization of the instructional materials determines students' engagement in the learning and hence ensures their learning and, thus, their achievement. The study on the utilization of instructional materials in Biology lessons could, there-

fore, through lights document what is going on in schools. This could eventually inform curriculum developers and policymakers on the appropriate interventional steps in addressing the problem of students' low performance in schools.

3. Methodology

3.1. Research design

A descriptive survey design that combines qualitative and quantitative data was employed to determine the frequencies to which certain instructional materials were used during the teaching and learning process. The study design enabled the concurrent collection of the data and the merging of the results during data analysis and discussion. With this design, the data collected through questionnaires are integrated with those that emerged from the observations.

3.2. Sample size and sampling procedures

Teachers and students who mainly interact with the instructional materials during Biology lessons form the population of this study. A total of 42 Biology teachers and 176 students were purposively selected. Biology teachers, as the case for other science teachers, are very scarce in Tanzania, and their numbers are relatively low compared to other subjects. For this reason, the study opted to involve all the Biology teachers found in the selected schools. On the other hand, the stratified random sampling technique was used to get 4 students from each class (form I, II, III and IV) in each of the involved schools to make a total of 176 students. In each class involved, students were grouped according to their gender, and then, in each gender group, they were asked to count numbers. Students counted the tenth and twentieth numbers from each gender group and were then sampled and involved in the study.

3.3. Data collection methods and instruments

Questionnaires and non-participatory observation methods were used to gather data in this study. Due to its low cost, a questionnaire method was used to collect information on the extent of utilization of instructional materials from the teachers and students. The closed-ended questions were developed to include the 5-point Likert scale. The rate ranges from 1 (never utilized) if that specific instructional material is not utilized in teaching and learning Biology lessons within scope of January to June 2023, 2 (rarely utilized) if utilized once in teaching and learning Biology lessons within the scope of January to June 2023, 3 (sometimes utilized) if utilized twice in teaching and learning Biology lessons within scope of January to June 2023, 4 (frequently utilized) if utilized thrice in teaching and learning Biology lessons within a scope of January to June 2023, and 5 (every time utilized) if utilized four times and above in teaching and learning Biology lessons within a scope of January to June 2023.

The questionnaire tool had two parts, namely parts A and B. Part A of the questionnaire tool included a column of the standard list of the typical teaching and learning instructional materials that were specified in the Tanzania ordinary level Biology syllabus [17]. Part B of the questionnaire tool involved five preferences, namely motivation, concrete, curiosity, lesson development and language development, along with thirteen questions. The respondents were asked to rank the extent to which instructional materials in the standard list and in each preference were used during the teaching and learning of the Biology lessons.

Nevertheless, the non-participatory observation method was used to provide first-hand information on the extent of utilization of instructional materials in learning Biology lessons. The method involved a direct observation that aided in the triangulation of the field data obtained from students' and teachers' responses to the questionnaires. The phenomena observed or not observed, as well as preferences

based on motivation, concrete, curiosity, lesson development, and language development, were rated during the study. The ratings were based on the scale range of 1 (never utilized), 2 (rarely utilized), 3 (sometimes utilized), 4 (frequently utilized) and 5 (every time utilized). Therefore, if the instructional materials were never utilized for a specific preference within the duration of the lesson implementation, then, it was rated as a never utilized instructional material. If the material was utilized once within the duration of the lesson implementation, it was regarded as rarely, twice within the duration of the lesson implementation as sometimes, thrice within the duration of the lesson implementation as frequently, and four times and above within the duration of the lesson implementation regarded as every time.

3.4. Validity and reliability

A pilot study was conducted in two secondary schools to check for practicability of the instruments. The questionnaires were administered to 50 students and 11 Biology teachers. Then, the responses were reviewed, which enabled some items to be changed and modified to sharpen the instruments.

The internal consistency reliability of the questionnaires and the observation checklists was calculated using Cronbach's alpha coefficient to check the reliability. The scale employed was quite dependable, as indicated by the overall alpha value of $>.93$. Each item's result is higher than the reliability threshold ($>.70$), indicating that they all measured related constructs.

3.5. Data analysis method

With the help of SPSS version 26, both the descriptive and inferential statistics were used to analyse the data gathered. The frequency, mean and standard deviation of the quantitative data from teachers' and students' responses on the most widely used instructional materials were computed using Microsoft Excel. The results were then displayed in various tables for interpretation. Based on the proposed Likert scale range in this study, the decision level was never (1), rarely (2), sometimes (3), frequently (4), and every time (5). Also, the overall mean scores by each respondent on the extent of utilisation were computed to determine the relationship between the extent of utilization of educational resources against the demographic characteristics of the study population. This overall mean score acted as a dependent variable and regressed the same with attendance of in-service training. The non-parametric approaches were adopted to establish the desired relationship since the data were not normally distributed, as shown in table 2.

