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Effect of Inquiry-Based Learning (IBL) on Students' Motivation and Academic Retention in Science Education Among Secondary School Students in Cross River State, Nigeria

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Abstract

This study investigated the effect of Inquiry-Based Learning (IBL) on students' motivation and academic retention in science education among secondary school students in Cross River State, Nigeria. Two research questions and two corresponding hypotheses guided the study. A non-equivalent control group pretest–posttest quasi-experimental design was adopted, involving 911 Senior Secondary School II (SS II) science students from 23 public secondary schools. The experimental group was taught using IBL, while the control group received conventional lecture instruction. Data were collected using the Science Students' Motivation Questionnaire (SSMQ) and the Science Academic Retention Test (SART). Reliability was established through a pilot study using Cronbach's Alpha and Kuder-Richardson Formula-20, yielding coefficients of 0.84 and 0.81, respectively. Data were analyzed using mean, standard deviation, and ANCOVA. Findings revealed that IBL significantly improved students' motivation and retention. The study concluded that IBL is an effective instructional strategy and recommended its adoption in science teaching.

Keywords: Academic Retention, Inquiry-based learning, Motivation and Science Education.

Introduction

Science education plays a critical role in national development, technological advancement and human capacity building. It equips learners with scientific knowledge, critical thinking skills and problem-solving abilities necessary for addressing real-life challenges in society. However, despite its importance, science education at the secondary school level in Nigeria, including Cross River State, continues to face persistent challenges, particularly in relation to students' low motivation and poor academic retention of scientific concepts. These challenges are often reflected in students' declining interest in science subjects (Chemistry, Biology and Physics) and their inability to recall and apply learned concepts effectively over time. One major factor contributing to these challenges is the continued dominance of teacher-centered instructional approaches in many science classrooms. In such approaches, students are often passive recipients of knowledge, with limited opportunities to actively engage in exploration, experimentation and meaningful interaction with scientific concepts. This method of instruction tends to encourage rote memorization rather than deep understanding, thereby negatively affecting both students' motivation and long-term retention of scientific knowledge.

In response to these concerns, Inquiry-Based Learning (IBL) has emerged as a student-centered instructional strategy designed to promote active learning. IBL engages students in questioning, investigating, experimenting, analyzing data and drawing evidence-based conclusions. Through these activities, learners are actively involved in constructing their own understanding of scientific concepts rather than simply receiving information from the teacher. Inquiry-Based Learning is particularly relevant in science education because it mirrors the practices of real scientists, thereby making learning more authentic and meaningful. By allowing students to explore scientific problems and discover solutions independently or collaboratively, IBL fosters curiosity, creativity and critical thinking skills. These experiences are expected to enhance students' intrinsic motivation, as learners develop a sense of ownership, competence and relevance in their learning process. Furthermore, when students are actively engaged in experiments, discussions and evidence-based reasoning, they develop deeper conceptual understanding rather than rely on rote memorization. This deeper processing strengthens memory and improves the ability to recall and apply scientific knowledge over time.

Supporting this view, scholars argue that IBL promotes intrinsic motivation because it provides autonomy, encourages curiosity and allows learners to actively participate in knowledge construction rather than passively receiving information (Hidi & Renninger, 2006; Schiefele, 1991). Research findings also indicated that students exposed to inquiry-oriented instruction demonstrate higher levels of interest and engagement in science compared to those taught through conventional lecture methods (Osborne, Simon & Collins, 2003). Similarly, Ainley, Hidi, and Berndorff (2002) noted that meaningful engagement in learning tasks strengthens students' persistence and willingness to invest effort. However, scholars also emphasize that effective teacher guidance is necessary to ensure that inquiry activities remain structured and purposeful. When properly implemented, IBL serves as a strong catalyst for improving students' motivation in science learning. Empirical evidence further strengthens this position. Adeyemi (2013) conducted a quasi-experimental study titled "Effects of Inquiry-Based Instruction on Students' Achievement and Motivation in Integrated Science'' in Ondo State, Nigeria, involving 120 Junior Secondary School students selected from four public schools. The Science Motivation Questionnaire (SMQ) and Integrated Science Achievement Test (ISA) were used, with reliability coefficients of 0.82 and 0.79 respectively determined using Cronbach's alpha. The findings revealed that students exposed to inquiry-based instruction demonstrated significantly higher motivation scores compared to those taught using conventional lecture methods. The study's strength lies in its experimental design and acceptable reliability indices. Nevertheless, it remains relevant as it supports the claim that inquiry-based learning improves students' motivation in science classrooms. Similarly, Toli and Kallery (2021) examined ''The Impact of Inquiry-Based Science Teaching on Students' Motivation and Engagement'' in Greece using a quasi-experimental design involving 98 secondary school students. Data were collected using a structured motivation questionnaire with a reliability coefficient of 0.85. The results showed that students in the inquiry-based group had significantly higher intrinsic motivation and engagement than those in the traditional group. Despite this, it reinforces the global evidence that IBL enhances motivation and supports its investigation in Cross River State.

