







 Research Article

# Impacts of Instructional Materials in Enhancing Biology Concepts Retention among Secondary School Students in Izzi, Ebonyi State, Nigeria

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## Abstract

This study examined how instructional materials influence secondary school students' ability to retain biology concepts. The study used a descriptive survey research approach and was directed by three research questions. Six hundred and two (602) SSII students comprised the study population, and 240 responders comprised the sample size using Slovin's formula for sample size determinations. The students were sampled using a simple random sampling technique. The tool for gathering data was a structured questionnaire. Three test experts with backgrounds in measurement and evaluation and biology teaching face-validated the questionnaire. The quantitative data were analyzed using mean scores and frequency distribution tables. The study's conclusions showed, among other things, that the effective and adequate use of instructional materials available for teaching and learning influences secondary school students' retention of biology concepts. This is because such materials help in the recall of certain concepts and the recognition of biological principles. Additionally, because they make biology easier to study, using instructional materials improved the effectiveness of biology topics taught and learned. Based on the findings, the researcher recommends that students, teachers, educational administrators, and policymakers place more value on using instructional materials in biology classrooms. Government agencies, Ministries of Education, and educational agencies should supply instructional materials to secondary schools to improve the quality of teaching and learning of biology, and biology teachers should participate in seminars and workshops on the use of instructional materials to stay current on their knowledge and improve their effectiveness as teachers.

**Keywords:** Instructional Material, Retention, Secondary School, Biology Concepts

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## 1. INTRODUCTION

Science serves as the foundational pillar for contemporary technological advancements and socio-economic development, underpinning innovations and shaping modern society. As Wood (2015) articulates, science is an active human pursuit to understand the natural world's mechanisms. In developing nations like Nigeria, increasing emphasis is being placed on advancing scientific and technological capacities to foster sustainable development. Science education plays a pivotal role in this process by cultivating scientifically literate individuals capable of making rational decisions and engaging in problem-solving activities (Zafer & Hilal, 2023).

The primary objective is to produce learners who can observe, investigate, and explain natural phenomena while fostering curiosity and applying their knowledge to real-world challenges. Within

Nigerian secondary education, biology is a core science subject offered at the senior secondary school level. It is integral to preparing students for careers in health, agriculture, and related fields (Salami & Eichie, 2018). Biology's significance is underscored by its higher enrollment rates compared to physics and chemistry at the Senior School Certificate Examination (SSCE) level. This subject provides foundational knowledge crucial for national development and individual career trajectories (Orji & Maekae, 2013). Instructional materials, according to Arko & Kporyi (2020), encompass resources employed by teachers and students to facilitate teaching and learning processes, ensuring effective teaching and learning by teachers and learners, and they bring life to learning as they stimulate students to learn. These include a variety of audio, visual, and audio-visual aids designed to support the achievement of specific educational objectives.

Effective utilization of instructional materials has been linked to improved comprehension, retention, and overall academic performance. However, inadequate availability and application of such resources due to infrastructural deficits, large class sizes, and suboptimal teaching practices have been identified as major impediments to student retention and mastery of biology concepts (Bukoye, 2019; Isma'il & Lukman, 2022). Empirical evidence by Chief Examiner's Reports, from 2013–2018 in Chukwu, & Arokoyu (2019) indicates that poor retention of biology content among secondary school students contributes significantly to low academic achievement, as reflected in internal assessments and external examinations.

The reliance on auditory and verbal instruction alone diminishes students' engagement and hampers meaningful learning. Consequently, the integration of instructional materials, especially visual and practical resources, becomes critical for enhancing understanding and retention (Etienne, Gacinya, Dufitumukiza, et. al. 2023). The theoretical basis for this approach aligns with the experiential learning paradigm, emphasizing multisensory engagement to reinforce cognitive processes. The challenges faced in Nigerian biology education, such as insufficient textbooks, technological tools, and laboratory facilities, highlight the need for research into effective instructional strategies. Many biological concepts are abstract and difficult to grasp without concrete, visual, or hands-on experiences, underscoring the importance of instructional materials.