Table 2

Test for normality assumption of the data.

Tests of normality	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Overall average extent utilization of educational resources	0.119	42	0.146	0.940	42	0.029

3.6. Ethical considerations

The Institutional Research Review Ethics Committee (IRREC) issued an ethical research clearance with reference number MA.84/261//64/134 to conduct this study. The permission to approach districts was granted by the Region Regional Administrative Secretary of the Dar es Salaam Region, who introduced the researcher to the District Executive Directors (DED) of Ilala and Temeke Municipal Councils, who introduced the researcher to the District Education Officer (DEO) and he introduced

the researcher to the heads of schools. Upon arrival at the field, the heads of schools introduced the researcher to the respondents. These were informed of the study's topic and goals and then given the option to participate in the study voluntarily and drop out at any time they would like to do so. The names of the respondents and the names of the schools were not connected to the information given to ensure confidentiality.

4. Results and discussion

The study investigated the extent of utilization of instructional materials during the teaching and learning of Biology lessons in Tanzanian secondary schools. The respondents had an opportunity to rate the extent of using the standard instructional materials during the lessons in one hand. On the other hand, their preferences behind the utilisation of the instructional materials were based on ratings of concrete, motivation, curiosity, lesson organisation and language development reasons. Results obtained were further conveniently categorised into two themes: utilisation based on the standard list of instructional materials and utilisation based on preferences. In the due process, the demographic characteristics of the study sample (table 3) were thought to interpret some of the inferential statistics.

Table 3

Teacher's demographic characteristics.

Variable	Categories	Count	Percentage
Gender	Male	25	59.5%
	Female	17	40.5%
Age categories	21-30 years	11	26.2%
	31-40 years	17	40.5%
	41-50 years	13	31.0%
	51-60 years	1	2.4%
Education level	Certificate grade IIIA	0	0.0%
	Diploma in Education	10	23.8%
	Bachelor's degree	28	66.7%
	Master's degree	4	9.5%
	PhD	0	0.0%
Number of times attended in-service training	Not attended	13	31.0%
	Once	8	19.0%
	Twice	8	19.0%
	More than twice	13	31.0%

Table 3 shows that the study involved biology teachers of different genders, ages, education levels and attendance of in-service training. This demographic information was regressed with the utilization of the instructional materials in teaching and learning Biology subject to understand the extent of utilization of the instructional materials based on the preferences.

4.1. Utilization of instructional materials based on the standard list

The findings indicate the extent of the utilization of instructional materials during the Biology lessons in three categories: highly utilized materials, rarely utilized materials and never utilised instructional materials based on the printed and digital instructional materials (table 4) as well as laboratory instructional materials (table 5).

Table 4 indicates that Biology textbooks are frequently utilized by teachers (4.71) and students (4.43), while digital materials such as computers, tablets, and films are rarely utilized by teachers. Furthermore, findings indicate that some instructional materials,

Table 4

Utilization of printed and digital materials (source: field data (2023)).

Standard instructional materials	Mean scores	
	Students	Teachers
Digital materials		
Projectors	2.08	2.67
Radio	1.08	1.86
Television	1.00	1.36
Educational slides	2.02	3.29
Films	1.47	2.75
Computer	1.42	2.16
Tablets	1.87	2.97
Printed materials		
Biology books	4.43	4.71

such as televisions and radios, had never been used during the teaching and learning of Biology lessons. No instructional materials under the category of digital materials are frequently utilized by teachers during Biology lessons. The printed instructional materials, notably the Biology textbooks, are the only instructional materials utilized at the rate of “frequently utilized” during the Biology lessons. The study revealed no instructional materials were utilized to the extent of “every time” utilization. This indicates that Biology books are the most readily available and most used instructional materials in Biology lessons. This is similar to the findings by Kirova and Jamison [15] that reveal Biology textbooks are the most commonly available instructional materials in all schools in Rwanda republic are Biology textbooks. This is also supported by Isma'il and Lukman [12], which demonstrates the Biology textbooks being one of the two most utilized instructional materials in the learning process in Nigeria republic. This suggests that Biology teaching and learning are embedded more in textual materials which engage learners mainly in theory rather than practical-oriented activities.

