# AVAILABILITY AND USABILITY OF INSTRUCTIONAL MATERIALS IN TEACHING AND LEARNING OF BIOLOGY IN OYE-EKITI SENIOR SECONDARY SCHOOLS

BY

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## Abstract
This study investigated the availability and usability of instructional materials in the teaching and learning of Biology in senior secondary schools in Oye Local Government Area, Ekiti State, Nigeria. Employing a descriptive survey design, data were collected from 120 Biology teachers using a validated questionnaire. Results showed that conventional instructional materials (charts, specimens, models, and microscopes) were moderately available (52.5–78.3%), while digital and technology-enhanced resources (interactive whiteboards, virtual labs, projectors) were largely unavailable (71.7–91.7%). Teachers frequently used available conventional materials (grand mean = 3.08), but usability was significantly constrained by inadequate teacher training, time constraints, overloaded syllabus, lack of electricity/internet, and poor administrative support (grand mean = 3.14). The study concludes that limited availability and low usability of modern instructional materials undermine effective Biology instruction. Recommendations include sustained teacher training, infrastructure upgrade, curriculum review, and targeted procurement of both conventional and digital resources.

**Keywords:** Instructional materials; Availability; Usability; Teacher competency; Digital resource

## Introduction
Biology, as a basic science discipline, occupies a strategic position in the senior secondary education curriculum in Nigeria. According to the Nigerian Educational Research and Development Council (NERDC, 2018), it is clear that Biology needs to instill in learners the capacity to observe, classify, hypothesise, experiment, and make valid conclusions about living systems. These goals cannot be effectively attained through the lecture-only approach; they must be systematically exposed to large quantities of instructional resources that bring abstract ideas to life and are observable (Okebukola, 2021; Abidoye and Olorundare, 2023).

Instructional materials can be broadly understood as all resources, whether physical or digital, that can be used to transfer knowledge, skills, and attitudes through addressing the sense of multiple senses (Eze and Akudolu, 2023). They include simple, locally fabricated materials (charts, preserved samples, models) and complex electronic devices (virtual labs, PhET simulations, AR applications, and interactive whiteboards). This is due to the fact that when properly chosen and strategically used, these materials are beneficial in terms of conceptual knowledge, learning, motivation, critical thinking, and abilities (Gambari et al., 2024; Oladejo and Adesina, 2022).

Irrespective of policy announcements and decades of educational reforms, acute shortages and under-use of instructional materials in Nigerian secondary schools, especially in rural and semi-urban schools continue to be recorded in empirical studies (Afolabi and Akinyemi, 2022; Owolabi and Adedayo, 2024). Its effects are far-reaching: systemic underachievement in Biology during the West African Senior School Certificate Examination (WASSCE) and National Examinations Council (NECO) (WAEC Chief Examiners Reports, 2020-2024), low participation in science-related tertiary programmes, and the end result: a diminished national potential of scientific and technological progress.

The initial informal discussions with principals and teachers in the study environment showed that most schools have a microscope that is either old or out of service, lack operational projector, and none has access to virtual laboratories. Teachers tend to use the talk and chalk pedagogy and students find it difficult to deal with the abstract issues such as genetics, ecology and physiology. It is on this basis that the current study aimed at delivering empirical underline information on the current state of provision and usability of instructional materials in teaching Biology and coming up with realistic and context-sensitive solutions.

## Research Questions

1. To what extent are instructional materials available for teaching Biology in senior secondary schools in Oye LGA?
2. How frequently do Biology teachers use the available instructional materials?
3. What factors constrain the usability of instructional materials by Biology teachers?
4. What strategies can enhance the effective utilization of instructional materials in Biology classrooms?