Despite the recognized importance of biology in fostering scientific literacy and national development, students in Nigerian secondary schools continue to perform poorly in biology examinations (Chief Examiner's report (2013-2018) in Chukwu & Arokoyu, 2019). Several factors contribute to this underachievement, including inadequate instructional resources, ineffective teaching methods, and limited practical exposure. The overreliance on verbal and lecture-based instruction, which often emphasizes memorization rather than comprehension, has been linked to poor retention and understanding of biological concepts. Additionally, infrastructural deficits such as insufficient textbooks, laboratory equipment, and technological tools hinder the delivery of effective instruction. Consequently, many students find biology concepts abstract, leading to disinterest, low motivation, and poor academic performance. These challenges raise concerns about the efficacy of current instructional approaches and underscore the need for empirically supported strategies to enhance student achievement and retention in biology.

This study is significant for several reasons. First, it contributes to the body of knowledge on the role of instructional materials in improving biology education outcomes in the Nigerian context, where educational challenges are prevalent. Findings from this research could inform curriculum developers, educators, and policymakers on effective strategies for integrating diverse instructional resources to enhance student comprehension, retention, and academic performance. Second, the study aligns with global calls for more experiential and learner-centered teaching methodologies, emphasizing multisensory engagement as a means to foster a deeper understanding of science concepts. Third, by identifying the impact of instructional materials, this research provides a practical framework for addressing persistent issues related to poor science achievement, thereby supporting efforts to improve science literacy and foster sustainable development. Ultimately, the results could serve as a basis for implementing more effective teaching practices, not only within Nigeria but also in similar developing countries facing comparable educational challenges.

As the Indian adage suggests, experiential learning, seeing, hearing, and touching, tends to produce more lasting knowledge than mere verbalization. Nonetheless, the overreliance on lecture methods that

emphasize verbal communication alone has contributed to student disinterest and poor academic outcomes (Beigzadeh, Bazyar, Delzende, et.al. 2024). This study seeks to investigate the impact of instructional materials on secondary school students' achievement and retention of biology concepts. The research aims to determine whether the strategic use of diverse educational resources can improve comprehension, retention, and academic performance, thereby addressing persistent challenges in biology education within the Nigerian context.

### 1.1. Purpose of the Study

The general purpose of this study is to examine the influence of instructional materials on the retention of biology concepts among secondary school students in Izzi, Ebonyi State. Specifically, the study will investigate whether the adequate usage of available instructional materials in teaching influences the retention of biology concepts among secondary school students, ascertain how the use of instructional materials enhances the learning effectiveness of biology concepts among these students, and determine how the application of instructional materials in teaching and learning advances the retention of biology concepts.

### 1.2. Research Questions

This study seeks to answer the following research questions:

1. In what way does adequate use of available instructional materials in teaching influence the retention of biology concepts among secondary school students?
2. In what ways does the use of instructional materials enhance the learning effectiveness of biology concepts among secondary students?
3. How does the use of instructional materials in teaching and learning advance the retention of biology concepts among secondary school students?

## 2. METHODOLOGY

### 2.1. Research Design

This study employed a descriptive survey research design to explore the impact of instructional materials on the retention of biology concepts among secondary school students in Izzi, Ebonyi State, Nigeria. This research design is suitable for gathering data that reflects the participants' experiences, perceptions, and behaviors, which are related to the utilization of instructional materials in biology education.

### 2.2. Research Area

The research was conducted in the Izzi Local Government Area, which is located within the Ebonyi North Senatorial Zone of Nigeria. Iboko, which is the administrative center of Izzi, served as the primary area for the study. This area was selected based on the reasons that there are public secondary schools and which is why it is important to the research objectives.

