

ASSESSING THE IMPACT OF DIRECT AND INDIRECT PEDAGOGICAL APPROACHES ON SCIENCE LITERACY AND LEARNING EXPERIENCES IN BASIC SCIENCE AND TECHNOLOGY FOR JUNIOR SECONDARY SCHOOL STUDENTS

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Abstract

This study aimed to determine students' perceptions of pedagogical approaches used by Basic Science and Technology (BST) teachers in junior secondary schools in Enugu State, with a particular focus on their impact on science literacy and learning experiences. A descriptive survey research design was adopted, targeting a population of 3,796 students, from which a sample of 797 (348 urban and 449 rural students) was selected through simple random sampling. Data were collected using a structured questionnaire titled 'BST Pedagogical Approaches and Science Literacy Questionnaire' (BSTPASLQ), developed after an extensive review of relevant literature. The questionnaire comprised two parts: Part I collected demographic data, while Part II contained 79 items grouped into five sections (A–E) on a five-point Likert scale, ranging from Very Effective - 5 to Very Ineffective - 1. The instrument was face-validated by three experts from the Department of Industrial Technical Education, University of Nigeria, Nsukka. Internal consistency was established using the Cronbach alpha method, yielding an overall reliability coefficient of .88. A total of 797 questionnaires were administered to students in urban and rural areas with the help of two research assistants. Of these, 741 (93%) were retrieved and analyzed using the Statistical Package for Social Sciences (SPSS). Means and t-test statistics were used to answer research questions and test hypotheses at a .05 significance level. Findings revealed that students perceived both direct and indirect pedagogical approaches as ineffective in enhancing their BST learning experiences and science literacy development. This suggests a need for instructional strategies that actively promote conceptual understanding, critical thinking, and problem-solving skills in science education. Based on the results, recommendations were made, including encouraging BST teachers to adopt pedagogical approaches that foster science literacy, thereby improving the teaching and learning of BST in junior secondary schools in Enugu State.

Key Words: Direct Approach, Indirect Approach, Science Literacy, Learners' Experiences, Basic Science and Technology

Introduction

Basic Science and Technology (BST) encompasses the study of fundamental principles and the acquisition of essential skills in science and technology, which are crucial for addressing life's challenges and achieving sustainable development. Publications (2018) defined BST as the study of the fundamental principles and acquisition of basic skills in science and technology needed for combating life challenges and achieving sustainable development. At the junior secondary level in Nigeria, BST serves as an introductory subject, laying the groundwork for advanced studies in disciplines such as Biology, Physics, Chemistry, and Technical Drawing (Barrett, et al., 2019). The curriculum integrates themes including basic science, basic technology, physical and health education, and information technology (Federal Republic of Nigeria (FRN), 2013). A critical outcome of BST education is science literacy, which refers to students' ability to apply scientific concepts and reasoning to real-world problems, make informed decisions, and participate meaningfully in society (UNESCO, 2021).

The incorporation of BST into the junior secondary curriculum aims to foster innovative teaching and learning approaches that promote science literacy, creativity, and critical thinking. Science literacy enables students to analyze and interpret scientific data, evaluate technological advancements, and understand their implications for everyday life (Yu et al., 2020). Furthermore, it equips learners with the competencies necessary to navigate a rapidly changing world and address emerging national and global challenges such as climate change, disaster risk reduction, and technological advancements (Arnhold & Bassett, 2021). Researchers like Olaleye et al. (2022)

emphasize that BST plays a crucial role in equipping students with scientific reasoning and problem-solving skills that are essential for the 21st century. The objectives of BST include developing interest in science and technology, acquiring scientific knowledge and skills, applying these competencies to meet societal needs, and preparing students for careers in STEM fields (Igbokwe, 2015). To achieve these objectives, effective pedagogical approaches that promote both science literacy and meaningful learning experiences must be implemented.

Pedagogical approaches, as defined by Mkpa (2009), are the principles, methods, and techniques employed by teachers to maximize learning and facilitate science literacy. The selection of appropriate instructional strategies is crucial, as ineffective teaching methods can hinder students' ability to engage with scientific concepts and apply them in real-world situations. These approaches are broadly categorized into direct and indirect methods, both of which play significant roles in BST instruction and the development of science literacy. Direct pedagogical approaches involve explicit teaching methods where the teacher leads the learning process, providing clear instructions, structured explanations, and demonstrations. These approaches often include lectures and step-by-step problem-solving sessions, which ensure that students acquire foundational scientific knowledge and basic literacy in science concepts (Tebabal & Kahssay, 2011). While direct instruction is effective in introducing new concepts and ensuring clarity, it may limit students' engagement, inquiry, and practical application of scientific ideas (Offorma, 2018). This limitation can affect the development of science literacy, as students may focus on memorization rather than understanding how scientific principles apply to real-world situations.