Furthermore, the study reveals that there is no single laboratory instructional material utilized every time or even at the rate of being frequently utilized (table 5).

Table 5 indicates rarely utilized instructional materials such as droppers, Bunsen burners, and funnels. Moreover, findings in table 5 indicate differences in teachers'

Table 5

Utilization of laboratory materials (source: field data (2023)).

Laboratory materials	Students	Teachers
Biology laboratory	2.21	3.07
Test tube holders	2.30	3.10
Beakers	2.34	3.07
Droppers	2.24	2.81
Petri dish	2.31	3.17
Mortar and pestle	2.32	3.02
Bunsen burner	2.06	2.70
Funnel	2.10	2.64
Measuring cylinder	2.22	3.02
Spatula	2.33	3.07
Potometer	0.00	0.00

and students' responses in utilizing some instructional materials. For example, the findings indicate that while teachers utilize the Biology laboratory, test tube holders, beakers, measuring cylinders and spatula to a certain extent, students, on the other hand, are observed opined that these materials are rarely or never utilised. Still, zero utilization of a photometer in all secondary schools suggests that students are not experimenting with transpiration. The potometer is an important instructional material for determining the effect of the environmental conditions on transpiration rate, which is a form two content in the topic of "Transport of materials in living things". This is one of the topics in which students perform poorly in most national biology examinations in Tanzania, as stated in table 1. Evidently, students learn the topic using only textbooks with little of these real materials and hence are not well engaged in learning, which then results in poor academic achievement.

Again, the Biology topics, such as "nutrition" and "classification of living things" of which students perform poorly, require the students to interact with more laboratory materials, especially during the allocated practical hours, for example, during the food test activities. However, the findings indicate a rare utilization of laboratory materials, which evidently suggests that students are not well engaged in hands-on activities that require the interaction of laboratory or digital instructional materials for effective learning. The study by Amos, Eghan and Oppong [3] indicates the utilization of laboratory materials in the teaching and learning process provides an excellent opportunity for students to actively engage in hands-on to nurture their learning experiences. Such findings corroborate with Hadiprayitno, Muhlis and Kusmiyati [10], which demonstrates that teachers mostly utilize the lecture approach that minimally uses the audio-visual or realia instructional materials. This eventually limits students' effective learning and, as a consequence, cultivates misunderstandings, information loss, and poor memory. Consequently, in the long run, students register poor academic performance in the Biology subject.

Moreover, findings inform that the tendency to utilization instructional materials varies across class levels, where in lower classes (I, II, and III), there is low utilization, and higher class (IV) records relatively higher rates in the utilization of instructional materials (table 6).

Table 6

Utilization of laboratory materials based on class level (source: field data (2023)).

Domain	Categories	Class			
		Form I	Form II	Form III	Form IV
Laboratory materials	Tripod stand	1.54	1.63	1.84	3.35
	Biology laboratory	1.35	1.70	2.00	3.86
	Test tube holders	1.91	1.70	1.82	3.79
	Beakers	1.91	1.74	1.89	3.84
	Droppers	1.91	1.74	1.86	3.47
	Petri dish	1.89	1.70	1.86	3.81
	Mortar and pestle	1.91	1.72	1.84	3.84
	Bunsen burner	1.83	1.64	1.73	3.05
	Funnel	1.84	1.68	1.78	3.10
	Measuring cylinder	1.91	1.74	1.82	3.42
	Spatula	1.91	1.72	1.89	3.81

Table 6 shows the variation in the utilization of instructional materials among class levels. It shows that only form four students sometimes utilize the Biology laboratory (3.86) and other laboratory apparatus such as beakers, test tube holders, Petri dishes, mortars and pestles, Bunsen burners, funnels, measuring cylinders, and spatulas,

while the rest of the classes (I, II, III) are never utilizing these instructional materials in the learning process. Utilization of instructional materials to the extent of “sometimes” is the largest extent of utilization observed. No mean score indicates a range of the extent of the frequency and every time in the utilization of instructional materials in learning Biology. The fact that the only form four students utilize the laboratory materials more than any other class levels suggests that, Biology lessons are solely given for the sake of examinations and not for effective learning of the biology concepts and understanding, which leads to rote learning and poor academic achievement. The practical activities that require students to interact with laboratory materials are rarely conducted at lower class levels, which deprives students of an opportunity to engage well in learning endeavours. The findings are consistent with studies by Amos, Eghan and Oppong [3], Çimer [4], and Etobro and Fabinu [7], which indicate teachers’ reluctance to conduct practical activities; instead, they present their lessons in an abstract manner using solely textual materials solely. Also, the study by Isma’il and Lukman [12] corroborated with this study. They revealed that the instructional materials that are potential for practical activities, such as laboratory materials, are not utilized evenly across the class levels.

