Effects of Inquiry-Based Method on the Achievement Students in Basic Science and Technology in Jss Ii in Lere, Kaduna State, Nigeria

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Article Info

ABSTRACT

This study investigated the effect of Inquiry- Based method on the achievement of Basic Science and Technology students of JSS II in Lere, Kaduna State, Nigeria. The study had two objectives, research questions and hypotheses. The population covered 26 Schools with a population of 3,738 students. The quasi-experimental design was employed for the study. Specifically, the non-equivalent pre-test, post-test control groups. A simple random sampling technique was used to select two schools with a sample of 110 Students, The research questions were answered using mean and standard deviation while the hypotheses were tested using ANCOVA at 0.05 level of significance. The instrument used for data collection was a Basic Science and Technology Achievement Test (BSTAT). The instrument was validated by three experts from University of Jos. The reliability coefficient was 0.75. The results showed that, the achievement of students in the experimental group was higher than the control group, significance difference existed between the achievement of male and female students. Based on the Study, it was recommended that, teachers should use the Inquiry-Based method in teaching and government should provide all necessary materials for teaching and Learning of Basic Science and Technology.

1. INTRODUCTION

Education is the cornerstone of societal progress, serving as the catalyst for individual growth and collective advancement. Within the realm of education, science and technology education is the foundation for sustainable national development, it is an enterprise on which the nations depend on in order to make advancement and get rid society of ignorance, illiteracy and poverty science education therefore, is receiving much attention because of its significance and relevance to life and society. The effectiveness of teaching strategies profoundly impacts student outcomes. In the 21st years, a shift towards activity-based method of teaching approaches has gained traction, particularly in subjects like Basic Science and Technology. To comprehensively understand this phenomenon, it's imperative to explore the various factors at play, including instructional methods, teacher characteristics, classroom environment, and student demographics.

Basic Science and Technology education serves as the bedrock for scientific literacy and technological fluency, equipping students with essential skills for navigating the complexities of the modern world [1]. Inquiry-based method teaching strategies prioritize active learning, critical thinking, and collaboration, aiming to empower students to take ownership of their learning process [2]. Lere Local Government Area, like many other regions, grapples with challenges in providing quality education to its populace. Factors such as limited resources, inadequate infrastructure, and socio-economic disparities may hinder educational attainment [3]. Additionally, cultural norms and traditions prevalent within the community may influence teaching and learning practices, shaping the effectiveness of different instructional approaches. Understanding how these contextual factors intersect with the implementation of inquiry-based strategy is crucial for improving educational outcomes in the region.

The various instructional methods employed by educators like Inquiry-based method teaching strategies encompass a spectrum of approaches

aimed at fostering active participation, inquiry, and collaboration among students [4]. These methods include but are not limited to problem-based learning, inquiry-based learning, cooperative learning, and project-based learning. Each method offers unique benefits, such as promoting critical thinking skills, enhancing retention, and encouraging real-world application of knowledge. By examining the effectiveness of these strategies in the context of Basic Science and Technology education, insights can be gained into their impact on students' achievement. The role of the teacher is pivotal in shaping the learning experience of students. Teacher characteristics such as experience, training, pedagogical beliefs, and instructional practices play a significant role in implementing [5]. Educators who embrace Inquiry-based method approaches demonstrate a willingness to relinquish control, facilitate discussions, and provide guidance rather than dictating information. However, factors such as resistance to change, lack of training, and institutional constraints may impede the adoption of these methods. A conducive learning environment promotes active participation, experimentation, and exploration, fostering a sense of belonging and motivation among students. Thus, optimizing the classroom environment is paramount for maximizing students' achievement.

Students come from diverse backgrounds with varying levels of prior knowledge, skills, and experiences. Demographic factors such as gender can influence learning outcomes For instance, students from disadvantaged backgrounds may face additional barriers to learning, requiring tailored instructional interventions. Similarly, cultural norms and values prevalent within the community may shape students' attitudes towards education and their receptivity to different teaching methods. By considering these demographic variables, educators can design inclusive and equitable learning experiences that cater to the needs of all students. The rationale for conducting this study stems from the pressing need to enhance educational outcomes in Basic Science and Technology within Lere Local Government Area. By investigating the effect of Inquiry-based of method teaching, valuable insights can be gained into improving instructional practices, enhancing student engagement, and ultimately, fostering academic achievement. Moreover, the findings of this study have broader implications for educational policy and practice, offering evidence-based recommendations for promoting inquiry-based method approaches across diverse contexts.

Research Questions

What are the pretest and post test scores of students' achievement in Basic Science and Technology in the experimental and control groups.

What are the pretest and post test scores of male and female students' achievements in Basic Science and Technology in the experimental and control groups

Hypotheses

There is no significant difference in the post test scores of students' achievement in Basic Science and Technology between the experimental and control groups .