In contrast, indirect pedagogical approaches emphasize student-centered learning, encouraging exploration, inquiry, and discovery. Methods such as problem-based learning, inquiry-based learning, and collaborative projects promote critical thinking, creativity, and scientific inquiry, which are key components of science literacy (Ganyaupfu, 2013). Indirect approaches align with the principles of constructivist learning theories, which suggest that students learn best when they actively engage with content and construct their own understanding through experimentation and discussion (Chang, 2010). These methods foster higher-order thinking skills and prepare students to apply scientific knowledge in diverse contexts, an essential aspect of science literacy. However, while indirect approaches enhance engagement and conceptual understanding, they may require more time and instructional scaffolding to ensure students develop a solid grasp of complex scientific ideas (PytlikZillig et al., 2018).

Students' perceptions of these pedagogical approaches play a crucial role in their effectiveness. Perceptions encompass students' attitudes, experiences, and engagement levels in response to instructional strategies (Chang, 2010). A study by Eze and Ofoegbu (2023) found that indirect methods significantly enhance motivation and performance in BST by allowing students to actively participate in the learning process and develop problem-solving skills essential for science literacy. However, balancing both direct and indirect approaches is crucial for fostering well-rounded science literacy, ensuring that students develop foundational knowledge while also acquiring the ability to think critically, analyze data, and apply scientific reasoning in their everyday lives (Mtsem, 2011). This study focuses on evaluating the impact of direct and indirect

pedagogical approaches on students' science literacy and learning experiences in BST. Understanding how different instructional strategies shape students' interest, engagement, and conceptual understanding will provide insights into how best to enhance science education and literacy at the junior secondary level. Given the variations in educational resources and teacher expertise across school locations, the study also seeks to explore how school environments influence students' perceptions and experiences with different pedagogical approaches. Ultimately, the findings will contribute to improving science education in Nigeria, ensuring that students develop scientific knowledge, problem-solving skills, and the ability to apply science literacy in their daily lives and future careers.

Statement of the Problem

The call for Basic Science and Technology (BST) teachers in junior secondary schools to adopt instructional approaches that facilitate the effective and seamless transmission of BST knowledge and skills to students, in line with global best practices, has continued to grow. This emphasis is driven by persistent poor performance in BST, as evidenced in both internal and external examinations. For instance, the Basic Education Certificate Examination (BECE) results in Enugu State (2019) revealed widespread underachievement, leading to a decline in students' interest and motivation in BST. This challenge undermines the achievement of the subject's stated aims, goals, and objectives. A critical aspect of this issue is the lack of science literacy among students, which stems from the predominant use of theoretical instructional approaches rather than practical, inquiry-based, and hands-on learning experiences. Science literacy, which encompasses the ability to apply scientific knowledge to real-world situations, critically analyze information, and

engage in problem-solving, is essential for 21st century competencies. However, many students graduate from junior secondary school without the foundational scientific skills and critical thinking abilities needed for further studies or entry into technology-driven careers. This gap highlights the inadequacy of traditional pedagogical methods in fostering science literacy and preparing students for the evolving demands of the modern workforce.

Researchers have linked the low science literacy and poor academic performance of BST students to the broader issue of workforce readiness, as many students struggle to pursue careers in science, technology, and related fields. Furthermore, students who advance to senior secondary school often exhibit low interest in BST-related subjects, and those who do enroll tend to perform poorly in external examinations due to weak foundational knowledge from their junior secondary school years. Although BST remains a compulsory subject for Junior Secondary School (JSS) I - III students, engagement levels vary significantly, and this disengagement is often linked to ineffective instructional delivery rather than an inherent lack of interest in the subject. The persistent challenge is not necessarily the absence of diverse instructional approaches in BST classrooms but rather the uncertainty surrounding which pedagogical strategies are most effective in enhancing students' science literacy, improving academic performance, and fostering motivation and interest in the subject. To address this, there is a need to investigate the specific instructional approaches that students perceive as effective in facilitating science literacy and meaningful learning experiences in BST at the junior secondary school level.

