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Exploring Teachers' Inquiry Based Science Learning Practices in Basic Science and Technology at Junior Secondary School in Plateau State

Deborah, Miri Gotep[1]; Iliya, Godiya Bako[2]; Henry David Katniyon[3]

[1,3]Professor

[1]Department of Integrated Science, Federal University of Education, Pankshin, Plateau State
[2]Department of Integrated Science, Federal University of Education, Pankshin, Plateau State
[3]Department of ECCE University of Education, Pankshin, Plateau State

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Abstract: This study investigated teachers' inquiry-based learning (IBL) practices in the teaching of Basic Science and Technology (BST) in junior secondary schools in Plateau State, Nigeria. The study was motivated by the need to improve science instruction in line with contemporary learner-centered pedagogies and the expectations of the Nigerian Educational Research and Development Council (NERDC, 2012) curriculum. Specifically, the study examined the extent to which teachers engage in inquiry-based practices, the challenges affecting its implementation, the alignment of such practices with curriculum expectations, and the influence of gender on implementation.

A descriptive survey research design was adopted for the study. The population comprised all BST teachers in junior secondary schools across the three education zones of Plateau State, from which a sample of 120 teachers was selected using a multi-stage sampling technique. Data were collected using a researcher-developed instrument titled *Teachers' Inquiry-Based Learning Practices Questionnaire (TIBLPQ)*, which was validated by experts and yielded a reliability coefficient of 0.70 using Cronbach's Alpha. Data analysis was carried out using the Statistical Package for Social Sciences (SPSS), employing both descriptive statistics (mean and standard deviation) and inferential statistics (Pearson Product Moment Correlation and independent samples t-test) at a 0.05 level of significance.

The findings revealed that teachers' engagement in inquiry-based learning practices was generally moderate to high. Practices such as group work, observation of student interaction, and the use of prior knowledge were highly implemented, while probing questioning and brainstorming were only moderately practiced. Inadequate resources emerged as the most critical challenge affecting the implementation of inquiry-based learning, alongside factors such as large class size, time constraints, and insufficient training. The results further indicated that there was no statistically significant relationship between teachers' inquiry-based practices and the challenges encountered. Additionally, no significant difference was found between male and female teachers in the implementation of inquiry-based learning, indicating that gender does not influence its adoption.

The study concludes that although teachers demonstrate a reasonable level of awareness and application of inquiry-based learning strategies, their effectiveness is constrained by systemic and infrastructural limitations. It is therefore recommended that government and educational stakeholders provide adequate instructional resources, strengthen teacher professional development programmes, and ensure effective monitoring of curriculum implementation to enhance the successful integration of inquiry-based learning in Basic Science and Technology classrooms.

Keywords: *Inquiry-Based Learning, Basic Science and Technology, Teaching Practices, Instructional Challenges, Gender, Plateau State.*

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I. INTRODUCTION

Basic Science and Technology (BST) has increasingly become a cornerstone for scientific development and technological advancement in the 21st century. As global competitiveness in science and innovation intensifies, the quality of science education at foundational levels has become a major concern for developing nations such as Nigeria. Countries like India, which once shared comparable developmental indices with Nigeria, have made remarkable progress in science and technology, including advancements in space exploration. This development underscores the urgent need to critically examine how BST is taught in Nigerian classrooms and to adopt more effective pedagogical approaches that can enhance learners' scientific competencies (Adeyemi, 2022; Abdullahi & Ogunniyi, 2023).

Recent efforts to improve science education have emphasized the adoption of innovative instructional strategies, particularly inquiry-based learning (IBL). Inquiry-based learning refers to a learner-centered instructional approach in which students actively engage in asking questions about natural, cultural, or material phenomena, collecting and analyzing data, and drawing evidence-based conclusions (Pedaste et al., 2015; Lazonder & Harmsen, 2016). This approach has been widely acknowledged for its effectiveness in promoting conceptual understanding, problem-solving skills, and positive scientific attitudes among learners (Hmelo-Silver et al., 2007; OECD, 2021). Furthermore, IBL fosters creativity and innovation as learners participate in project-based activities that require them to generate solutions to real-world scientific problems (Bybee, 2020).