### 2.3. Population, Sample, and Sampling Technique

The population of this study comprised all Senior Secondary II (SSII) students enrolled in the 2023/2024 academic year in public secondary schools within the Izzi Local Government Area, totaling six hundred and three (603) students across eighteen (18) schools. From this population, a sample size of two hundred and forty (240) students was determined utilizing Slovin's method to represent the larger population effectively. The selection aimed to ensure a diverse representation of students from different schools, enhancing the reliability and validity of the research findings. The sample size was selected utilizing a simple random sampling technique to ensure a representative and unbiased sample of SSII students in

Izzi, which will facilitate an accurate examination of the importance of instructional materials on the retention of biology concepts. This will enhance the reliability and validity of the research findings and allow for the practical application of the results, which will be of significance to improve biology education in the local government area.

## 2.4. Data Collection Instrument

A structured questionnaire was used as the primary data collection tool. The questionnaire consisted of two sections: Section A gathered demographic information of the respondents (students), including age, gender, school type, and academic performance, while Section B included items specifically designed to address the research questions of the study, each of which had a total of five questions. The questions were formulated to get responses that reflect the participants' experiences and perspectives regarding the use of instructional materials in biology instruction.

### 2.4.1. Validation of the Instrument

The instrument, which was made up of five items in each section, was subjected to face and content validity by three experts in the Faculty of Education. Two experts in the Department of Science Education (Biology Option) and one in Measurement and Evaluation, all in the Faculty of Education, Ebonyi State University, Abakaliki. The experts vetted each of the items, sentence structure, and adequacy of the instrument. Based on their suggestion and comments, three weak items were dropped from each research question, and the remaining five were restructured for quantitative data collection.

### 2.4.2. Reliability of the Instrument

To establish the reliability of the questionnaire, a test-retest method was employed. The instrument was administered to forty-five (45) SSII students in the Abakaliki Local Government Area of Ebonyi State, Nigeria. It was chosen due to its similarity in cultural, educational, and geographic traits to the Izzi Local Government Area. The results from the two administrations of the questionnaire were analyzed using Pearson's Product-Moment Correlation technique, yielding a reliability coefficient of 0.86. This high reliability score indicated that the instrument was suitable for capturing the necessary data consistently.

## 2.5. Data Collection Procedure

The researchers administered the questionnaire directly to the selected participants. To ensure a high return rate, the questionnaires were distributed and collected immediately after completion. This method minimized the potential for data loss and ensured that all respondents provided their feedback promptly.

## 2.6. Data Analysis

The collected data were analyzed using mean scores and frequency distribution tables. A mean score greater than 2.50 was considered acceptable, while scores below 2.50 were rejected. The cutoff mark of 2.50 was established based on a modified rating scale, with response options assigned the following values: Strongly Agree (SA) = 4 Points, Agree (A) = 3 Points, Disagree (D) = 2 Points, and Strongly Disagree (SD) = 1 Point. The decision rule employed by the researchers stipulated that any mean score below 2.5 would be regarded as negative feedback, while scores above 2.5 would indicate a positive importance of instructional materials on the retention of biology concepts.

## 3. RESULTS

Figure 1 shows the demographic characteristics of students from the eighteen secondary schools in the Izzi local government area of Ebonyi State.