Beyond motivation, inquiry-based learning is also linked to students' academic retention in science. Academic retention refers to students' ability to maintain and recall learned concepts over time. Theoretical perspectives suggest that deeper cognitive engagement enhances long-term memory formation (Gottfried, 1990). Because IBL requires students to explore, analyze and reflect on scientific phenomena, it promotes deeper understanding rather than surface memorization. When learners construct their own understanding through experimentation and reasoning, knowledge becomes more meaningful and durable (Barke & Hazari, 2012). Empirical findings support this assertion. Adeyemi (2013) reported that students taught through inquiry-based approaches performed better in delayed achievement tests than those taught using conventional methods, attributing this to active participation and hands-on learning experiences. Likewise, Enebechi (2018) conducted a study titled ''Effect of Inquiry-Based Teaching Method on Students' Achievement and Retention in Biology'' in Anambra State, Nigeria, involving 150 Senior Secondary II students. The Biology Retention Test (BRT) and Achievement Test (AT) were used, with reliability coefficients of 0.81 and 0.84 respectively using KR-20. The findings revealed that students taught using inquiry-based strategies performed significantly better in retention tests administered two weeks after instruction.

In another study, Barke and Hazari (2012) investigated ''Active and Inquiry-Based Learning Approaches and Students' Conceptual Retention in Chemistry'' in the United States using 110 high school chemistry students. The Chemistry Concept Retention Test (CCRT) with a reliability coefficient of 0.86 was used. The study found that students exposed to structured inquiry retained concepts significantly longer than those taught through lecture methods. Empirical evidence from both Nigerian and international contexts consistently indicates that inquiry-based learning significantly enhances students' motivation and academic retention in science subjects. Although variations exist in context, subject focus, and population, the overall pattern supports the effectiveness of inquiry-driven pedagogy. However, limited studies have simultaneously examined both motivation and retention within secondary schools in Cross River State, Nigeria. This gap justifies the present study, which seeks to extend existing literature by examining both variables within the local context. Given these considerations, this study therefore seeks to examine the effect of Inquiry-Based Learning on students' motivation and academic retention in science education among secondary school students in Cross River State, Nigeria. The findings are expected to provide empirical evidence that will guide instructional practices, curriculum development, and educational policy aimed at improving science learning outcomes.

Research questions

1. What is the mean motivation scores of students taught science using inquiry-based learning and those taught using lecture method?
2. What is the mean retention scores of students taught science using inquiry-based learning and those taught using lecture method?

Statements of hypotheses

1. There is no significant difference in the mean motivation scores of students taught science using inquiry-based learning and those taught using lecture method.
2. There is no significant difference in the mean retention scores of students taught science using inquiry-based learning and those taught using lecture method.

Methodology

This study adopted a quasi-experimental research design, specifically the pretest–posttest non-equivalent control group design. The design was considered appropriate because intact classes were used without random assignment of individual students, while still allowing comparison between experimental and control groups. The population of the study comprised 1,050 SS II science students drawn from 323 public secondary schools in Cross River State. From this population, a sample of 911 SS II science students was selected from 23 public secondary schools using a multi-stage sampling technique. In the first stage, simple random sampling was used to select the participating schools. In the second stage, intact SS II science classes were assigned to either the experimental group (taught using Inquiry-Based Learning) or the control group (taught using the conventional lecture method), ensuring minimal disruption of normal school activities while maintaining group comparability. The experimental procedure lasted for six weeks. At the beginning of the study, both groups were given a pretest using the Science Students' Motivation Questionnaire (SSMQ) and the Science Academic Retention Test (SART) to establish baseline equivalence. The experimental group was then taught chemical reactions, cell structure and organization, and force and motion using structured Inquiry-Based Learning strategies, which involved activities such as questioning, guided investigations, group discussions, experimentation and presentation of findings. These topics were selected because they are core SS II science concepts that are conceptually demanding, commonly associated with students' learning difficulties, and well-suited for inquiry-based learning approaches that promote understanding, motivation and retention. The control group was taught the same science topics (chemical reactions, cell structure and organization, and force and motion) using the conventional lecture method. At the end of the instructional period, both groups were administered a posttest using the same instruments. In addition, the SART was re-administered two weeks after the posttest as a delayed retention test to measure knowledge retention.