Science education plays a critical role in equipping learners with the knowledge, skills, and competencies necessary for technological advancement and sustainable development. Contemporary studies emphasize that science learning not only enhances cognitive development but also prepares learners to contribute meaningfully to societal progress through innovation and critical thinking (UNESCO, 2023). In the Nigerian context, the Nigerian Educational Research and Development Council (NERDC, 2012) conceptualizes science as the systematic study of the natural environment, involving both the acquisition of knowledge and the development of scientific processes. The curriculum emphasizes three interrelated domains of learning—knowledge, skills, and attitudes—which are best achieved when learners actively engage in observation, experimentation, and discovery-based activities.

Inquiry-based learning is fundamentally an intentional and systematic process that involves diagnosing problems, formulating hypotheses, designing and conducting investigations, analyzing data, constructing models, and communicating findings using evidence-based reasoning (Pedaste et al., 2015). Such processes are effectively facilitated through practical and laboratory-based activities, which are essential components of science instruction. However, evidence from developing countries suggests that the implementation of practical and inquiry-oriented learning remains suboptimal due to constraints such as inadequate teacher capacity, limited resources, and insufficient institutional support (Abdullahi & Ogunniyi, 2023; Adeyemi, 2022).

Empirical literature reveals ongoing debates regarding the effectiveness of inquiry-based learning. While some scholars argue that minimally guided inquiry may impose excessive cognitive load on learners, thereby reducing learning efficiency (Kirschner et al., 2006; Sweller et al., 2019), others contend that well-structured and scaffolded inquiry significantly enhances students' understanding, reasoning abilities, and motivation (Hmelo-Silver et al., 2007; Lazonder & Harmsen, 2016). Recent meta-analyses further indicate that the effectiveness of IBL largely depends on the level of guidance provided by teachers, with structured or guided inquiry producing more favorable outcomes than unguided approaches (Furtak et al., 2012; OECD, 2021). This suggests that the teacher's role in designing learning activities, providing scaffolding, and modeling scientific thinking is critical to the success of inquiry-based instruction.

Despite the growing advocacy for inquiry-based learning, research evidence indicates that students often do not demonstrate the expected gains in scientific understanding, skills, and attitudes. This raises concerns about the fidelity of implementation of IBL in classroom settings, particularly in resource-constrained environments. In Nigeria, factors such as overcrowded classrooms, inadequate laboratory facilities, and limited professional development opportunities for teachers have been identified as major barriers to effective implementation (Abdullahi & Ogunniyi, 2023). Consequently, there is a need to investigate how teachers are actually implementing inquiry-based learning in practice and the extent to which their practices align with curriculum expectations.

Against this backdrop, this study seeks to explore teachers' inquiry-based learning practices in Basic Science and Technology classrooms in Plateau State, Nigeria. Specifically, the study examines the nature of inquiry-based activities employed by teachers across three education zones and evaluates their alignment with the NERDC (2012) national curriculum. The study is guided by the overarching research question: What teaching practices are employed by Junior Secondary School teachers in promoting inquiry-based learning in BST classrooms, and what are the associated outcomes?

➢ *Objective of the Study*

The primary aim of this study is to explore teachers inquiry based science learning practices in basic science and technology at junior secondary school in Plateau state. Specifically, other aims of the study are to:

- Find out teachers' inquiry based learning practices in basic science and technology JSS Classrooms in Plateau state.

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- Find out the challenges teachers faced in implementing inquiry based learning basic science at JSS classrooms in Plateau state.
- Find out gender based dimension in implementing inquiry based learning in basic science and technology in JSS in Plateau state.