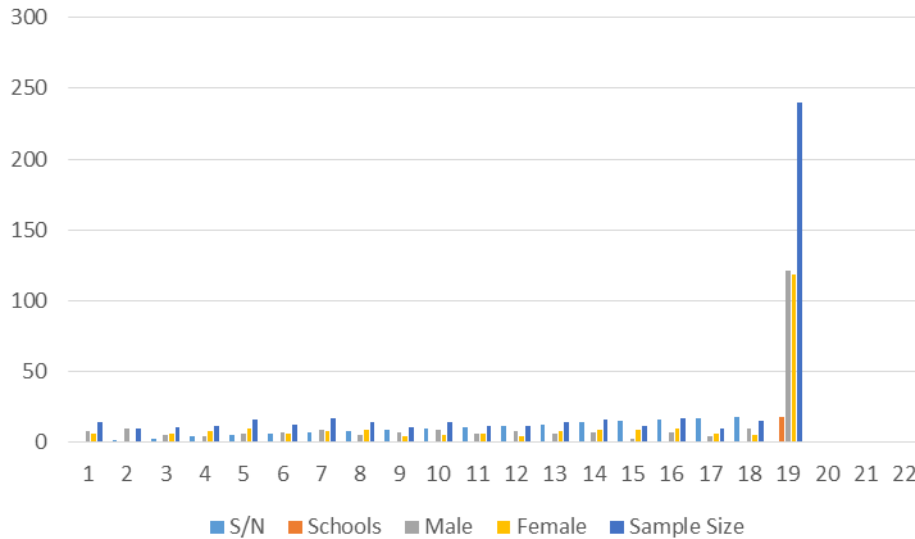


Figure 1. The Demographic Characteristics

**Research question 1:** In what way does adequate use of available instructional materials in teaching influence the retention of biology concepts among secondary school students?

**Table 1.** To Investigate Whether the Adequate Usage of Available Instructional Materials in Teaching Influences the Retention of Biology Concepts among Secondary School Students

S/N	ITEMS	SA 4	A 3	D 2	SD 1	$\bar{N}$	$\bar{X}$	Decision Rule
1.	It helps the biology students recall concepts of biology	120	100	13	7	240	3.38	Accepted
2.	It also helps the biology students in the recognition of biology principles	115	110	10	5	240	3.39	Accepted
3.	It helps the students to perform excellently in biology in their internal examinations	123	102	9	6	240	3.42	Accepted
4.	It helps the students to perform excellently in biology in their external examinations	124	106	7	3	240	3.46	Accepted
5.	Effective utilization of instructional materials helps students in the retention of biology concepts as taught in class	122	98	10	10	240	3.38	Accepted
	Grand Mean						3.40	Accepted

The responses from the respondents on the way adequate use of available instructional materials in teaching influences the retention of biology concepts among secondary school students are in Table 1. The table’s results showed that items 1 through 5 had mean scores of 3.38, 3.39, 3.42, 3.46, and 3.38, respectively. These scores were deemed acceptable as they exceeded the 2.50 cut-off point, as stated by the researchers as the decision rule. This shows that when teaching and learning biology, using the available instructional materials effectively aids students in retaining certain concepts, identifying biology principles, performing exceptionally well on internal and external exams, and retaining concepts that are taught in the classroom. This merely demonstrates how secondary school students’ recollection of biology topics is influenced by the efficient and sufficient use of the teaching materials that are now accessible.

**Research question 2:** In what ways does the use of instructional materials enhance the learning effectiveness of biology concepts among secondary students?

The respondents’ opinions of how the usage of instructional materials improved secondary school students’ understanding and instruction of biology concepts are shown in Table 2. With mean scores of 3.25, 3.00, 3.57, 3.41, and 3.25 for secondary school students, respectively, all items on how the use of

instructional materials enhanced the teaching and learning effectiveness of biology concepts were deemed acceptable by the researchers in the decision rule because they were above the 2.50 cut-off mark. The findings simply show that the respondents thought the use of instructional materials improved the efficiency with which biology concepts were taught and learned because they facilitate biology instruction, give biology students hands-on experience, enhance classroom performance, relieve biology teachers of stress, and aid in classroom management.

**Table 2.** To Ascertain How the Use of Instructional Materials Enhances the Learning Effectiveness of Biology Concepts among Secondary Students

S/N	Items	SA 4	A 3	D 2	SD 1	$\bar{N}$	$\bar{X}$	Decision Rule
1.	It makes teaching and learning biology easy	113	87	27	13	240	3.25	Accepted
2.	It helps provide the students of biology with firsthand experience	117	83	24	16	240	3.00	Accepted
3.	Students' performance in the classroom when learning biology is influenced by the use of instructional materials.	153	77	6	4	240	3.57	Accepted
4.	It makes the biology teacher teach without stress.	128	92	12	8	240	3.41	Accepted
5.	The effective use of instructional materials helps biology teachers manage their classroom	100	105	15	20	240	3.25	Accepted
	Grand Mean						3.29	Accepted

**Research Question 3.** How does the use of instructional materials in teaching and learning advance the retention of biology concepts among secondary school students?

