EFFECTIVENESS OF INQUIRY-BASED TEACHING METHOD ON BASIC SCIENCE ACADEMIC PERFORMANCE AMONG JUNIOR SECONDARY SCHOOL STUDENTS OF EKITI STATE, NIGERIA

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Abstract

The study examined the effectiveness of inquiry-based teaching method on Basic science academic performance among junior secondary school students of Ekiti state. Two research questions were raised while two research hypotheses were generated for the study. The hypotheses were tested at 0.05 level of significance. The study adopted quasi-experimental research design. A simple random sampling technique was used to select two intact classes for the study. The study sample comprised one hundred and ten junior secondary school two (JSS2) Basic science student. Basic science Performance Test (BPT) made up of twenty five multiple choice items that was validated and tested for reliability was used for data collection for the study. The data collected were analyzed using mean, standard deviation and t-test. The results between the experimental group (Inquiry-based teaching method) and control group (Traditional method) showed that there was a significant difference between the experimental and control in favour of the experimental group. This showed that inquiry-based method was better than the traditional method. The result also indicated that there was no significant difference in the performance of both male and female taught Basic science using inquiry-based teaching method. It was therefore recommended among others that Basic science teachers should be encouraged to teach their students using inquiry-based method to enhance the academic performance of students in Basic science.

Keywords: Effectiveness, Inquiry-based teaching method, Traditional teaching method, Academic performance, Basic science

Introduction

Basic science, also known as integrated science is one of the subjects in the secondary school curriculum in Nigeria. The subject is offered at the Junior secondary school level. It is a prerequisite to science subjects like Physics, Chemistry and Biology at senior secondary schools. Sciences are very important subjects in the development of every nation. The development of a country rest on science and technology in the world of work (Shadreck & Mambanda, 2012; Anamnah-Mensah, August, 2004). The study of Basic science at junior secondary schools help to prepare students for science like Physics, Chemistry and Biology at senior secondary school level. Azure (2015) observed that sciences are needed to produce the necessary human resource and skilled labour force to manage our local industries and educational institutions. The study of these sciences helps us to understand our natural world and also approach challenges we face in life and our work place in a more systematic and logical manner. Science education is the conscious effort to raise the level of scientific of all students and equip them with relevant basic scientific knowledge needed for their own living and also contribute to the country development (Nasir, 2018).

Due to its usefulness the method of teaching the subject should be of great importance to science educators. Udor (2020) observed that the use of inappropriate teaching methods contributes to the low participation and performance of students in Basic science. The methods employed by teacher in

teaching Basic science have a great impact on the understanding and interest developed by students in the subject. Smorl (2018) opined that the method of teaching the subject play a pivotal role in enhancing the efficiency of the practitioners. Teaching involve both methodology and pedagogy and the teacher is supposed to select appropriate method which will effectively engage the learners in the teaching and learning process. Topman (2010) was of the view that several studies have indicated that there is a general problems with the teaching of Basic science within secondary school where much attention is focused on the factual information, driven by textbook use and tests, lack of small group activity, negotiation of low level cognitive demand, and the concentration of conceptual activity in a minority of target student. Thompson (2018) found out that students in junior secondary schools were not made to perform practical activities in Basic science as suggested by the science curriculum. This has contributed to poor attitude shown by students towards Basic science.

Wood and Gentidt (2003) were of the view that educators are beginning to recognize that there are better ways to lean than the traditional method. The traditional method of teaching is passive rather than active. It does not enhance critical thinking and collaborative problem solving since students are made to act as spectators and passive recipient of information. Science educators have from to time emphasize the need to produce students who are skilled in solving basic problems within their immediate environment through analysis and experimentation and adopting a scientific way of life based on pragmatic observation and investigation of phenomena. They also stress the need to encouraging students to develop interest and high motivation towards science. To achieve this, students should be exposed to skills in creating their own knowledge in order to understand scientific concept rather than providing them with set of rules and already prepared concepts without understanding them. Students should be exposed to several strategies of solving problems and also providing them a conducive leaning environment where they can learn through inquiry and so student are placed at the centre of the learning process.

Educators came up with inquiry based instructional strategy which employs active participation of learners in the teaching and learning process and also placed the learners at the centre of the teaching and learning process where the student is made to interact with teaching and learning materials (TLMs) and also asks questions to discover scientific concepts, facts or principles with or without any teacher support. Academic performance is the extent to which a student has attained short or long-term educational goals. It is commonly measured through examination or continuous assessments. It is considered to be the center around which the whole education system revolves. Buckon and Riodan (2019) opined that the academic performance of students determines the success or failure of any academic institution. Donald (2017) also argued that the academic performance of students has a direct impact on the social-economic development of a country. According to Bhat, Joshi and Wani (2016), academic performance is the knowledge gained which is assessed by marks awarded by a teacher educational goals set by students and teachers to be performed over a specific period of time and these goals are measured using examination results.

The problem of poor performance of students in Basic science is of great concern to science educators and relevant stakeholders in education. Reason given by some stakeholders of education are unstable method and techniques used by teachers to teach the subject which seems to have resulted into under-performed lack of interest, poor attitude of students towards the subject. Some education researchers have reported on the use of inquiry-based method for teaching. Desmond (2018) find out the effectiveness of the inquiry-based method for teaching Basic science at the secondary level. The research sample was two hundred and ninety-two students studying at secondary level in Obaisi Municipality, Pretest posttest control group design was used for this research study. Experimental and

control group were formed equally on the basis of pretest performance. Both groups were taught for two weeks. The experimental group was treated with an inquiry-based method while the control group was treated by the traditional method. After treatment posttest was held and results were compared. Result revealed that the inquiry-based method was better than the traditional method.