➢ *Research Questions*

- To find out teachers' inquiry-based learning practices in JSS basic science and technology Classrooms in Plateau state.
- To what extent do the challenges teachers faced have on the implementation of inquiry based learning basic science at JSS classrooms in Plateau state?
- To what extent do gender based dimension has on the implementation inquiry based learning in basic science and technology in JSS classrooms in Plateau state

➢ *Research Hypotheses*

- $H0_1$: There is no significant relationship between teachers' inquiry-based learning practices and the challenges affecting its implementation.
- $H0_2$: There is no significant difference between male and female teachers in the implementation of inquiry-based learning.
- $H0_3$: Gender has no significant influence on the implementation of inquiry-based learning.

II. METHODOLOGY

This study adopted a descriptive survey research design to explore teachers' inquiry-based learning (IBL) practices in Basic Science and Technology (BST) classrooms in Plateau State, Nigeria. The choice of this design was informed by its suitability for collecting data from a relatively large population and describing existing conditions without manipulating variables. It enabled the researcher to systematically gather information on teachers' practices, challenges, and perceptions regarding the implementation of inquiry-based learning.

The population of the study comprised all Junior Secondary School (JSS) Basic Science and Technology teachers in the three education zones of Plateau State. From this population, a sample of 120 teachers was selected using a multi-stage sampling technique. First, schools were stratified based on education zones to ensure adequate representation. Subsequently, a simple random sampling technique was employed to select participating schools and teachers within each zone. This approach ensured that the sample was representative of the population and enhanced the generalizability of the findings.

Data for the study were collected using a structured questionnaire titled "Teachers' Inquiry-Based Learning Practices Questionnaire (TIBLPQ)" developed by the researcher. The instrument consisted of two main sections: Section A captured respondents' demographic information (such as gender, age, qualification, and teaching experience), while Section B contained items measuring inquiry-based learning practices, challenges affecting implementation, and gender-related perceptions. Responses from the Likert-scale questionnaire were coded and weighted as follows: Always = 4, Sometimes = 3, Rarely = 2, and Never = 1 for Research Question 1, while Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1 were used for Research Questions 2 and 3. Mean and standard deviation were computed for each item.

To ensure the validity of the instrument, the questionnaire was subjected to face and content validation by experts in Science Education and Measurement and Evaluation. Their feedback led to necessary modifications in item clarity, relevance, and coverage of the constructs under investigation. The reliability of the instrument was established using the Cronbach's Alpha method, which yielded a coefficient of 0.70, indicating that the instrument was sufficiently reliable for the study.

The procedure for data collection involved obtaining official permission from relevant educational authorities and school administrators in Plateau State. The researcher, with the assistance of trained research assistants, administered the questionnaires directly to the respondents in their respective schools. Clear instructions were provided, and respondents were assured of confidentiality and anonymity to encourage honest responses. The completed questionnaires were retrieved on the spot to minimize loss and ensure a high return rate.

Data collected were analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics, including frequency counts, percentages, mean, and standard deviation, were used to answer the research questions. A decision rule based on mean scores was adopted as follows: 3.50–4.00 (high extent), 2.50–3.49 (moderate extent), 1.50–2.49 (low extent), and 1.00–1.49 (very low extent). Inferential statistics were employed to test the hypotheses: Pearson Product Moment Correlation was used to examine the relationship between inquiry-based practices and implementation challenges, while an independent samples t-test was used to determine differences based on gender. All hypotheses were tested at the 0.05 level of significance. This rigorous methodological procedure ensured the reliability and validity of the findings and provided a solid basis for drawing conclusions.