The responses from each of the respondents regarding how the use of instructional materials in teaching and learning increased secondary school students' understanding and retention of biology concepts are presented in Table 3. With mean scores of 3.47, 3.36, 2.94, 3.16, and 3.32, respectively, all of the items under how the use of instructional materials in teaching and learning advanced the understanding and retention of biology concepts among secondary school students were deemed acceptable, according to the table's results. This suggests that the respondents supported the idea that the use of instructional materials in teaching and learning advanced secondary school students' comprehension and retention of biology concepts because it fosters better understanding, makes it easier to explain abstract ideas, enhances learning capacity, develops better study habits, and piques students' interest in the subject matter.

**Table 3.** To Determine How the Application of Instructional Materials in Teaching and Learning Advances the Retention of Biology Concepts

S/N	Items	SD 4	A 3	D 2	SD 1	$\bar{N}$	$\bar{X}$	Decision Rule
1.	Instructional materials increase understanding and retention of what is taught	135	90	9	6	240	3.47	Accepted
2.	Instructional materials facilitate the explanation of abstract concepts to biology students	120	98	12	10	240	3.36	Accepted
3.	Instructional materials improve students' learning ability	100	80	26	14	240	2.94	Accepted
4.	Instructional materials improve biology students' study habits	104	91	25	20	240	3.16	Accepted
5.	Instructional materials motivate biology students' interest in the classroom	110	109	11	10	240	3.32	Accepted
	Grand Mean						3.25	Accepted

#### 4. DISCUSSION

The result of these findings as summarized in Table 1 shows that students overwhelmingly agreed that adequate utilization of available instructional materials in teaching and learning influences retention of biology concepts among secondary school students in Izzi Local Government Area of Ebonyi State because it helps them in recalling some concepts, recognition of biology principles, perform excellently in their

internal and external examinations and as well, helps them in retention of concepts as taught in the classroom. This aligns with the findings of Chigbu et al. (2023), highlighting that students who engage with different instructional tools tend to have better retention rates when compared to those who rely only on textbooks or lessons. Similarly, this study is supported by the study from several educational studies, which show that visual and hands-on materials can significantly improve cognitive recognition of scientific concepts (Maizaliani et al., 2024). Additionally, according to Bwenvu (2023), students are more likely to perform well in both internal and external examinations when they can combine studied materials with practical examples, and exposure to a well-rounded education experience will, in turn, improve academic outcomes. The implication here is clear: instructional materials serve as vital scaffolding that bolsters both learning and academic performance. Finally, the results align with the conceptual framework that was established by an educational theorist who highlights experiential learning and multisensory engagement in education (McPherson-Geysler et al., 2020). The emphasis placed on retention in this study resonates with the findings of Salani and Sethukge (2024), who find that students often underperform when confined to traditional instructional methods that lack material variety. While these results from items 1-5 reveal only positive responses, it is also very important to look at the contrasting results from different contexts. For instance, research in more resource-limited settings may indicate that students face barriers to accessing instructional materials, leading to diminished retention and understanding (Afolabi & Adeleke, 2010; Areachot, 2023). In such cases, despite the acknowledged value of instructional materials, the practical implementation remains a challenge due to a lack of availability or quality. Furthermore, some studies have shown that overreliance on instructional materials can lead to superficial learning, where students may memorize content without truly understanding underlying principles. This highlights the importance of not only utilizing instructional materials but also ensuring their integration into a comprehensive teaching strategy that emphasizes critical thinking and understanding.