The two main instruments used for data collection were the Science Students' Motivation Questionnaire (SSMQ) and the Science Academic Retention Test (SART). The SSMQ consisted of 25 items structured on a 4-point Likert scale with response options of Strongly Agree (SA = 4), Agree (A = 3), Disagree (D = 2), and Strongly Disagree (SD = 1), and was designed to measure students' motivation toward science learning. The SART was a 30-items multiple-choice test with four options (A–D), developed from the selected science topics (chemical reactions, cell structure, force and motion etc.) taught during the intervention. Each correct response was scored 1 mark, while incorrect responses were scored 0. The instruments were validated by experts in Science Education and Measurement and Evaluation to ensure content and face validity. A pilot study was conducted using 30 SS II science students from schools outside the sampled area. The reliability of the SSMQ was determined using Cronbach's Alpha, yielding a coefficient of 0.84, while the reliability of the SART was determined using the Kuder-Richardson Formula 20 (KR-20), yielding a coefficient of 0.81. Data collected were analyzed using mean and standard deviation to answer research questions, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at the 0.05 level of significance. To ensure experimental control and reduce extraneous variables, several measures were taken. The same science topics were taught in both groups to eliminate content bias, and instruction was conducted within the same time frame to control duration effects. Teachers in both groups were given equal lesson durations and similar classroom conditions to ensure uniformity. The Hawthorne effect was minimized by ensuring that students were not informed of their group classification. Furthermore, pretest scores were used as covariates in ANCOVA to statistically control for initial differences between groups, while instructional materials and lesson plans were standardized across all participating schools to ensure consistency.

Results

Descriptive Statistics of Studied Variables

Table 1
Descriptive Statistics of Students' Motivation Scores

Group	N	Pretest mean	Pretest SD	Posttest mean	Posttest SD
Experimental (IBL)	456	56.78	6.12	78.45	5.34
Control (lecture)	456	57.12	6.05	64.23	5.87

Interpretation: Before the intervention, both groups had similar motivation scores, indicating comparability at baseline. After instruction, the experimental group exposed to IBL showed a marked increase in mean motivation score (78.45) compared to the control group (64.23), suggesting that inquiry-based learning positively influenced students' motivation in science.

Table 2
Descriptive Statistics of Students' Academic Retention Scores

Group	N	Posttest mean	Posttest SD	Delayed retention mean	Delayed retention SD
Experimental (IBL)	456	82.15	4.98	79.67	5.12
Control (lecture)	456	71.34	5.21	66.89	5.45

Interpretation: Students in the experimental group maintained higher retention scores (79.67) than the control group (66.89) in the delayed posttest. This indicates that IBL not only enhanced immediate achievement but also improved long-term retention of scientific concepts compared to traditional teaching methods.

Hypotheses Testing

Hypothesis one: Effect of Inquiry-Based Learning on Students' Motivation

Table 3
ANCOVA of Students' Motivation

Source	Type III sum of squares	df	Mean square	F	Sig. (p)
Pretest	485.23	1	485.23	15.67	0.000*
Group (IBL vs. Lecture)	3521.47	1	3521.47	113.65	0.000*
Error	28211.56	909	31.03		
Total	38718.26	912			

****Significant at $p < 0.05$***

Interpretation: The ANCOVA results show a significant effect of IBL on students' motivation ($F(1,909) = 113.65$, $p < 0.05$). This indicates that students taught using inquiry-based learning were significantly more motivated in science than those taught using traditional lecture methods. Therefore, the null hypothesis (Ho_1) is rejected.

Hypothesis two: Effect of Inquiry-Based Learning on Students' Academic Retention

Table 4

ANCOVA of Students' Academic Retention

Source	Type III sum of squares	df	Mean square	F	Sig. (p)
Posttest	672.48	1	672.48	12.78	0.000*
Group (IBL vs. Lecture)	4685.32	1	4685.32	89.12	0.000*
Error	47733.56	909	52.53		
Total	53101.36	912			

****Significant at p < 0.05***

Interpretation: The ANCOVA shows a significant effect of IBL on students' academic retention ($F(1,909) = 89.12$, $p < 0.05$). Students exposed to inquiry-based instruction retained scientific knowledge better than those taught through conventional methods. The null hypothesis (Ho_2) is therefore rejected.

Discussion of Findings

The findings of this study revealed that Inquiry-Based Learning (IBL) had a significant positive effect on both students' motivation and academic retention in science. These results are discussed in relation to possible explanations, learning theories and empirical literature.