There are no significant differences in the post test scores male and female student's achievement in both the experimental and control groups.

2. MATERIALS AND METHODS

This study adopted a quasi-experimental design. Specifically, the pretest and post-test design in which intact classes within the study area were randomly assigned to experimental and control groups in Lere Local Government Area of Kaduna State, Nigeria. The design was chosen due to the fact that it was not be possible to carry out random assignment of subjects to group the students and schools that would be involved in the study. The population of the study comprised of all the 3,738 JSS11 students in Lere Local Government Area from 26 junior secondary schools in Lere local government area.

The sample comprised of junior secondary school students from two schools. Intact classes were used for the study. One for experimental group while one for the control group. The sampling technique employed for this study was a simple random sampling and cluster sampling. Random sampling was utilized to select schools from the population of 26 junior secondary schools in Lere Local Government Area. This method ensures that each school has an equal chance of being chosen, minimizing selection bias and enhancing the representativeness of the sample. Subsequently, within the selected schools

The researcher used on instrument for the data collection that is the BSTAT. This test was specifically designed to assess the achievement levels of junior secondary school students in Basic Science and Technology in response to the implementation of Inquiry-based method teaching strategies. The BSTAT consisted of 25 multiple-choice questions, covering various topics withi

the Basic Science and Technology curriculum. The questions were carefully crafted to align with the learning objectives of the Inquiry-based method teaching approach, emphasizing critical thinking, active engagement, and collaborative learning experiences.

The development of the BSTAT involves a rigorous and meticulous process to ensure validity, reliability, and alignment with the research objectives. The instrument was subjected to experts collaborations to generate items that comprehensively cover the content domain of Basic Science and Technology at the University of Jos which provided valuable inputs on the relevance and comprehensiveness of the test items. . The questions underwent rounds of review and revision to ensure clarity, relevance, and alignment with the curriculum standards. Pilot testing with a representative sample of junior secondary school students in Lere Local Government Area allows for the gathering of feedback for further refinement of the items. The standardization of the BSTAT involved the establishment of clear scoring guidelines and standardized administration procedures to ensure consistency and fairness in assessment administration. To validate the items and contents of the instrument for data collections in the study, the instrument was subjected to three experts, two in the Department of Science and Technology education, and one in Research, Measurement and Evaluation.

The test instrument was then pilot-tested on similar but smaller sample students who were not part of the study school to find out how the respondents reacted to the instrument, scrutinized the questionnaire to ensure that the instrument provided adequate information that world guide the answers to the research questions and research hypothesis. The experts were required to judged appropriateness, comprehensiveness and clarity of the test items and questionnaire. Observation made by the experts were taken into consideration in producing final copy of the instrument.

In order to ascertain the level to with the instrument is reliable. Test – retest method was used to determine the measure of stability of the instrument. (Internal Consistency) of the instrument which the same test was administered twice to the same group of students outside the study area with a given time internal between the administration of the test instrument. The result of the test score was correlated to get the stability coefficient so that the stability of responses in both tests reflected the reliability of the test instrument. Two weeks interval between the two tests not be strictly monitored so that it would not be too short or too long with may affect the stability of the testing process. The primary instrument chosen for data collection in this research is the Basic Science and Technology Achievement Test (BSTAT). The choice of a standardized test reflects a commitment to objectivity, reliability, and validity in measuring reading comprehension levels.

The instrument that was developed for the study was a Basic Science and Technology student achievement test (BSTAT) which was administered to the experimental and control groups, the participants were allowed some few minutes to go through the questions and items statements to another questions. The researcher and the assistant explained verbally the areas of confusion to the students. This was to determine the student level of achievement in the topic of study and compare that with the scores after treatment. These initial scores were recorded. One week after administration of pre-test, the experimental group were subjected to the inquiry-based strategy as the post test. The method of data analysis that was used in the study is based on the research questions and hypotheses. ANCOVA method of data analysis was employed for testing the hypotheses, while the mean and standard deviation were used to answer the research questions raised.

3. RESULTS

Table 1 reveals the pre-test and post-test achievement mean score of students offering Basic Science and Technology in the experimental and control groups. The result for experimental group yielded a mean score ($\bar{x}$ =42.08, SD = 6.62) before treatment and had a mean score of ($\bar{x}$= 60.15., SD = 9.03) after treatment. The control group had a mean score of ($\bar{x}$ = 31.16, SD = 7.16) before and had a mean score of ($\bar{x}$= 32.08., SD = 7.24). The mean difference is 17.15, indicating that the mean score of students taught using inquiry-based method in the experimental group was higher than the control group taught using the conventional lecture method. The result further indicated that those taught with inquiry-based method performed better than those in the control group.