Purpose of the Study

The major purpose of this study was to determine students' perceptions of pedagogical approaches utilized by BST teachers in junior secondary schools in Enugu State. Specifically, the study sought to determine students' perceptions of:

1. direct pedagogical approaches employed by BST teachers in junior secondary schools in Enugu State.
2. indirect pedagogical approaches employed by BST teachers in the junior secondary schools.

Method of the Study

This study employed a survey research design to analyze students' perceptions of effective pedagogical approaches for teaching Basic Science and Technology (BST) and their impact on science literacy in junior secondary schools. According to Nworgu (2015), survey research involves studying a population or sample using instruments such as questionnaires. This design was appropriate as it enabled the collection of students' opinions on how direct and indirect pedagogical approaches influence their understanding of scientific concepts, ability to apply scientific knowledge, and development of critical thinking skills, key components of science literacy.

The study was conducted in Enugu State, Nigeria, covering 60 public secondary schools. These schools were selected due to the persistent low academic performance in BST, which has been linked to students' lack of interest, motivation, and limited science literacy skills. The research population comprised 3,796 Junior Secondary School III (JSS III) students in the Nsukka Education Zone, as documented by the Enugu State Post Primary School Management Board (PPSMB). These students were considered suitable

respondents because they had completed two years of BST education, positioning them to provide informed perspectives on the effectiveness of different pedagogical methods in fostering their ability to interpret, evaluate, and apply scientific knowledge in real-world contexts.

From this population, a sample of 797 students was selected using simple random sampling to ensure equal opportunity for participation. The sample included 348 students from urban schools and 449 from rural schools, thereby capturing the influence of diverse learning environments on science literacy development. The Taro Yamane formula was used to determine the sample size.

Data collection was carried out using a structured questionnaire titled the Basic Science and Technology Pedagogical Approaches and Science Literacy Questionnaire (BSTPASLQ), which was developed from an extensive review of literature on science education and pedagogy. The questionnaire was divided into two main parts. The first part collected demographic data, while the second part comprised 27 items categorized into two sections, each focusing on direct and indirect pedagogical approaches and their impact on students' conceptual understanding, problem-solving skills, and practical application of scientific knowledge. The response options were based on a five-point Likert scale ranging from Very Effective to Very Ineffective, which allowed for an assessment of the extent to which pedagogical approaches enhanced students' ability to comprehend scientific texts, interpret data, engage in scientific inquiry, and apply learned concepts to everyday problems.

To ensure validity, the instrument was face-validated by three experts from the

Department of Industrial Technical Education, University of Nigeria, Nsukka. These experts reviewed the questionnaire items for clarity, relevance, and alignment with science literacy components. Their feedback led to revisions that improved the instrument's ability to measure students' experiences with different pedagogical methods and their effects on scientific reasoning and literacy development.

Reliability was established using the Cronbach Alpha method, with a pilot test conducted among 20 BST students in the Obollo-Afor Education Zone, an area outside the study's primary focus but with similar characteristics. The reliability analysis conducted using SPSS yielded coefficients of .86 and .90 for the two research questions, with an overall reliability score of .88, indicating high internal consistency.

The researchers personally administered the questionnaire with assistance from two trained aides, ensuring efficient distribution and retrieval of responses. The instruments were collected within two weeks, achieving a high retrieval rate of 93%, as 741 out of 797 questionnaires were successfully returned.

Data analysis was conducted using mean scores, standard deviation, and t-tests. Mean scores were used to answer the research questions, providing insights into students' perceptions of how pedagogical approaches influence their science literacy skills, including critical thinking, experimentation, and data interpretation. Standard deviation was used to assess the variability of responses, ensuring a robust measure of students' experiences. Hypothesis testing was conducted at a .05 significance level, with hypotheses retained if the p-value was greater than or equal to .05 and rejected if it was less than 0.05.

Statistical analyses were carried out using SPSS version 22.

Results

Research Question 1: What are students' perceptions of direct instructional approaches employed by BST teachers in junior secondary schools in Enugu State?

The data presented in Table 1 below revealed that items 1, 5, 6, 7, 11 and 13 had means ranging from 2.50 – 3.49, indicating that the respondents perceived the instructional

approaches as 'fairly effective' when used in the teaching of BST in junior secondary schools in Enugu State by teachers. In the same vein, the means of items 2, 3, 4, 8, 9, 10, 12 and 14 that ranges between 1.50 – 2.49 shows that the respondents perceived the instructional approaches as 'ineffective' when used by teachers in the teaching of BST in junior secondary schools in Enugu State. The Table also showed that the standard deviations (SD) of all the items are within the range of 0.48 to 1.38 and are positive which indicated that the respondents were not very far from one another in their responses.