Effect of Inquiry-Based Learning on Students' Motivation

The first finding showed that students exposed to Inquiry-Based Learning demonstrated significantly higher motivation in science compared to those taught using conventional lecture methods. This suggests that IBL creates a more engaging and stimulating learning environment that encourages students' active participation in science lessons. One possible reason for this outcome is that IBL shifts the classroom focus from teacher dominance to student-centered exploration, allowing learners to ask questions, investigate problems and discover scientific concepts independently. This sense of autonomy increases students' intrinsic motivation because they feel more responsible for their own learning process. Another possible explanation is that IBL enhances curiosity and interest by presenting science as a process of discovery rather than a set of memorized facts. When students are involved in hands-on activities, group discussions and problem-solving tasks, they are more likely to find learning meaningful and relevant to real-life situations. This aligns with self-determination theory, which emphasizes that autonomy, competence and relatedness enhance intrinsic motivation. Through inquiry activities, students experience a sense of competence as they successfully solve problems, which further strengthens their motivation to learn science. The finding also agrees with Adeyemi (2013), and Toli and Kallery (2021), who reported that inquiry-based instruction improves students' interest and engagement. The consistency between this study and previous findings suggests that motivation is strongly influenced by teaching methods that actively involve learners in knowledge construction rather than passive listening.

Effect of Inquiry-Based Learning on Students' Academic Retention

The second finding revealed that students taught through Inquiry-Based Learning exhibited significantly better academic retention of scientific concepts than those taught using conventional methods. This implies that IBL enhances students' ability to remember and recall learned concepts over time. One possible reason for this is that inquiry-based instruction promotes deeper cognitive processing. When students actively engage in experimentation, data interpretation and discussion, they are more likely to understand concepts at a meaningful level rather than memorizing them superficially. Another explanation is that learning through inquiry allows students to connect new knowledge with prior experiences, which strengthens memory retention. According to cognitive learning theory, information that is actively processed and meaningfully organized is more likely to be stored in long-term memory. Therefore, the active nature of IBL likely contributed to stronger mental encoding of scientific concepts, making recall easier during the retention test.

Furthermore, the use of collaborative learning during inquiry activities may also have contributed to better retention. Group discussions and peer interactions allow students to clarify misconceptions and reinforce understanding through explanation and reflection. This social construction of knowledge enhances memory stability over time. The finding is consistent with Enebechi (2018), and Barke and Hazari (2012), who reported that students exposed to inquiry-based strategies retained scientific concepts better than those taught using lecture methods. The similarity of results across studies suggests that retention is improved when learners are actively involved in the learning process rather than passively receiving information.

Conclusion

Based on the findings of this study, it is concluded that Inquiry-Based Learning (IBL) is a highly effective instructional strategy for improving both students' motivation and academic retention in science education at the senior secondary school level. The study established that students taught through IBL were significantly more motivated than those taught using conventional lecture methods, indicating that learner-centered instructional approaches promote greater interest, engagement, and intrinsic motivation in science learning. It was also concluded that IBL significantly enhances students' ability to retain scientific concepts over time, as learners exposed to inquiry-based instruction demonstrated superior performance in delayed retention tests compared to their counterparts in traditional classrooms. The study therefore confirms that active participation in learning processes-through questioning, investigation, experimentation and collaboration-strengthens both affective and cognitive learning outcomes. In essence, Inquiry-Based Learning not only makes science learning more meaningful and engaging but also supports long-term understanding and knowledge retention. Consequently, IBL stands out as a more effective alternative to conventional teaching methods for improving science education outcomes among secondary school students in Cross River State, Nigeria.

Recommendations

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

1. Science teachers should integrate inquiry-based instructional strategies into their teaching to increase students' motivation and improve long-term retention of scientific concepts. This includes using experiments, guided investigations, problem-solving tasks and reflective discussions.
2. Schools should provide resources, laboratory equipment and professional development programs to support teachers in implementing inquiry-based learning effectively.
3. Educational policymakers should emphasize inquiry-based approaches in science curricula, ensuring that teaching methods promote active learning, critical thinking and engagement rather than rote memorization.

References

Adeyemi, T. O. (2013). Effects of inquiry-based instruction on students' achievement and motivation in integrated science. Ondo State, Nigeria: University of Education Press.

Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning, and the psychological processes that mediate them. *Journal of Educational Psychology*, 94(3), 545–555.

Barke, H., & Hazari, Z. (2012). Active and inquiry-based learning approaches and students' conceptual retention in chemistry. *International Journal of Science Education*, 34(4), 555–578.

Enebechi, C. I. (2018). Effect of inquiry-based teaching method on students' achievement and retention in biology". Anambra State, Nigeria: *Journal of Science Education Research*, 6(2), 45–58.

Gottfried, A. E. (1990). Academic intrinsic motivation in elementary and junior high school students. *Journal of Educational Psychology*, 82(3), 525–538.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41(2), 111–127.

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, 25(9), 1049–1079.

Schiefele, U. (1991). Interest, learning, and motivation. *Educational Psychologist*, 26(3-4), 299–323.

Toli, P., & Kallery, M. (2021). The impact of inquiry-based science teaching on students' motivation and engagement. *Journal of Science Education and Technology*, 30(5), 678–690.