## Literature Review

### *The Cognitive Theory of Multimedia Learning and Constructivism.*

The current review is grounded in two perspectives that are complementary, the Constructivist Learning Theory (Bruner, 1977; Vygotsky, 1978) and the Cognitive Theory of Multimedia Learning (CTML) by Mayer (Mayer, 2009). Constructivism assumes that learners build knowledge by means of engaging with real experiences and significant stimuli. The instructional materials, especially the visual and manipulative and digital learning tools, thus serve as mediational that assists the learners to close in the gap between the abstract scientific information and real-life phenomena. CTML in its turn claims that when information is delivered in good combination of verbal and visual channels, learning is maximized, cognitive load is minimalized, and retention is maximized. The theory offers a practical approach to consider the usefulness of the traditional and digital instructional materials in Biology, which is a subject that highly depends on diagrams, microscopic structures, animation, and models. These theories combined underline that the availability of instructional resources and the pedagogical cohesion of these learning resources are the key determinants of effective learning and, thus, the conceptual framework of the current research.

### *Conceptualizing Instructional Materials and Usability in Biology Education*

Instructional materials can be broadly understood as materials that help the teachers to make abstract concepts concrete and more interesting to the learners (Eze & Akudolu, 2023). The modern-day classification separates traditional/print materials, audio-visual aid, and digital/interactive technologies (Abidoye and Olorundare, 2023). Nonetheless, new research indicates that owning these materials is no longer sufficient, instead, their usability is determined by the competence of teachers, readiness of infrastructures, pedagogical focus, and the level of compliance with curriculum requirements (Fakomogbon & Adegbija, 2024). Usability in a constructivist approach includes the affordances of the material, that is, its ability to enable inquiry, manipulation, visualization, as well as the skill of the teacher to arrange the learning experiences around the material. This changes the subject of discussion to be not about availability but rather meaningful integration, which emphasizes the dynamic nature of the interaction of materials, teachers, and learners.

### *Instructional Materials and its Impact on Learning Outcomes.*

There is a lot of evidence worldwide that shows that quality teaching materials contribute greatly to conceptual understanding, motivation, and success in Biology. Research in Africa, Europe, and North America confirms that technologically improved materials, including simulations, virtual labs, and animations, generate medium to large learning effects (effect size = 0.52-0.81) when systematically incorporated into learning (Hillmayr et al., 2020; Gambari et al., 2024). These have been found to be in line with the predictions of CTML that well-constructed multimodal content enhances cognitive processing. The use of instructional materials and student achievement is also positively correlated in local Nigerian and sub-Saharan African studies (Babalola and Alabi, 2021; Okebukola, 2021; Oladejo and Adesina, 2022). As an example, Afolabi and Akinyemi (2022) found a high correlation between the availability of materials and the learning outcomes in Biology (r = 0.68) and Oladejo and Adesina (2022) indicated a 42-percent increase in the utilisation rates when teachers are trained on improvisation. Taken together, these results imply that instructional materials are not just facilitators of the knowledge construction of learners but are also considered crucial.

### *Systemic and Contextual Barriers to Effective Utilization*

The adoption of instructional resources, especially digital ones, is still heterogeneous across the schools of Nigeria, although there have been documented advantages. Common barriers have been cited as the lack of proper teacher training, poor electrical power, poor networking, lack of funds, and overloaded curriculum (Adesoji and Olatunbosun, 2023; Fakomogbon and Adegbija, 2024). Such an increase in the digital divide, which is particularly pronounced in rural schools, is also found in post-COVID literature, where both devices and digital pedagogy skills are low (Bello and Oke, 2024; Eze and Akudolu, 2023). These disparities are depicted through empirical surveys. According to the study published by Owolabi and Adedayo (2024), just 38 percent of sampled schools in southwest Nigeria had functioning microscopes, and only 12 percent of them had projectors. Also, fewer than 15 percent of rural schools possess equipment that can run virtual laboratories (Bello & Oke, 2024). Such infrastructural and human capacity gaps indicate a systemic imbalance between what the curriculum requires, which focuses on inquiry and practical science, and what schools are about in reality.

Theoretically, these barriers prevent the constructivist necessity of experiential learning and the preconditions of effective multimedia processing of CTML. Therefore, the usability issue in Biology education is multidimensional, and it involves the lack of material, poor professional development, and structural limitations. Although, a number of studies show low access to digital tools or lack of competence in teachers, not many of them differentiate between traditional and digital instructional resources in rural local government areas. Additionally, the available evidence is seldom positioned to chart the influence of availability, infrastructure and the teacher's skill in combining to form practical usability. The current research fills this gap by analysing simultaneously, availability, frequency of use, constraints, as well as strategies recommended by teachers in Biology classrooms. This holistic view gives a more insight into the systemic and pedagogical dynamics influencing integration of instructional material in rural Nigerian environment.