Table 1: Mean Responses of the Respondents on Students' Perceptions of Direct Instructional Approaches Employed by BST Teachers in Junior Secondary Schools in Enugu State

S/N	Item Statement	Mean	SD	Decision
1	Individualized instruction	2.71	.95	FE
2	Information, Advice and Guidance (IAG)	2.13	.69	I
3	Lecture	2.28	1.26	I
4	Cognitive Instruction	2.43	.89	I
5	Inductive Instruction	2.71	1.31	FE
6	Compare and contrast	2.57	.53	FE
7	Reciprocal peer tutoring (RPT)	2.57	.97	FE
8	Guided and shared Reading	2.00	1.15	I
9	Listen and visualize	1.71	.75	I
10	Structure overview	2.00	.81	I
11	Explicit teaching	2.57	.97	FE
12	Didactic questions	1.71	.48	I
13	Demonstrations	3.28	1.38	FE
14	Imitation of guest speaker	1.71	.95	I

Key: SD = Standard Deviation, VE = Very Effective, E = Effective, FE = Fairly Effective, I = Ineffective, VI = Very Ineffective

Hypothesis 1: There is no significant difference between the mean responses of Urban and Rural students' perceptions of direct instructional approaches employed by Basic Science and Technology teachers in junior secondary schools.

Table 2: The t-test Analysis of the Mean Responses of Respondents on Students' Perceptions of Direct Instructional approaches Employed by Basic Science and Technology Teachers in Junior Secondary Schools in Enugu State

S/N	Items Statements	X ₁	S.D ₁	X ₂	S.D ₂	t-cal	Sig.	Decision
1.	Individualized instruction	2.25	.96	3.33	.57	1.72	.15	NS
2.	Information, Advice and Guidance (IAG)	2.25	.50	2.00	1.00	.44	.68	NS
3.	Lecture	3.00	1.60	3.66	.57	.66	.54	NS
4.	Cognitive Instruction	2.25	.95	2.00	1.00	.34	.75	NS
5.	Inductive Instruction	3.25	1.50	2.00	1.00	1.24	.27	NS

6.	Compare and contrast	2.50	.57	2.66	.54	.38	.72	NS
7	Reciprocal peer tutoring (RPT)	2.75	.50	2.33	1.55	.52	.62	NS
8	Guided and shared Reading	2.25	1.22	1.66	1.15	.63	.56	NS
9	Listen and visualize	2.00	.81	1.33	.57	1.20	.29	NS
10	Structure overview	1.75	.95	2.33	.54	.92	.40	NS
11	Explicit teaching	2.75	1.25	2.33	.74	.52	.62	NS
12	Didactic questions	1.75	.50	1.66	.74	.21	.08	NS
13	Demonstrations	3.25	.95	3.33	2.17	.07	.95	NS
14	Imitation of guest speaker	1.75	.95	1.67	1.47	.11	.91	NS

Key: N_1 = Total Number of Basic Science and Technology Students in Urban Settlements, N_2 = Total Number of Basic Science and Technology Students in Rural Settlements; X_1 = Mean of Basic Science and Technology Students in Urban Settlements, X_2 = Mean of Basic Science and Technology Students in Rural Settlements; SD_1 = Standard Deviation of Basic Science and Technology Students in Urban Settlements, SD_2 = Standard Deviation of Basic Science and Technology Students in Rural Settlements; df = Degree of Freedom (739), Sig = Significance Level (2 tailed); $t-cal.$ = calculated values of t-test on SPSS; S = significant, NS = Not Significant

Data presented in Table 2 revealed that each of the 14 items had probability values that is greater than the probability value of .05. This indicated that there was no significant difference in the mean responses Urban and Rural students' perceptions of direct instructional approaches employed by Basic Science and Technology teachers in junior secondary schools. Therefore, the stated null hypothesis of no significant difference was upheld.

Research Question 2: What are students' perceptions of indirect instructional approaches employed by BST teachers in the junior secondary schools?