The results of these findings, as shown in Table 2, indicate that students (respondents) strongly agreed with the use of instructional materials because they facilitate biology teaching and learning, give biology students first-hand experience, enhance student performance in the classroom, allow biology teachers to teach without stress, and assist teachers in maintaining classroom management. The results are consistent with those of Omariba et al. (2017) and Marielle et al. (2024), who suggested that the utilization of educational resources improves biology academic performance, fosters scientific reasoning, and promotes the teaching and learning of the subject. Similarly, research by Mayer (2020) indicated that multimedia instructional materials can significantly enhance learning outcomes by providing multiple pathways to understanding complex concepts. Furthermore, research highlights that hands-on activities in biology labs, supported by instructional materials, greatly enhance students' engagement and understanding (Lazaro & Paglinawan, 2025). Such experiences are shown to significantly improve retention and application of biology concepts in real-world scenarios. Also, studies have shown that students who use a mix of instructional tools consistently achieve greater academic outcomes and show greater engagement when compared to those relying solely on the lecture method. This suggests a strong correlation between instructional material and academic performance. Additionally, studies have shown that teachers equipped with the right instructional materials often report feeling more confident in their teaching pedagogy, which leads to better classroom management and student engagement (Shah, 2023). Finally, research by Umuhoza and Uworwabayeho (2021) reveals that teachers who employ structured instructional materials report greater classroom discipline and student participation. This correlation suggests that clear, well-implemented instructional strategies contribute positively to classroom management. While there are positive results, there is a need to look at the contrasting results. Some studies have shown that poorly designed and organized instructional materials can confuse students rather than facilitate learning. In areas where resources are inadequately aligned with the stated learning objectives, students may still struggle, underscoring the importance of not just having the instructional materials but having high-quality, well-structured materials. However, there are schools where there is a lack of instructional materials to implement hands-on experiences effectively, and students may miss out on these practical applications. In some instances, reliance on traditional methods can lead to limited understanding, as demonstrated by Afolabi and Adeleke (2010) and Miremba (2024) emphasized that barriers to access can diminish the benefits of purportedly effective instructional materials. In some cases, it is important to note that some research reveals that it is not all about having access to these instructional materials that is sufficient for enhancing academic performance; pedagogical skills and teaching strategies (Odinakachi et al., 2023), and that without effective teaching, even the best-designed instructional materials may not yield the desired

educational results. Furthermore, it is important to note that if teachers lack training on how to effectively utilize these materials, they feel unprepared or overwhelmed by the materials, which can result in increased anxiety and diminished teaching effectiveness (D'Angelo et al., 2023). Finally, in some contexts, dependence on instructional materials might lead to teacher dependency, where teachers may struggle with classroom management if materials are unavailable or if students participate with them passively rather than actively (Akaba & Audu, 2023).

The results of the findings are summarized in Table 3, which shows that students strongly agreed that the use of instructional materials in teaching and learning increases understanding, facilitates the explanation of abstract concepts, improves learning ability, improves study habits, and is a means of piquing students' interest in the material. The results align with those of Aina (2023), who believed that teachers' resourcefulness determines how successful their lessons are. To improve teaching and learning, it is generally beneficial for dedicated teachers in all subject areas to participate in the daily activities in the classroom that entail the use of instructional materials. Thus, during teaching, teaching aids should always be utilized. The process of giving the student practical information is made easier by the use of instructional material. Similarly, research by Hattie (2009) and Wisniewski et al. (2019) has shown that the effective use of instructional materials leads to a significant increase in student achievement and retention. Also, research by Abdulrahman et al. (2020) supports the idea that students exposed to different instructional formats, such as infographics and interactive models, better understand complicated topics. Furthermore, findings from previous studies suggest that by engaging multiple learning modalities, instructional materials can help strengthen cognitive processes involved in learning, thus improving overall learning abilities. Therefore, the presence of structured instructional materials can guide students toward better study habits and organization. Studies also suggest that students who utilize different resources, such as study guides and interactive quizzes, tend to develop more disciplined and effective study habits (Somuah et al., 2014). Finally, research by Jafari (2024) has demonstrated that the use of different instructional materials enhances student motivation and interest in subjects. Engaging students' interests through multimedia presentations and interactive activities can lead to deeper educational participation. Looking at the results analysis from Table 3, it shows positive results with supporting results; therefore, there is a need to look at the contrasting results. While many studies endorse the positive effects of instructional materials, others have indicated that their effectiveness can be contingent upon factors such as the quality and relevance of the instructional materials used. Green (2023) emphasizes that poorly designed materials may lead to confusion rather than clarity, which can hinder retention; however, there is a need to recognize that students are from different backgrounds and they respond differently to various instructional materials. For instance, some students may struggle with visual learning styles, preferring textual information and direct instruction instead. Similarly, some research highlights that an overemphasis on instructional materials might lead to a passive learning approach instead of an active approach, where students depend on the instructional materials instead of actively engaging with the content (Afolabi & Adeleke, 2010). This can diminish critical thinking skills, making the learning experience less effective. Furthermore, the implication of improved study habits can also vary based on individual differences. For instance, if students fail to engage with the instructional materials proactively, they may not develop enhanced study habits despite having access to different materials. Without effective guidance on how to use these materials, the expected improvement in study habits may not be fully realized at the end (Ebele & Olofu, 2017). However, some findings indicate that if instructors overly rely on beautiful instructional materials without connecting what is presented to the curriculum objectives, then students may perceive the material using it as superficial entertainment rather than serious educational content (Hattie, 2009). This points to the necessity of balancing motivational tools with substantial educational outcomes.