4.2. Utilization of the instructional materials based on preferences

The study also enlightens on the extent of utilization of instructional materials based on preferences, which are termed motivation, concrete, curiosity, lesson organization, and language development. Data, in this case, were gathered through questionnaires and by conducting classroom observation while the teacher was teaching, noting down the instructional materials being used by teachers and students and then rating the extent of utilization based on preferences, which are motivation, concrete, curiosity, lesson organization, and language development. Results indicate variations in teachers’ and students’ reasons in rating preferences for their utilization (table 7).

Findings in table 7 indicate minimum mean scores in motivation (1.65, 2.98, and 2.54), concrete (2.58, 3.89, and 2.60), and curiosity (1.61, 3.21, and 2.47) during learning of Biology in the study area. This implies that the materials are rarely utilized to promote concrete learning and promotion of curiosity. Findings inform that teachers rarely use instructional materials to motivate students to learn Biology by doing interactive classroom activities, solving problems, role-playing, and giving them the opportunity to choose what to learn as envisaged in the school curriculum.

Furthermore, the data in table 7 indicates maximum mean scores rating in lesson organization (4.20) and language development (3.70), indicating teachers utilize instructional materials frequently to sometimes in these two preferences. Perhaps this evidently explains how teachers and students work separately during the learning process. In this case, teachers’ choices of instructional materials are more inclined towards helping them organize their flow in the classroom as well as managing language in the classroom. The current basic principles of teaching push more on student centred approaches in most of the aspects of teaching, including the selection of resources [24]. This is contrary to what the findings in table 7, which indicate teacher-centred approaches in selecting the instructional materials.

Nevertheless, teachers rated with a mean score of 3.08 that motivational reasons are behind their preferences to allow students to choose what to learn. This is contrary to students who rated it at a mean score of 1.35, indication that teachers never allow students to choose instructional materials for what they have to learn. Teachers’ and students’ variations in the preferences are more evident even in aspects of concrete, curiosity and motivation (2.49, 2.54, and 2.72), while teachers’ rates are (3.89, 3.21, and 2.98) respectively. For effective learning, teachers are supposed to support students in learning [25]. Instructional materials are considered to be the medium

Table 7

Utilization based on preferences (source: field data (2023)).

Statement	Average		
	Students	Teachers	Observation
Motivation			
Instructional materials used to do an interactive classroom activity	2.55	3.74	2.58
Instructional materials used to do activity that need to solve problem	1.64	3.17	2.42
Instructional materials used to role-play about Biology content	1.08	2.07	1.07
Instructional materials used to list down the areas of interest	1.35	3.05	2.00
Overall mean	1.65	2.98	2.54
Concrete			
Instructional materials used to demonstrate anything about Biology content	2.49	3.86	2.02
To relate what you know from what you don't know using the instructional materials provided	2.54	3.93	2.50
Instructional materials used to relate what is taught in Biology with life	2.72	4.02	2.75
Overall mean	2.58	3.89	2.60
Curiosity			
Instructional materials used to ask any questions regarding what's taught in order to get more information	1.97	3.48	2.42
Instructional materials used to make prediction of what your teacher is going to teach	1.25	2.62	2.17
Overall mean	1.61	3.21	2.47
Lesson organization			
Instructional materials used to ask about previous lesson when teaching new lesson	2.06	4.14	2.83
Use various teaching aids in teaching Biology lesson	2.71	4.02	3.25
Overall mean	2.32	4.20	3.38
Language development			
Provided with activities that support to talk in English	3.10	3.83	2.83
Offered with text-based resources that support to improve English proficiency	3.49	3.60	2.75
Overall mean	3.30	3.70	2.69

through which the teachers support students' engagement for effective learning [6]. This can definitely be attained if the choice of the materials is geared towards students rather than teachers' perspectives, as portrayed in this study.