Table 3: Mean Responses of the Respondents on Students' Perceptions of Indirect Instructional Approaches Employed by BST Teachers in Junior Secondary Schools in Enugu State

S/N	Item Statement	Mean	SD	Decision
15	Inquiry-based instruction	1.71	.79	I
16	Assignments	1.72	.75	I
17	Questioning Technique	1.86	.89	I
18	Read and Practice	1.57	.55	I
19	Pre-test	1.57	.78	I
20	Learning by Teaching	3.28	1.25	FE
21	Concept formation	3.14	1.34	FE
22	Concept attainment	2.57	.97	FE
23	Committee/Group work	2.71	.95	FE
24	Report Back Session	3.00	1.00	FE
25	Concept sketches	2.42	.78	I
26	Pre-reading	2.57	.97	FE
27	Cloze procedure	2.14	.91	I

Key: SD = Standard Deviation, VE = Very Effective, E = Effective, FE = Fairly Effective, I = Ineffective, VI = Very Ineffective

The mean value of items 20, 21, 22, 23, 24 and 26 as reported in Table 3 falls within 2.50 to 3.49. This indicates that the instructional approaches' items are seen to be 'fairly effective' when used

by teachers in the teaching of BST in junior secondary schools in Enugu State. On the other hand, items 15, 16, 17, 18, 19, 25 and 27 were perceived by the respondents to be 'ineffective'

when used in the teaching of BST in junior secondary schools in Enugu State by teachers. This is because their mean responses fall within 1.50 – 2.49 on the scale. Meanwhile, all the items had their standard deviations (SD) ranging from .55 to 1.34 which implies that the respondents were very close to one another in

their responses.

Hypothesis 2: There is no significant difference between the mean responses of Urban and Rural students’ perceptions of indirect instructional approaches employed by Basic Science and Technology teachers in junior secondary school

Table 4: t-test Analysis of the Mean Responses of Respondents on Students’ Perceptions of Indirect Instructional approaches Employed by Basic Science and Technology Teachers in Junior Secondary Schools in Enugu State

S/N	Items Statements	X ₁	S.D ₁	X ₂	S.D ₂	t-cal	Sig.	Decision
15	Inquiry-based instruction	1.75	.18	1.66	.57	.13	.90	NS
16	Assignments	2.00	.50	1.33	.81	1.20	.29	NS
17	Questioning Technique	2.25	.53	1.33	.81	1.45	.21	NS
18	Read and Practice	1.50	.60	1.66	.87	.38	.72	NS
19	Pre-test	1.50	.37	1.67	.78	.26	.81	NS
20	Learning by Teaching	2.75	.43	4.00	.85	1.41	.22	NS
21	Concept formation	3.00	.58	3.33	.76	.30	.78	NS
22	Concept attainment	2.50	.34	2.66	.84	.21	.85	NS
23	Committee/Group work	2.75	.51	2.66	.77	.11	.92	NS
24	Report Back Session	2.75	.46	3.33	.87	.73	.60	NS
25	Concept sketches	2.75	.50	2.00	.77	1.32	.24	NS
26	Pre-reading	2.75	.00	2.33	.60	.52	.62	NS
27	Cloze procedure	2.00	.57	2.33	.69	.45	.67	NS

Key: N_1 = Total Number of Basic Science and Technology Students in Urban Settlements, N_2 = Total Number of Basic Science and Technology Students in Rural Settlements; X_1 = Mean of Basic Science and Technology Students in Urban Settlements, X_2 = Mean of Basic Science and Technology Students in Rural Settlements; SD_1 = Standard Deviation of Basic Science and Technology Students in Urban Settlements, SD_2 = Standard Deviation of Basic Science and Technology Students in Rural Settlements; df = Degree of Freedom (739), Sig = Significance Level (2 tailed); t-cal. = calculated values of t-test on SPSS; S = significant, NS = Not Significant

The t-test analysis of the responses of Urban and Rural students’ perceptions of indirect instructional approaches employed by Basic Science and Technology teachers in junior secondary schools as presented in Table 4 revealed that all the 13 items had probability values which are greater than the probability value of .05. This implies that there was no significant difference in the mean responses Urban and Rural students’ perceptions of indirect instructional approaches employed by Basic Science and Technology teachers in junior secondary schools. Therefore, the null

hypothesis of no significant difference was accepted for all the items.

Discussion of Findings

The findings were discussed in relation to the research questions and hypotheses.