## 5. CONCLUSIONS

The findings from this research underscore the critical role of instructional materials in enhancing the retention and understanding of biology concepts among secondary school students in Izzu Local Government Area of Ebonyi State, Nigeria. Across all three research questions, students indicated a strong agreement regarding the effectiveness of these materials, highlighting their influence on various aspects of the learning process, including recall, recognition, academic performance, and student engagement. The consistent positive results align well with existing literature that emphasizes the value of interactive, visually engaging, and hands-on instructional tools in improving educational outcomes. However, it is essential to

acknowledge the contrasting results observed in different contexts, which reveal that factors such as material quality, accessibility, and implementation can significantly impact the effectiveness of instructional resources. Ensuring that teachers are well-equipped and trained to utilize these materials effectively is also paramount in maximizing their benefits.

### 5.1. Practical Implications of the Study

This study explores the impacts of instructional materials in enhancing biology education at the secondary school level and has vital implications for educational stakeholders such as teachers, students, policymakers, and educational administrators.

- a. For teachers: Integrating different types of instructional material, like visual aids, models, multimedia resources, and interactive activities, can boost students' conceptual retention and foster active learning environments. Teachers should be encouraged to integrate these materials to make abstract biology concepts simpler and engaging. To achieve an engaging class, professional development training, workshops, seminars, and conferences that focus on the utilization of instructional resources are important. Such training can equip teachers with diverse pedagogical skills that ensure alignment with curriculum objectives, thereby facilitating a better active classroom environment and student understanding of biology concepts.
- b. For students: The utilization of instructional material for the teaching of biology lessons not only makes the lessons interesting and engaging but also fosters a deeper understanding of the biology concepts. It will also help students develop better study habits and longer retention of information, which will lead to improved academic performance.
- c. For policymakers and school administrators: There is a need for the integration of instructional material when planning the curriculum, and during budgeting of educational resources, especially in rural schools where access to educational resources is limited. There should be policies that focus on making the resources available, and also investing in infrastructure that ensures the continuous teacher training to create an enabling environment that improves the quality of science education globally, promotes equal learning opportunities for diverse learners, which will lead to improved educational performance across diverse school environments.