The maximum score in the utilization of the instructional materials based on lesson organization and language development preferences implies that teachers are putting more effort into themselves as far as they can present the prepared lessons in a logical

manner rather than on the fact that students learn in a logical manner. This is a teaching perspective coined by a teacher-centred rather than a student-centred. Table 4 supports the findings by demonstrating that the Biology books are only instructional materials utilized frequently. Evidently, it is possible that teachers mostly utilize books for themselves in the preparation stage and during the implementation stage. Biology books are largely used as the main reference instructional materials for teachers to understand and clarify the concepts behind them. Frequently enough, Biology books are entirely used by Biology teachers in the preparation of notes. The study by Smith and Laslett [23] asserted that in lesson organization, “most lessons should involve some listening, looking, thinking, talking, reading and writing”. Nevertheless, teachers ensure language development themselves is an essential preference considered behind the utilization of the instructional materials for their logical and effective presentation of the lesson. This can be interpreted by the fact that teachers are also worried about the language used in the presentation of the lesson in the learning endeavour. However, this should also be the case for students to worry about, which is not the case in this study. This is again another issue that indicates teacher-centred rather than student-centred orientation. It is, therefore, high time that teachers consider language development for students during the learning process. Students should always be provided with text-based instructional materials to boost their language skills in terms of learning biology-specific languages, such as new biological terms and how to form sentences and paragraphs, as well as communicating new biological concepts learned. This will definitely foster learning about biology.

Moreover, teachers’ extent of utilization of instructional materials is influenced by their attendance frequencies in the teacher in-service training. The findings indicate that Biology teachers who attended in-service training more than once utilize instructional materials frequently (4.1 ± 0.4) in concrete aspect to sometimes (3.2 ± 0.6) and (3.4 ± 0.7) in motivation and curiosity (table 8).

Table 8

Teachers’ extent of utilization with respect to training based on preferences (source: field data (2023)).

Number of times attended in-service training	Statistics	Motivation	Concrete	Curiosity	Lesson organization	Language development	Overall
Once	Mean	2.90	3.80	3.20	4.10	3.60	3.50
	N	8	8	8	8	8	8
	Std. Deviation	0.50	0.80	0.90	0.90	1.00	0.70
Twice	Mean	2.90	3.80	3.00	4.30	3.80	3.50
	N	8	8	8	8	8	8
	Std. Deviation	0.50	0.60	0.50	0.60	0.70	0.50
More than twice	Mean	3.20	4.10	3.40	4.20	3.80	3.70
	N	13	13	13	13	13	13
	Std. Deviation	0.60	0.40	0.70	0.30	0.50	0.40

Table 8 indicates the overall mean score (3.7 ± 0.4) to demonstrate that Biology teachers who attended in-service training programs more than twice utilize the instructional materials more frequently than others. Evidently, in-service training programs for

teachers are indicated to play a great role in modelling and motivating teachers in the utilization of instructional materials during teaching. In-service training for teachers makes them more comfortable and competent with the utilization of instructional materials [14, 18]. In-service training contributes significantly to the utilization of different instructional materials, including digital devices such as computers, tablets and projectors. This finding corroborated with the study conducted by Hamad, Ndibalema and Matalu [11], which revealed that the teachers' capacity to utilize digital instructional materials is influenced by the in-service training programs.

5. Conclusion

The study investigated the extent of utilisation of the instructional materials during biology lessons. The findings revealed that printed instructional materials, which were biology textbooks, were more frequently utilized over laboratory instructional materials and digital instructional materials such as projectors, computers, tablets, and radios. The extent of utilization of laboratory instructional materials and digital instructional materials is very minimal. Preferences behind the utilization of printed materials such as Biology textbooks were mainly noted to be based more on teachers' lesson organization and their language development rather than on students' perspectives. Convincingly, the extent of teachers' utilization of the instructional materials was found to be more influenced by their attendance to the in-service training programs.

Deliberate efforts towards investing more in teachers' professional development in the rational and optimum utilization of instructional materials should be a priority towards enhancing students' effective learning. Teachers need to frequently participate in discussions and modelling towards the significance of taking into consideration of the students' orientations in the choices and uses of certain instructional materials ranging from printed instructional materials, laboratory instructional materials and digital instructional materials in schools. Importantly, orientations in the utilization of the instructional materials on the preferences towards developing students' curiosity, motivation, and concrete experiences in learning Biology should be at the central position in the professional learning arrangement of teachers.

6. Recommendations

The study revealed that some instructional materials in schools, such as laboratory materials and digital materials that enhance the teaching and learning of Biology topics, are rarely utilized or not utilized. Biology teachers are therefore aware of the potential use of the instructional materials on students' learning and hence develop a culture of utilizing the materials every time they step into the classroom to boost the learning outcomes as envisaged in the Biology curriculum.

The heads of schools (HoS) in each school should use their administrative power to ensure the maximum utilization of all the available instructional materials for optimum students' learning of the Biology lessons. This learning of biology lessons can be achieved by conducting regular supervision, support, and monitoring and using the available instructional materials in every lesson at all class levels to ensure equal opportunities for students' learning. The School Quality Assurers (SQAs) officers can also apply for this equal opportunity. These can support the HoS with supervisory strategies and, where possible, guide them to reprimand the teachers.