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III. RESULTS

➢ *Personal Information (Bio-Data)*

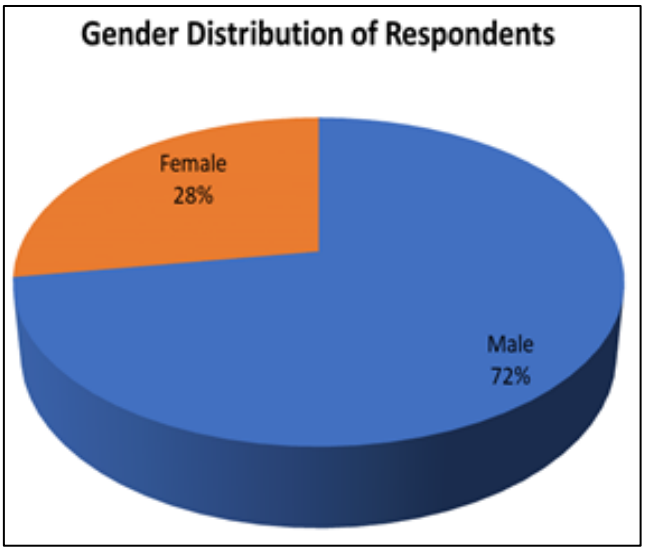

Fig 1 Gender Distribution of Respondents

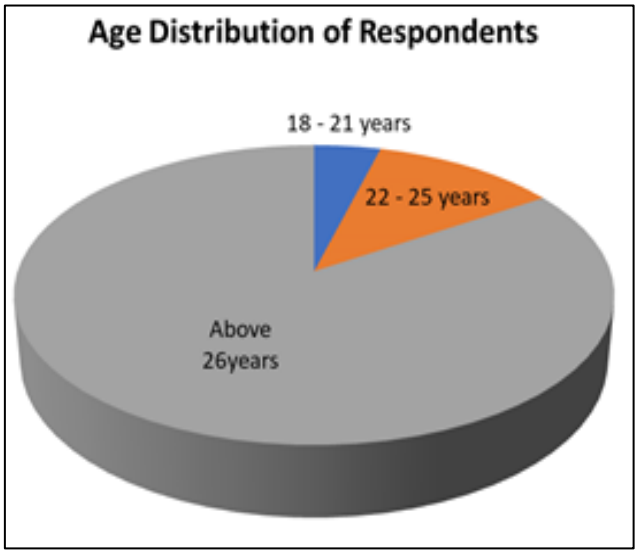

Fig 2 Age Distribution of Respondents

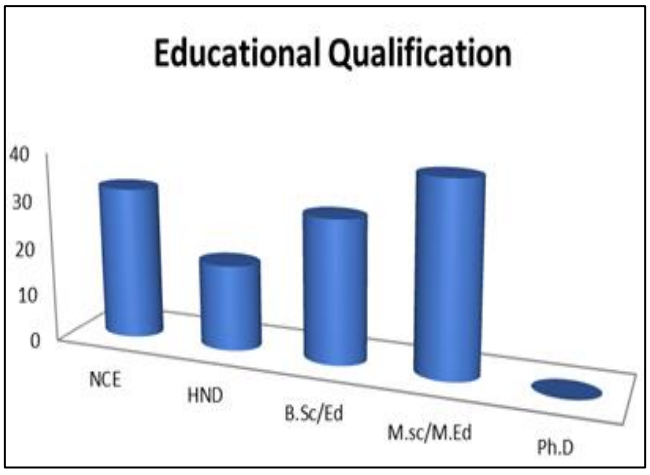

Fig 3 Educational Qualification

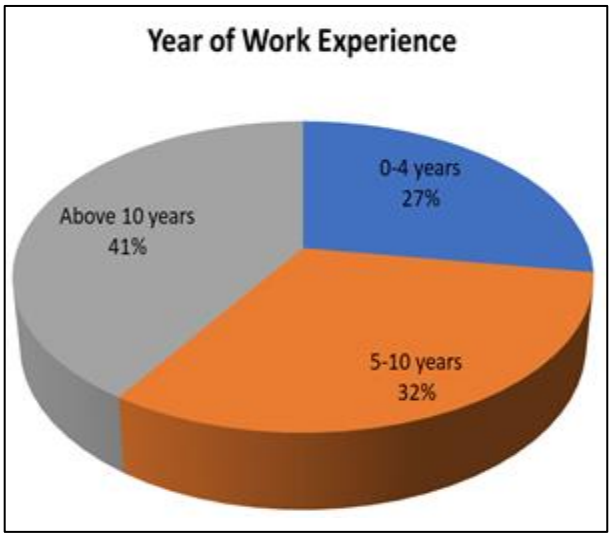

Fig 4 Year of Work Experience

➢ *Analysis of Respondents' Bio-Data*

The Bio-data characteristics of the respondents indicate that the study sample was predominantly male, with 72% of the participants being male and 28% female as presented in Fig. 1. This suggests that the responses obtained may largely reflect male perspectives. With respect to age, Fig. 2 shows that the majority of respondents were above 26 years, while a smaller proportion fell within the 22–25 years category and only a few were within the 18–21 years range. This implies that most of the participants were mature individuals with sufficient life and professional experience. In terms of educational qualification, Fig. 3 reveals that the highest proportion of respondents possessed M.Sc./M.Ed degrees, followed by those with NCE and B.Sc./Ed qualifications, while fewer respondents held HND certificates and only a negligible number possessed Ph.D qualifications. This indicates that the respondents were generally well qualified academically, thereby enhancing the credibility of the data collected. Furthermore, Fig. 4 shows that 41% of the respondents had above 10 years of teaching experience, 32% had between 5–10 years, and 27% had between 0–4 years of experience. This suggests that a large proportion of the respondents were experienced teachers. Overall, the distribution of respondents indicates that the data were obtained from predominantly male, mature, academically qualified, and experienced teachers, which strengthens the reliability of the findings.

➢ *Analysis Research Questions*

- *Research Questions One:*

Find out teachers' inquiry-based learning practices in basic science and technology JSS Classrooms in Plateau state.