Table 1. Pre-test and post-test mean score of the achievement of students in the experimental and control groups

| Group | N | Pretest | | Post-test | | | |
		X	SD	X	SD	Mean Gain	$\overline{X}_{Diff}$
Experimental	60	42.08	6.62	60.15	9.03	18.07	17.15
Control	50	31.16	7.16	32.08	7.241	0.92	

Table 2 shows the post-test achievement scores of male and female students exposed to inquiry-based method of teaching. The male students had a mean score of 62.23 with a standard deviation of 8.82 while, the female students had a mean score of 57.24 with a standard deviation of 8.67. This implies that the male students' achievement mean score is higher than the female with a mean difference of 4.99.

Table 2. Post-test mean scores of male and female students' achievements in basic science and technology after treatment

Gender	N	Mean	SD	Mean Difference
Male	30	62.23	8.82	4.99
Female	20	57.24	8.67	

Hypothesis testing

Analysis of Covariance (ANCOVA) was conducted to determine if a significant difference exists in the achievement mean scores of students taught Basic Science and Technology using Inquiry-based and those taught without. Table 6 shows that F (1,107) =.23.12, P < 0.05, since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant effect of Inquiry-based method of teaching on students' achievement in Basic Science and Technology. The result further reveals an adjusted R squared value of .432 which means that 43.2 percent of the variations in the students' achievement mean scores could be attributed to the treatments given to the experimental group. This implies that there is a significant difference in the achievement of students taught Basic Science and Technology using Inquiry-based method and those taught without.

Table 3. summary result of ancova on achievement mean scores of students taught basic science and technology using ınquiry-based method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	5181.595a	2	2590.797	42.523	.000
Intercept	6493.197	1	6493.197	106.574	.000
Covariate	536.981	1	536.981	8.814	.004
GROUP	1408.701	1	1408.701	23.121	.000
Error	6519.169	107	60.927		
Total	335058.000	110			
Corrected Total	11700.764	109			

a. R Squared = .443 (Adjusted R Squared = .432)

Analysis of Covariance (ANCOVA) was conducted to determine the significant difference in the achievement mean score of students taught Basic Science and Technology using Inquiry-based method and those taught without. Table 8 shows that F (1,57) = 1.88, P > 0.05, since the p-value of 0.176 is greater than 0.05 level of significance, the null hypothesis was retained, indicating that there was a significant effect of on students' achievement in Basic Science and Technology. The result further reveals an adjusted R squared value of .194 which means that 19.4 percent of the variations in the students' achievement mean scores can be attributed to the treatments. This implies that

there is a significant difference in the achievement of students taught Basic Science and Technology

using Inquiry-based method and those in the control group taught without.

Table 4. Summary result of ancova on achievement mean scores of male and female students taught basic science and technology using ınquiry-based method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	1062.924ª	2	531.462	8.085	.001
Intercept	1852.655	1	1852.65	28.185	.000
Covariate	700.005	1	700.005	10.649	.002
Gender	123.220	1	123.220	1.875	.176
Error	3746.726	57	65.732		
Total	221891.000	60			
Corrected Total	4809.650	59			

4. DISCUSSIONS

Table one determined the effect of inquiry-based method on Basic Science and Technology interest and achievement in Basic Science and Technology in Lere, Kaduna state. The result of students indicated that the achievement of students taught with Inquiry-based method shown much improvement than the Control group taught with the conventional lecture method. In table two, the result indicated that the male student's achievement is higher than the female with a mean difference of 4.99. The study revealed that male student's achievement is higher than female student of junior secondary two in Lere Local Government, Kaduna State. There is significance difference in the interest of students taught Basic Science and Technology using inquiry-based method and those that were taught without. This finding is in agreement with that of [6], who conducted a study on the effectiveness of inquiry-based method in improving critical thinking skills in Basic Science and Technology and found the method to be effective. These finding was supported by [7], who found that, male students of public co-operated better than their counterpart. [8], who reported that "Gender differences devour girls in performance" this also goes contrary [9], who find out that, gender has no significance effect on male and female on interest and achievement, the results also disagree with [10], who observed that male students scored higher than female students academically.
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5. Conclusion

The achievement of students in the sampled junior public secondary two performed well, though male students perform better than female students, based on these research study

this happened because of lack using the appropriate method of teaching Basic Science and Technology. Improper, use of instructional materials (teaching aids) by teacher during teaching and learning of Basic Science and Technology, Inadequate infrastructures, inadequate science teachers, and lack of organizing workshops/seminar for science teaches by the government.

Conflict of Interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Author Contributions

Study Design, AEB; Data Collection, AEB; Statistical Analysis, AEB; Data Interpretation, AEB; Manuscript Preparation, AEB; Literature Search, AEB. All authors have read and agreed to the published version of the manuscript.

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