Different authorities should invest in rigorous and continuous professional development programs for Biology teachers to enhance maximum and optimum utilization of the instructional materials during learning. These instructional materials should include the use of ICT facilities such as supportive devices such as projectors and Chromecasts, especially in this era of digital technology for countries that have not yet

effectively embraced the use of digital materials in the teaching and learning process. This digital technology could help enhance learning and implement the ICT policy for basic education to transform the world from a knowledge-driven society to an information- and digital-driven society. It is high time for policymakers to consider the significance of instructional materials embedded with ICT for teachers and learners of Biology and other science subjects.

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A. Internal consistency reliability of the questionnaire Likert items

Item	Corrected item-total correlation	Cronbach's alpha if item deleted
To what extent have you used instructional materials to design an interactive classroom activity?	0.534	0.927
To what extent have you used instructional materials to design activity that elicit problem solving?	0.588	0.925
To what extent have you used instructional materials to provide immediate feedback?	0.522	0.927
To what extent have you used instructional materials to transform assignment into puzzles?	0.405	0.930
To what extent have you use instructional materials to Set up role play or simulation activities to allow student to deal with content in direct way?	0.505	0.928
To what extent have you use instructional materials to allow students to list their particular interest in the topic?	0.636	0.925
To what extent have you used instructional materials to Conduct demonstration?	0.384	0.928
To what extent have you used instructional materials to help students to relate new knowledge with existing knowledge?	0.637	0.925
To what extent have you used instructional materials to elaborate the text?	0.780	0.922
To what extent have you used instructional materials to relate subject matter with everyday living?	0.814	0.922
To what extent have you used instructional materials to do set-up that make students feel the need to obtain more information about a topic?	0.694	0.924
To what extent have you used instructional materials to ask students to make predictions about what they will be learning?	0.595	0.926
To what extent have you used instructional materials to raise questions that successful completion of the activity will enable them to answer?	0.663	0.924
To what extent have you used instructional materials in an introduction stage to provide advance organizers?	0.749	0.924
To what extent have you used instructional materials to relate present lesson to previous?	0.679	0.924
To what extent have you used variety of relevant illustration?	0.801	0.922
To what extent have you make effective use of board and other instructional materials?	0.272	0.931
To what extent have you used instructional materials to present lesson in logical sequence?	0.465	0.928
To what extent have you used instructional materials to define unfamiliar terms, concepts and principles?	0.498	0.927
To what extent have you used instructional materials to encourage students to restate information in own words?	0.668	0.924
To what extent have you provided activities that support students to talk in English?	0.749	0.923
To what extent have you offered text-based resources that support students to improve their English proficiency?	0.727	0.923

B. Extent of utilization from students' responses

Standard instructional materials	Never	Rarely	Sometimes	Frequently	Every time	Average
Digital materials						
Projectors	29 (16.5)	8 (4.5)	0 (0)	0 (0)	11 (6.3)	2.08
Radio	70 (39.8)	4 (2.3)	1 (0.6)	0 (0)	0 (0)	1.08
Television	58 (33.0)	0 (0)	0 (0)	0 (0)	0 (0)	1.00
Educational slides	30 (17.0)	5 (2.8)	0 (0)	2 (1.1)	9 (5.1)	2.02
Films	23 (13.1)	0 (0)	7 (4.0)	0 (0)	0 (0)	1.47
Computer	104 (59.1)	8 (4.5)	0 (0)	0 (0)	11 (6.3)	1.42
Tablets	106 (60.2)	27 (15.3)	12 (6.8)	22 (12.5)	9 (5.1)	1.87
Realia materials						
Biology laboratory	59 (33.5)	64 (36.4)	11 (6.3)	41 (23.3)	1 (0.6)	2.21
Test tube holders	31 (17.6)	97 (55.1)	13 (7.4)	35 (19.9)	0 (0)	2.30
Beakers	28 (15.9)	98 (55.7)	13 (7.4)	37 (21.0)	0 (0)	2.34
Droppers	32 (18.2)	100 (56.8)	14 (8.0)	30 (17.0)	0 (0)	2.24
Petri dish	31 (17.6)	96 (54.5)	13 (7.4)	36 (20.5)	0 (0)	2.31
Mortar and pestle	29 (16.5)	99 (56.3)	11 (6.3)	37 (21.0)	0 (0)	2.32
Bunsen burner	45 (25.6)	80 (45.5)	16 (9.1)	19 (10.8)	0 (0)	2.06
Funnel	34 (19.3)	92 (52.3)	26 (14.8)	12 (6.8)	0 (0)	2.10
Measuring cylinder	30 (17.0)	102 (58.0)	20 (11.4)	24 (13.6)	0 (0)	2.22
Spatula	29 (16.5)	96 (54.5)	14 (8.0)	36 (20.5)	0 (0)	2.33
Potometer	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.00
Printed materials						
Biology books	4 (2.3)	3 (1.7)	11 (6.3)	53 (30.1)	105 (59.7)	4.43