## Methodology

### *Research Design*

This study employed a descriptive survey design, deemed appropriate for systematically examining the availability and usability of instructional materials among Biology teachers in a natural school setting. The design enabled the collection of quantitative data reflecting teachers' perceptions, practices, and contextual constraints without manipulating existing conditions.

### *Population and Sampling Procedures*

The target population consisted of all Biology teachers in the 28 public senior secondary schools in Oye Local Government Area. A multi-stage sampling approach was adopted. First, ten schools

were chosen through simple random sampling to ensure equal representation across the LGA. Subsequently, twelve Biology teachers were randomly selected from each school, yielding a total sample size of 120 respondents. This sample was judged sufficient for capturing variability in instructional resource availability and utilization patterns within the context.

***Instrumentation***

Data were collected using a researcher-developed instrument titled the Availability and Usability of Instructional Materials in Biology Questionnaire (AUIMBQ). The questionnaire comprised 36 items organized into four thematic sections:

1. Demographic Information: capturing teacher characteristics relevant to resource use.
2. Availability Checklist: a binary (Available/Not Available) inventory of conventional and digital instructional materials.
3. Frequency of Use: a 4-point scale (Always, Often, Rarely, Never) assessing utilisation intensity.
4. Constraints and Suggested Strategies: a 4-point Likert scale assessing perceived barriers and enhancement measures.

The instrument was subjected to validation by three experts in Science Education and Measurement & Evaluation, ensuring face and content validity. Reliability testing using Cronbach's alpha yielded coefficients ranging from 0.85 to 0.89, with an overall reliability index of 0.87, indicating strong internal consistency.

***Data Collection Procedure***

The researcher personally administered the AUIMBQ to participants in the selected schools. This approach facilitated immediate clarification of items, enhanced compliance, and ensured complete retrieval. All 120 questionnaires were successfully collected on the same day, resulting in a 100% return rate.

***Data Analysis Techniques***

Data analysis was conducted using SPSS version 27. Descriptive statistics—frequency counts, percentages, means, and standard deviations—were employed to summarize availability levels, frequency of use, perceived constraints, and suggested strategies. A mean decision benchmark of 2.50 was set on the Likert-type scales, such that values ≥ 2.50 were interpreted as Accepted/High, while values < 2.50 were classified as Rejected/Low.

**Results and Discussion**

This section is concerned with the analysis and interpretation of the data gathered from respondents to investigate the availability and usability of instructional materials in teaching and learning Biology. The first section deals with demographic information of the respondents and the second section deal with respondent's opinion on the availability and usability of instructional materials in teaching and learning Biology.

**Demographic Information**

**Table 1**

***Demographic Information of the Respondents***

| Variable | Category | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 51 | 42.5 |
| | Female | 69 | 57.5 |
| Teaching Experience | Less than 6years | 7 | 5.8 |
| | 5 – 10years | 23 | 19.2 |
| | 11 – 15years | 47 | 39.2 |
| | Over 15years | 43 | 35.8 |
| | **Total** | **120** | **100** |

*Source: Field Survey, 2025*

Table 1 above showed the demographic information of the respondents who were Biology teachers in Secondary Schools. It was obtained that 42.5% of the respondents were male while 57.5% were female. This is an indication that most of the teachers who responded to the questionnaire were female. Based on the respondents' year of teaching experience, it was obtained that 5.8% had less than 6years, 19.2% had 5 – 10years, 39.2% had 11 – 15years while 35.8% had above 15years teaching experience. This is an indication that most of the respondents had over 10years teaching experience and below. Figure 1 further explain the demographic characteristics of the respondents.