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Table 1 Mean Ratings of Teachers' Inquiry-Based Learning Practices (RQ1)

S/N	Item	N		Mean (M)	Decision
1	Probing Questions	120		3.15	Moderate
2	Brainstorming	120		3.07	Moderate
3	Ask for Information	120		3.07	Moderate
4	Observe Interaction	120		3.89	High
5	Redirect Questions	120		3.48	Moderate
6	Act as Consultant	120		3.58	High
7	Group Work	120		3.70	High
8	Explain Concepts	120		3.32	Moderate
9	Justify Thinking	120		3.44	Moderate
10	Use Prior Knowledge	120		3.79	High

Source: Field Study, 2026

The results in Table 1 show that teachers' engagement in inquiry-based learning practices is generally moderate to high. Items such as observing student interaction (M = 3.89), group work (M = 3.70), and use of prior knowledge (M = 3.79) recorded high mean scores. However, instructional strategies such as probing questions (M = 3.15) and brainstorming (M = 3.07) were rated at a moderate level. This indicates that while teachers actively support student participation, they are less consistent in initiating inquiry-based learning.

- *Research Questions Two:*

To what extent do the challenges teachers faced have on the implementation of inquiry based learning basic science at JSS classrooms in Plateau state?

Table 2 Mean Ratings of Challenges Affecting Implementation (RQ2)

S/N	Item	N	Mean (M)	Decision
28	Inadequate Resources	120	3.80	High
29	Lack of Training	120	2.85	Moderate
30	Inadequate Qualified Teachers	120	3.38	Moderate
31	Large Class Size	120	3.38	Moderate
33	Time Constraint	120	3.38	Moderate
34	Tight Schedule	120	3.16	Moderate

Source: Field Study, 2026

Table 2 shows that inadequate resources (M = 3.80) is the most critical challenge affecting the implementation of inquiry-based learning. Other factors such as large class size and time constraints also show moderate to high impact. This suggests that infrastructural and systemic issues are the main barriers.

- *Research Questions Three:*

Find out gender based dimension in implementing inquiry based learning in basic science and technology in JSS in Plateau state.