C. Students' responses on extent of utilization based on five dimension

Statement	Never	Rarely	Sometimes	Frequently	Every time	Average
Motivation						
Have you provided with instructional materials to do an interactive classroom activity?	6 (3.4)	94 (53.4)	49 (27.8)	27 (15.3)	0 (0)	2.55
Have you provided with instructional materials to do activity that need you to solve problem?	85 (48.3)	71 (40.3)	18 (10.2)	2 (1.1)	0 (0)	1.64
Have you used instructional materials to role-play about Biology content?	165 (93.8)	8 (4.5)	3 (1.7)	0 (0)	0 (0)	1.08

Continued on next page

Statement	Never	Rarely	Sometimes	Frequently	Every time	Average
Have you asked to use instructional materials to list down the areas of the topic which you are interested with?	129 (73.3)	33 (18.8)	14 (8.0)	0 (0)	0 (0)	1.35
Concrete						
Have you/or your teacher demonstrate anything about biology content?	15 (8.5)	85 (48.3)	51 (29.0)	25 (14.2)	0 (0)	2.49
Have you asked to relate what you know from what you don't know using the instructional materials provided?	6 (3.4)	73 (41.5)	93 (52.8)	4 (2.3)	0 (0)	2.54
Have you used instructional materials to relate what is taught in biology with your life?	1 (0.6)	57 (32.4)	109 (61.9)	9 (5.1)	0 (0)	2.72
Curiosity						
Have you used instructional materials to ask any questions regarding what your teacher is teaching in order to get more information?	58 (33.0)	74 (42.0)	35 (19.9)	9 (5.1)	0 (0)	1.97
Have you asked to use instructional materials provided to make prediction of what your teacher is going to teach?	142 (80.7)	24 (13.6)	10 (5.7)	0 (0)	0 (0)	1.25
Lesson organization						
Is your teacher use instructional materials to tell you the lesson objective before teaching?	17 (9.7)	118 (67.0)	33 (18.8)	8 (4.5)	0 (0)	2.18
Is your teacher use instructional materials to ask you about previous lesson when teaching new lesson?	52 (29.5)	74 (42.0)	39 (22.2)	9 (5.1)	2 (1.1)	2.06
Is your teacher use various teaching aids in teaching Biology lesson?	2 (1.1)	87 (49.4)	47 (26.7)	40 (22.7)	0 (0)	2.71
Language development						
Have you provided with activities that support you to talk in English?	2 (1.1)	25 (14.2)	104 (59.1)	43 (24.4)	2 (1.1)	3.10

Continued on next page

Statement	Never	Rarely	Sometimes	Frequently	Every time	Average
Have you offered with text-based resources that support you to improve your English proficiency?	6 (3.4)	9 (5.1)	56 (31.8)	102 (58.0)	3 (1.7)	3.49

D. Students' responses on extent of utilization based on class level

Categories		Class			
		Form I	Form II	Form III	Form IV
Laboratory materials	Biology laboratory	1.35	1.70	2.00	3.86
	Aquarium	1.50	1.27	1.35	1.73
	Test tube holders	1.91	1.70	1.82	3.79
	Beakers	1.91	1.74	1.89	3.84
	Droppers	1.91	1.74	1.86	3.47
	Petri dish	1.89	1.70	1.86	3.81
	Mortar and pestle	1.91	1.72	1.84	3.84
	Bunsen burner	1.83	1.64	1.73	3.05
	Funnel	1.84	1.68	1.78	3.10
	Measuring cylinder	1.91	1.74	1.82	3.42
	Spatula	1.91	1.72	1.89	3.81
	Watch glasses	1.46	1.40	1.30	2.70
	Biology books	4.24	4.30	4.68	4.51