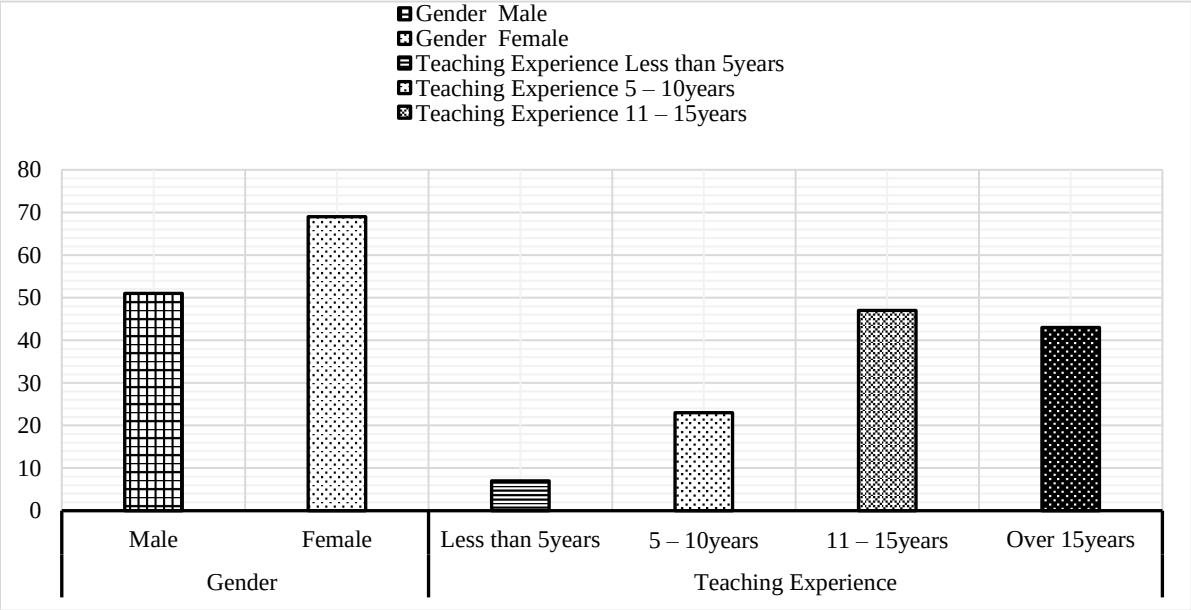


**Figure 1: Demographic characteristics of the respondents**

**Research Question 1: To what extent are instructional materials available for teaching Biology in senior secondary schools?**

To answer this question, respondents were asked to indicate whether various instructional materials were available in their schools. The results are presented in Table 2.

**Table 2: Availability of Instructional Materials (n = 120)**

| Instructional Material | Available (%) | Not Available (%) |
|---|---|---|
| Charts/posters/diagrams | 94 (78.3) | 26 (21.7) |
| Preserved specimens | 78 (65.0) | 42 (35.0) |
| Plastic/wooden models | 71 (59.2) | 49 (40.8) |
| Compound microscopes | 63 (52.5) | 57 (47.5) |
| Dissecting kits | 58 (48.3) | 62 (51.7) |
| Projectors | 34 (28.3) | 86 (71.7) |
| Computers/laptops with internet | 23 (19.2) | 97 (80.8) |
| Interactive whiteboards | 13 (10.8) | 107 (89.2) |
| Virtual laboratory software/PhET | 10 (8.3) | 110 (91.7) |

Findings from Table 2 show that conventional instructional materials are more available than digital ones. Charts/posters/diagrams are available in 78.3% of schools, preserved specimens in 65%, and models in 59.2%. Microscopes are available in 52.5% of schools, while less than half have dissecting kits (48.3%). In contrast, digital and technology-based instructional

materials are largely unavailable: only 28.3% of schools have projectors, 19.2% have computers/laptops with internet, 10.8% have interactive whiteboards, and only 8.3% have virtual laboratories or simulation software.

**Research Question 2: How frequently do Biology teachers use the available instructional materials?**

To address this research question, the study examined how often teachers utilised the instructional materials that were available to them. The findings are shown in Table 3.