Table 3 Mean Ratings of Gender-Based Dimensions (RQ3)

S/N	Item	N	Mean (M)	Decision
36	Males perform better	120	2.08	Low
37	Females perform better	120	2.00	Low
38	Both perform better	120	3.44	Moderate
39	Both do not perform well	120	2.00	Low
40	Gender has no effect	120	3.44	Moderate

Source: Field Study, 2026

The results in table 3 indicate that gender does not significantly influence inquiry-based learning. Items suggesting superiority of one gender recorded low mean scores, while agreement that both genders benefit equally recorded higher mean values.

➢ *Testing of Research Hypotheses*

- *Hypothesis One*

$H0_1$ There is no significant relationship between teachers' inquiry-based learning practices and the challenges affecting its implementation.

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Table 4 Variables

Variables	N	r	p-value	Decision
Practices vs Challenges	120	0.127	0.168	Not Significant

The results show that there is a weak positive correlation between inquiry-based learning practices and challenges, r(118) = 0.13, p = .168. Since the p-value is greater than .05, the relationship is not statistically significant. The null hypothesis is not rejected

- *Hypothesis Two*

$H0_2$ There is no significant difference between male and female teachers in the implementation of inquiry-based learning.

Table 5 Independent Samples t-test for Gender Difference

Group	N	Mean (M)	SD
Male	~60	3.38	0.40
Female	~60	3.40	0.39

t-value	Df	p-value	Decision
-0.17	118	0.866	Not Significant

An independent samples t-test was conducted to compare inquiry-based learning practices between male and female teachers. The results indicated no significant difference between male (M = 3.38, SD = 0.40) and female teachers (M = 3.40, SD = 0.39), t(118) = -0.17, p = .866. The null hypothesis is not rejected.

- *Hypothesis Three*

$H0_3$ Gender has no significant influence on the implementation of inquiry-based learning.

Table 6 t-test on Gender Influence (Composite Score)

Variable	Mean (M)	SD
Gender Influence Score	3.42	0.45

Test	Value
t-value	-0.15
Df	118
p-value	0.881

The analysis revealed that gender does not significantly influence the implementation of inquiry-based learning, t(118) = -0.15, p = .881. This indicates that both male and female students benefit equally from inquiry-based instructional approaches. The null hypothesis is not rejected.

IV. DISCUSSION OF FINDINGS

The findings of this study revealed that teachers' engagement in inquiry-based learning (IBL) practices in Basic Science and Technology classrooms in Plateau State is generally at a moderate to high level. Specifically, practices such as group work, observation of student interaction, and activation of prior knowledge recorded high mean scores, indicating that teachers are making conscious efforts to adopt learner-centered approaches. This suggests a shift from traditional teacher-dominated instruction toward more participatory and interactive pedagogies. This finding aligns with Furtak et al. (2012), who reported that structured inquiry activities led by teachers significantly improve students' learning outcomes. However, the moderate ratings observed in probing questions and brainstorming indicate that teachers may not be fully engaging learners in deeper levels of inquiry that stimulate critical thinking and independent knowledge construction.

Furthermore, the study identified inadequate resources as the most significant challenge affecting the implementation of inquiry-based learning, followed by factors such as large class size, time constraints, and limited training opportunities. This implies that despite teachers' willingness to adopt IBL strategies, systemic and infrastructural barriers hinder effective implementation. This finding corroborates Adeyemi (2022) and Abdullahi and Ogunniyi (2023), who emphasized that insufficient laboratory facilities, instructional materials, and overcrowded classrooms significantly limit the use of inquiry-based approaches in Nigerian schools. The implication is that successful implementation of IBL is not solely dependent on teacher competence but also on the availability of supportive teaching and learning environments.