E. Teachers' responses on extent of utilization of instructional materials

Standard instructional materials	Available instructional materials		Extent of utilization					
	Yes	No	Never	Rarely	Sometimes	Frequently	Every time	Average
Digital materials								
Projectors	12	30	2	4	3	2	1	2.67
Radio	7	35	3	2	2	0	0	1.86
Television	11	31	7	4	0	0	0	1.36
Video tapes	2	40	0	2	0	0	0	2.00
Educational slides	7	35	0	2	2	2	1	3.29
Films	4	38	0	1	3	0	0	2.75
Computer	25	17	11	5	4	4	1	2.16
Tablets	36	6	8	3	9	14	2	2.97
Laboratory materials								
Biology laboratory	42	0	0	7	27	6	2	3.07
Test tube holders	42	0	0	13	13	15	1	3.10
Beakers	42	0	0	12	16	13	1	3.07
Droppers	42	0	1	15	18	7	1	2.81
Petri dish	42	0	0	10	17	13	2	3.17

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Standard instructional materials	Available instructional materials		Extent of utilization					
	Yes	No	Never	Rarely	Sometimes	Frequently	Every time	Average
Mortar and Pestle	42	0	0	13	15	14	0	3.02
Bunsen burner	40	2	3	13	17	7	0	2.70
Funnel	42	0	0	21	15	6	0	2.64
Measuring cylinder	41	1	0	13	14	14	0	3.02
Spatula	42	0	0	10	19	13	0	3.07
Potometer	0	42	0	0	0	0	0	0.00
Printed materials								
Biology books	42	0	0	1	1	7	33	4.71

F. Teachers' responses on extent of utilization based on five dimension

Statement	Average	SD
Motivation		
To what extent have you used instructional materials to design an interactive classroom activity?	3.74	0.50
To what extent have you used instructional materials to design activity that elicit problem solving?	3.17	0.79
To what extent have you used instructional materials to provide immediate feedback?	3.79	0.52
To what extent have you used instructional materials to transform assignment into puzzles?	2.07	1.00
To what extent have you use instructional materials to set up role play or simulation activities to allow student to deal with content in direct way?	2.07	1.02
To what extent have you use instructional materials to allow students to list their particular interest in the topic?	3.05	0.82
Concrete		
To what extent have you used instructional materials to conduct demonstration?	3.86	0.52
To what extent have you used instructional materials to help students to relate new knowledge with existing knowledge?	3.93	0.51
To what extent have you used instructional materials to elaborate the text?	3.76	0.82
To what extent have you used instructional materials to relate subject matter with everyday living?	4.02	0.60
Curiosity		
To what extent have you used instructional materials to do set-up that make students feel the need to obtain more information about a topic?	3.48	0.71
To what extent have you used instructional materials to ask students to make predictions about what they will be learning?	2.62	1.01
To what extent have you used instructional materials to raise questions that successful completion of the activity will enable them to answer?	3.52	0.77
Lesson organization		
To what extent have you used instructional materials in an introduction stage to provide advance organizers?	3.86	0.57

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Statement	Average	SD
Motivation		
To what extent have you used instructional materials to relate present lesson to previous?	4.14	0.65
To what extent have you used variety of relevant illustration?	4.02	0.64
To what extent have you made effective use of board and other instructional materials?	4.55	0.77
To what extent have you used instructional materials to present lesson in logical sequence?	4.40	0.70
Language development		
To what extent have you used instructional materials to define unfamiliar terms, concepts and principles?	3.57	0.86
To what extent have you used instructional materials to encourage students to restate information in own words?	3.81	0.67
To what extent have you provided activities that support students to talk in English?	3.83	0.70
To what extent have you offered text-based resources that support students to improve their English proficiency?	3.60	0.80

G. Extent of utilization with respect to in-service training

Number of times attended in-service training	Statistics	Motivation	Concrete	Curiosity	Lesson organization	Language development	Overall
Once	Mean	2.90	3.80	3.20	4.10	3.60	3.50
	N	8	8	8	8	8	8
	Std. Deviation	0.50	0.80	0.90	0.90	1.00	0.70
Twice	Mean	2.90	3.80	3.00	4.30	3.80	3.50
	N	8	8	8	8	8	8
	Std. Deviation	0.50	0.60	0.50	0.60	0.70	0.50
More than twice	Mean	3.20	4.10	3.40	4.20	3.80	3.70
	N	13	13	13	13	13	13
	Std. Deviation	0.60	0.40	0.70	0.30	0.50	0.40
Total	Mean	3.00	3.90	3.20	4.20	3.70	3.60
	N	29	29	29	29	29	29
	Std. Deviation	0.56	0.55	0.68	0.58	0.69	0.50