**Table 3: Frequency of Use of Available Materials (n = 120)**

| Material | Always/Often (%) | Rarely/Never (%) | Mean | SD |
|---|---|---|---|---|
| Charts/diagrams | 86.7 | 13.3 | 3.41 | 0.68 |
| Preserved specimens | 72.5 | 27.5 | 3.12 | 0.79 |
| Models | 68.3 | 31.7 | 3.05 | 0.82 |
| Microscopes | 58.3 | 41.7 | 2.74 | 0.91 |
| **Grand Mean** | | | **3.08** | |

Table 3 reveals that teachers frequently use the instructional materials that are available to them. Charts/diagrams are the most used (Mean = 3.41), followed by preserved specimens (Mean = 3.12) and models (Mean = 3.05). Microscopes are used less frequently (Mean = 2.74). The grand mean of 3.08 shows that teachers generally make moderate-to-high use of the conventional materials that are present in their schools.

**Research Question 3: What factors constrain the usability of instructional materials by Biology teachers?**

In response to Research Question 3, teachers rated the extent to which specific factors hindered their effective use of instructional materials. The results are presented in Table 4.

**Table 4: Constraints to Usability (Grand Mean = 3.14 > 2.50)**

| Constraint | Mean | SD | Remark |
|---|---|---|---|
| Inadequate training on improvisation | 3.48 | 0.72 | High |
| Time constraint/overloaded syllabus | 3.41 | 0.79 | High |
| Lack of electricity/internet | 3.36 | 0.81 | High |
| Insufficient funding/maintenance | 3.29 | 0.84 | High |
| Lack of administrative support | 3.19 | 0.88 | High |

Table 4 shows that all identified constraints recorded mean scores above the decision benchmark of 2.50. The most prominent constraint is inadequate teacher training on improvisation (Mean = 3.48). Other notable constraints include time limitations due to an overloaded syllabus (Mean = 3.41), lack of electricity and internet (Mean = 3.36), insufficient funding (Mean = 3.29), and weak administrative support (Mean = 3.19). The grand mean of 3.14 indicates that constraints affecting usability are widespread and significant.

**Research Question 4: What strategies can enhance the effective utilization of instructional materials in Biology classrooms?**

To answer this question, respondents identified strategies they believe would improve the utilization of instructional materials in Biology teaching. These findings are displayed in Table 5.

Table 5: Suggested Strategies (Grand Mean = 3.56 > 2.50)

| Strategy | Mean | SD | Remark |
|---|---|---|---|
| Regular in-service training/workshops | 3.68 | 0.61 | Very High |
| Government procurement of materials | 3.64 | 0.65 | Very High |
| Establishment of functional Biology labs | 3.59 | 0.69 | Very High |
| Syllabus review to allow practical time | 3.52 | 0.73 | Very High |

Table 5 indicates that all proposed strategies were strongly supported by respondents, with mean values above 3.50. Regular in-service training (Mean = 3.68) and government procurement of instructional materials (Mean = 3.64) received the highest ratings. Establishing functional Biology laboratories (Mean = 3.59) and revising the syllabus to allow adequate time for practical activities (Mean = 3.52) were also highly endorsed. The grand mean of 3.56 suggests strong teacher agreement on the need for systemic and sustainable improvements.

## Discussion

The research results indicate that there is an existing lack of balance in the provision of instructional resources in teaching Biology at senior secondary level. Traditional teaching media like charts, diagrams, preserved examples and anatomical models were found to be somewhat meticulously accessible in schools, with digital and technology-enhanced content and media being a scarcity. This is reflective of the historical record of research in Nigerian and African science education on average, with low-technology resources continuing to be the primary tool used in most of its public schools, as a result of insufficient funding and lack of infrastructure (Afolabi and Akinyemi, 2022; Owolabi and Adedayo, 2024). The close lack of projectors, computers, interactive whiteboards, and virtual laboratory software is also supportive of the idea of a digital divide as it is reflected in post-COVID literature, which focuses on the idea that rural and semi-urban learning settings remain under-equipped with ICT learning resources compared to urban centres (Eze & Akudolu, 2023; Bello and Oke, 2024).