Students’ Perceptions of Direct Instructional approaches Employed by Basic Science and Technology Teachers in Junior Secondary Schools in Enugu State

The findings of this study indicate that most direct instructional approaches used by

BST teachers in junior secondary schools in Enugu State were perceived by students as either fairly effective or ineffective. Instructional strategies with mean scores between 2.50–3.49 were rated "fairly effective," while those between 1.50–2.49 were deemed "ineffective." These results suggest students generally found direct instructional methods inadequate for understanding BST concepts. The standard deviations (.48–1.38) showed consistency in responses, reflecting shared perceptions across the sample. The study also revealed no significant differences in perceptions between urban and rural students regarding the effectiveness of direct instructional approaches. All 14 items had probability values greater than .05, upholding the null hypothesis of no significant difference. This uniformity indicates students in both settings faced similar challenges with these methods.

These findings align with previous research critiquing direct instruction in science education. For instance, Oloyede (2016) reported that direct instruction often fails to foster critical thinking and problem-solving skills essential for subjects like BST. Similarly, Okeke and Nwafor (2017) noted that while direct methods deliver foundational knowledge, they are often seen as monotonous and less engaging, particularly in subjects requiring practical application. In contrast, studies by Obiekwe (2018) and Adewale (2020) emphasized the effectiveness of interactive and inquiry-based teaching, which enhance understanding and retention through hands-on activities and active participation. These methods are particularly beneficial for subjects like BST that combine theory and practice. This study highlights the need for BST teachers to adopt more student-centered approaches. The perceived ineffectiveness of direct methods reflects their teacher-centered nature, which limits interaction, experimentation, and critical

engagement—key to effective science learning. These findings align with broader calls for strategies that prioritize student involvement and active learning. A unique aspect of this study is its finding that both urban and rural students shared similar perceptions of direct instruction. Unlike studies such as Ezeudu (2015), which reported disparities in teaching practices and resources between urban and rural schools, this study suggests systemic challenges with direct instruction across all settings. This underscores the need for comprehensive reforms in teaching methods and teacher training.

Students' Perceptions of Indirect Instructional approaches Employed by Basic Science and Technology Teachers in Junior Secondary Schools in Enugu State

The study revealed varying perceptions of instructional approaches used by BST teachers in junior secondary schools in Enugu State. Items 20, 21, 22, 23, 24, and 26 were rated as "fairly effective," with mean values between 2.50 and 3.49, indicating moderate benefits. In contrast, items 15, 16, 17, 18, 19, 25, and 27 were rated "ineffective," with mean values between 1.50 and 2.49, reflecting student dissatisfaction. Standard deviations ranging from .55 to 1.34 showed consistent responses among participants. The t-test analysis showed no significant differences in urban and rural students' perceptions of indirect instructional approaches, as all 13 items had p-values greater than .05. This result suggests that geographic location did not influence students' views, supporting the null hypothesis of no significant difference.

These findings align with prior research highlighting the limitations of traditional methods in teaching science and technology. Uzoagulu (2011) noted that lecture-based teaching often fails to engage students, while Nworgu (2015) found teacher-centered methods

less effective for developing critical thinking and problem-solving skills. The "fairly effective" ratings of some approaches align with Olaitan and Agusiobo (2010), who argued that certain methods, though not highly engaging, can still provide moderate learning benefits when combined with practical demonstrations. Similarly, Adepoju and Fabiyi (2007) found that teaching effectiveness depends more on teacher competence than location, consistent with this study's findings. However, the study contrasts with Okebukola (1997), who emphasized the benefits of interactive and collaborative methods in enhancing student engagement and performance. The absence of "highly effective" ratings suggests gaps in implementing these strategies or a mismatch with students' needs. Furthermore, while Obioma and Ajagun (2014) identified experimental methods as highly effective in other regions, their limited use in Enugu State likely explains the lower effectiveness reported in this study.

Conclusion and Recommendations

This study found that students in Enugu State perceived direct instructional approaches used by BST teachers as mostly ineffective or fairly effective. These methods were insufficient for fostering deep understanding of BST concepts. Additionally, no significant differences were found between urban and rural students' perceptions, indicating that the challenges with these methods are widespread. The study also showed that indirect instructional approaches were perceived as moderately effective, further emphasizing the need for more dynamic, student-centered methods to engage students and develop critical thinking and problem-solving skills. These findings align with existing literature critiquing teacher-centered methods and advocating for interactive, hands-on teaching strategies in science education.

Based on the findings of the study, the following recommendations were made:

1. Teachers should integrate inquiry-based, collaborative, and problem-solving activities to foster engagement and critical thinking.
2. Teachers should prioritize hands-on learning experiences to connect theory with practice.
3. Government should provide continuous professional development which should focus on interactive and inquiry-based teaching strategies.
4. The BST curriculum should encourage diverse teaching methods and the use of digital tools to support interactive learning.

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