### 5.2. Theoretical Implications of the Study

This study's findings have significant implications for current learning theories and instructional design in scientific education. The findings corroborate the legitimacy of experiential learning theories that highlight the significance of varied instructional resources for effective education. The positive correlation between instructional materials and retention corresponds with Vygotsky's Social Constructivist Theory, which underscores the significance of active, experiential, and collaborative learning in knowledge formation. Moreover, the use of visual and multimedia resources reinforces the notion that learners construct understanding through engagement with diverse stimuli. The findings also corroborate Howard Gardner's Multiple Intelligences Theory, which posits that employing various teaching modalities, such as visual, aural, and kinesthetic, accommodates diverse learning environments, hence enhancing understanding of concepts and retention. This corresponds with the study's findings that multisensory and diverse instructional techniques augment engagement, active learning, and comprehension, affirming that effective science instruction caters to various intelligences to optimize learning outcomes. The results contest behaviorist models that prioritize rote memorization and passive learning, demonstrating that well-designed instructional materials not only encourage rote learning but also cultivate critical thinking, inquiry, and active participation, which are fundamental to Constructivist and Inquiry-Based Learning Theories. Effective instructional design, as indicated by the findings, should incorporate resources that foster problem-solving, experimentation, and adherence to constructivist learning principles through experiential engagement. The identified challenges and contradictions in resource-constrained environments and varied student backgrounds indicate that current models must incorporate equity and individual differences, thereby strengthening the socio-cultural aspect of learning frameworks like Lave and Wenger's Situated Learning Theory. The findings indicate that the design of instructional materials must be flexible, contextually

relevant, and inclusive to meet diverse learner needs, hence fostering a more comprehensive and student-centered approach to science teaching.

### 5.3. Recommendations

To enhance the effectiveness of instructional materials in biology education, educational stakeholders must implement a series of strategic recommendations. Firstly, there should be a strong emphasis on quality assurance, ensuring that high-quality instructional materials are developed and provided, which align with the biology curriculum and learning objectives. Additionally, establishing professional development programs will equip teachers with the necessary skills to effectively integrate these materials into their teaching practices, including training on how to select, adapt, and implement resources that cater to diverse learning styles. Furthermore, educators are encouraged to adopt a mixed approach by utilizing various instructional strategies and materials, ranging from traditional textbooks to multimedia and hands-on experiences, to promote active student engagement. Regular assessments and feedback mechanisms should be implemented in schools to evaluate the effectiveness of instructional materials in facilitating student learning and retention, fostering continuous improvement in educational practices. Moreover, efforts must be made to enhance access to instructional materials, especially in resource-limited settings, ensuring that all students can benefit from effective teaching tools. Ultimately, instruction should go beyond rote learning; integrating strategies that promote critical thinking and understanding will enable students to engage more deeply with the content. By embracing these recommendations, educational stakeholders can significantly improve the overall teaching and learning experience in biology, ultimately leading to better academic outcomes for students.

### 5.4. Limitations of the Study

Notwithstanding the significant information presented in this study, several limitations must be acknowledged, which may impact the generalizability and interpretation of the results. The study was conducted in the Izzi Local Government Area of Ebonyi State, potentially restricting the generalizability of the findings to other local government areas and states that may exhibit varying resource availability, teacher training levels, and student demographics, all of which can affect the efficacy of instructional materials. The sample size and demographic attributes of the respondents in this study may influence the generalizability of the findings to the wider population of secondary school pupils. If the sample was inadequate in size or diversity, it may not comprehensively represent the spectrum of experiences related to the use of instructional materials. The study relies significantly on self-reported data from students, which may be influenced by biases, such as respondent bias, potentially exaggerating the positive perception of instructional materials. The study ultimately neglects to consider variables such as the quality and type of instructional materials employed, as well as the pedagogical competencies of educators, which are significant factors affecting the efficacy of instructional resources but may not have been adequately controlled or analyzed.

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**Research Ethics.** This research on the impacts of instructional materials in enhancing biology concepts retention among secondary schools in Izzi, Ebonyi State, Nigeria, was approved by the Department of Science Education Research Ethics Committee of Ebonyi State University, Nigeria.

**Consent to Participate.** Participants in the study consented by signing an informed consent form, after being fully told about the study's objectives regarding the impacts of instructional materials in enhancing biology concepts retention among secondary schools in Izzi, Ebonyi State, Nigeria.

**Data Availability Statement.** The researchers declared the availability of the data used in the research.

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