In addition, the results showed that there is no significant relationship between teachers' inquiry-based learning practices and the challenges affecting implementation. Although challenges exist, they do not significantly predict or determine the extent to which teachers engage in inquiry-based practices. This suggests that some teachers are able to adapt and still incorporate elements of inquiry despite existing constraints. This finding may be interpreted in light of teacher resilience and

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improvisation skills, which are common in resource-constrained educational contexts. It also supports the argument by Hmelo-Silver et al. (2007) that effective scaffolding and teacher commitment can sustain inquiry-based learning even in less-than-ideal conditions.

The findings further revealed that gender does not significantly influence the implementation of inquiry-based learning. Both male and female teachers demonstrated similar levels of engagement in IBL practices, and no statistically significant differences were found between the two groups. This indicates that the ability to implement inquiry-based instruction is not dependent on gender but rather on professional training, experience, and access to resources. This finding is consistent with global research trends which suggest that gender is not a determinant of instructional effectiveness when equal opportunities and support systems are provided for teachers.

Finally, the study revealed that inquiry-based learning practices moderately align with the expectations of the NERDC (2012) Basic Science and Technology curriculum. While teachers demonstrate awareness of curriculum requirements, the moderate level of implementation suggests a gap between policy and classroom practice. This gap may be attributed to insufficient professional development, lack of monitoring, and limited instructional support. The implication is that curriculum reforms alone are insufficient without corresponding investments in teacher capacity building and resource provision. Therefore, strengthening the link between curriculum design and classroom implementation is essential for achieving the desired learning outcomes in Basic Science and Technology education.

V. CONCLUSION

The study revealed that teachers' engagement in inquiry-based learning (IBL) practices in Basic Science and Technology classrooms in Plateau State is generally moderate to high, indicating growing adoption of learner-centered approaches. Teachers demonstrated strong use of group work, student interaction, and prior knowledge, although critical inquiry strategies such as probing questioning and brainstorming were less frequently applied. Inadequate instructional resources emerged as the most significant challenge, alongside issues of large class sizes, time constraints, and limited training opportunities. Despite these challenges, no significant relationship was found between IBL practices and implementation constraints, suggesting that teachers strive to apply inquiry methods regardless of limitations. The findings also showed that gender does not significantly influence the implementation of IBL, indicating equal capability among male and female teachers. Overall, while progress has been made in adopting inquiry-based approaches, implementation remains suboptimal. The gap between curriculum expectations and classroom practice persists due to systemic and infrastructural constraints. Therefore, improving resource availability, teacher capacity, and institutional support is essential for effective IBL integration.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

- Government and relevant stakeholders should prioritize the provision of functional science laboratories, equipment, and instructional materials in schools. Adequate resources will enable teachers to effectively implement practical and inquiry-based activities, thereby enhancing students' engagement and understanding of scientific concepts.
- Regular training, workshops, and seminars should be organized to equip teachers with the necessary pedagogical skills for effective implementation of inquiry-based learning. Such programmes should focus on strategies such as questioning techniques, scaffolding, experimental design, and facilitation of student-centered learning.
- Educational authorities should strengthen supervision and monitoring mechanisms to ensure that the NERDC curriculum is implemented as intended. This includes providing instructional guides, mentoring support, and feedback systems that help teachers align their classroom practices with curriculum expectations.
- Efforts should be made to reduce overcrowding in classrooms and balance teachers' workload. Smaller class sizes will allow teachers to effectively manage inquiry-based activities, provide individualized support, and facilitate meaningful student participation.
- School timetables should be structured to allow sufficient time for practical and inquiry-based learning activities. Inquiry processes require adequate time for experimentation, discussion, and reflection, which should be deliberately incorporated into lesson schedules.
- Schools should encourage collaboration among teachers through professional learning communities where they can share best practices, develop instructional materials, and collectively address challenges related to inquiry-based teaching.
- Policymakers should provide sustained funding and policy support for science education reforms. This includes investing in infrastructure, teacher training, and research initiatives aimed at improving the quality of science instruction in Nigerian schools.

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