The average access to cheap materials seems to favour the utilisation tendency of the teachers. The statistics indicate that teachers commonly resort to traditional formats like charts, models, and preserved specimens, which is consistent with the previous results that Nigerian Biology teachers tend to use the materials that are easy to obtain, inexpensive, and familiar (Oladejo and Adesina, 2022; Abidoye and Olorundare, 2023). This implies that it is not the willingness of teachers that becomes the main constraint to pedagogical innovation. Rather, the difficulty is to increase the number of resources they have at their disposal. The same conclusion has been reached in other regions in Nigeria, where the utilisation rate is quite high when the materials are available, particularly practical and visual ones (Fakomogbon and Adegbija, 2024; Afolabi and Akinyemi, 2022).

Even with this willingness, the research also found that there exist several limitations which strongly hinder effective use of instructional materials. The most notable of these obstacles are lack of training of teachers in the field of improvisation and integrating ICT, overloaded curriculum material, electricity, and internet connectivity, insufficient funding, and lack of administrative support. These limitations are reminiscent of national and regional studies that have continued to define competency gaps in teachers and infrastructural deficiencies as the primary barriers to contemporary science education (Yusuf and Afolabi, 2025; Onwuachu and Ngozi, 2023). The teacher preparation programmes in Nigeria have been condemned over an years as having a shortfall in focus on practical exploration, digital pedagogy, as well as resource improvisation: the competencies required to effectively teach

Biology within a low-resource setting (Adesoji and Olatunbosun, 2023; Okebukola, 2021).

The salience of the electricity supply and internet supply as confining variables are also consistent with larger systemic concerns implying educational technology integration in sub-Saharan Africa. Similar results were obtained in Tanzania, Kenya, and South Africa, where researchers concluded that the inability to have reliable electricity and poor connectivity spoil the successful implementation of digital tools in the classroom (Mtebe & Raphael, 2022). This implies that this is more of a problem of functionality rather than a problem of procurement.

Moreover, the fact of limited access to the contemporary instructional material has its consequences not only regarding the classroom practice but also the conceptual knowledge of a student, his/her motivation, and future interest in the science. Studies conducted in Nigeria have repeatedly indicated that exposure to laboratory equipment, models, and simulation improve the achievement and problem-solving capacity of students, especially on abstract subjects, including genetics, ecology, and physiology (Babalola and Alabi, 2021; Afolabi and Akinyemi, 2022; Gambari et al., 2024). Thus, the lack of resources causes the continuation of superficial learning, memorisation, and low performance in national exams because of the use of talk-and-chalk teaching methods (often mentioned in the reports of WAEC Chief Examiners) (WAEC, 20202024).

Overall, teachers revealed that they were highly concerned with strategies that could alleviate these problems. The top-priority practices that have been identified by the respondents are engaged in continuous professional development, the governmental acquisition of instructional materials, developing Biology laboratories equipped with modern equipment, and restructuring the curriculum to gain more time to do practical tasks. Such suggestions are corroborated by the findings of studies that show the necessity of system-level changes that consider teacher capacity, infrastructure, and curriculum alignment in complementary partnership, but not individually (Okebukola, 2021; Adesoji and Olatunbosun, 2023; Gambari et al., 2024). The multifaceted approach is also supported by international studies that show that the effects of resource provision are insignificant unless they are accompanied by instructing teacher training and the support mechanism (Hillmayr et al., 2020).

## Conclusion

The results of this research highlight the unending gaps in providing and using instructional resources effectively in teaching Biology in senior secondary schools. Although teachers have shown a willingness to deliver instruction and adopt the flexibility of employing the traditional, low-tech resources, the larger instructional context is still manifested by structural insufficiency, outdated resources, and insufficient access to the modern digitalized tools. These limitations interfere with effective interaction of inquiry-based, activity-based learning models that are the key aspect of contemporary science education.

The research points out that the means of enhancing the education of Biology is not just by increasing the availability of the material but by making long-term investments on the capacity development of the teachers, the school infrastructure, the resources in accordance with the curriculum and the support mechanisms, which can stimulate innovative teaching. Unless there are such intentional, research-based reforms, the transformative objectives of the national science curriculum of Nigeria, already expressed as scientific literacy, problem-solving, and proficiency in applied skills, will not be achieved, but may be something to look forward to. A further provision of instruction materials and complementing their integration into the pedagogical environment is thus further measures that will lead to a more equitable, engaging, and future-oriented learning of Biology among students of secondary schools.

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