Nwena and Edan (2023) investigated the effectiveness of inquiry teaching method on senior secondary school students' academic performance in physics in Awka education zone of Anambra state, Nigeria. Results revealed that there was a significant difference between the mean performance experimental score of students taught Basic science using inquiry teaching method and those taught using traditional method. Also, it was revealed that there was no significant difference between male and female students taught physic using inquiry teaching method.

Harson and Nelson (2019) found out that students exposed to inquiry-based method perform better in Basic science than their counterpart students who were exposed traditional method, Oluwatosin (2015) examined the effect of inquiry-based teaching method on students, performance in Basic science in secondary schools on gender basis. It was found that there was no significant statistical difference between male and female students taught Basic science with inquiry-method. Also, Omolere (2017) investigated the effectiveness of inquiry-based teaching method on the students' performance in secondary education on gender basis. It was found that there was no significant difference between male and female students in their Basic science academic performance implying that both gender benefited from the inquiry teaching method.

The above findings give room to ensure the accuracy of the of inquiry-based method and an attempt to solve the problem of poor academic performance of students in Basic science, the researcher investigated the effectiveness of inquiry-based teaching method on Basic science academic performance among Junior secondary school (JSS) students in Ado-Ekiti local government area of Ekiti State, Nigeria.

Purpose of the Study
The purpose of this study was to examine the effectiveness of inquiry-based method on the JSS students academic performance in Ado-Ekiti local government area of Ekiti State. The study was specifically designed to
1. find the difference in the mean performance scores between students taught Basic science using inquiry-based teaching method and those taught Basic Science using traditional method
2. find the difference in the mean performance scores between male and female students taught Basic science using inquiry-based method.

Research Questions
The following research questions were raised for the study
1. What is the difference in the mean performance score of students taught Basic science using Inquiry-based teaching method and those taught with traditional teaching method?
2. What is the difference in the mean performance score of male and female students taught Basic science   using inquiry-based teaching method

Hypotheses
The following research hypotheses were generated for the study
1. There is no significant difference in the mean performance score of students taught Basic science using inquiry-based teaching method and those taught using traditional teaching method.
2. There is no significant difference in the mean performance score of male and female students taught Basic science using inquiry-based teaching method

Methodology

A quasi-experimental research design specifically, the non-equivalent control group design was adopted for the study. A quasi-experimental research design is a type of research design that does not provide for full control of extraneous variables primarily because of the lack of random assignment to a group (Ali, 2006). A quasi-experimental research design is considered appropriate for the study because intact classes were used to avoid disruption in normal classrooms. Therefore, the specific design that was employed for the study was a pre-test, post-test and non-equivalent group design.

The population of the study consisted of all the Junior secondary school two (JSS2) Integrated science students in all eighteen co-educational secondary schools Ado Ekiti local government area of Ekiti state, Nigeria. At the time of the study (2023/2024 academic session), there were one thousand six hundred and ninety eight (1698) JSS3 students (Source: Zonal post primary schools board, Ado Ekiti education zone). Intact classes which comprised a total of one hundred and ten (110) JSS2 students formed the sample for the study. A simple random technique was used to select two (2) Junior secondary school in Ado Ekiti L.G..A in which one school was used as an experimental and the other school was used as the control group A further simple random sampling technique was used to select one arm of JSS3 class in each selected school. The experimental groups consisted of fifty-eight (58) students made up of twenty-eight (28) males and thirty (30) females while the control group consisted of fifty-two (52) students made up of twenty-five males (25) and twenty-seven (27) females.

The instrument for data collection was the Basic science Performance Test (BPT) The BAT was made up of twenty-five (25) items drawn from the JSS2 scheme of work (second term) which were all multiple-choice questions. To establish the validity of the instrument it was presented to experts in the field of tests and measurement, and science education in faculty of education, Adeyemi Federal University of Education, Ondo and to one experienced Basic science teacher in junior secondary school for face and content validity. The experts ascertained the appropriateness and relevance of the items of the instrument in relation to research purpose as well as it adequacy in measuring what it is purported to measure. To establish the reliability of the instrument using test retest method, trial testing of the BAT was done by administering twenty (20) of the instrument to JSS2 students in one of the junior secondary schools, not within the area of study. The instrument was administered to twenty (20) students twice (interval of two weeks). This was done to determine the time it would take to complete the test control, how reliable the items in the instrument were. The two set of scores received from the two tests were computed using Pearson product moment correlation (PPMC) and the result revealed the reliability index/coefficient of 0.94. Based on this coefficient of reliability the instrument was statistically determined to be reliable and appropriate for the investigation.

The researchers visited the selected schools and trained the class teachers of the experimental and control group classes as research assistants. They taught their class for two weeks (Nwena and Edan, 2023) the experimental group was taught using the inquiry-based teaching method while the control group was taught using traditional teaching method. Copies of Basic science Performance Test (BPT) was given to each group, Pretest was given before the treatment and was collected on the spot. The teaching lasted for two weeks after which a post-test was given to the two groups and were collected on the spot. The Basic science Performance Test (BPT) was marked and scored. The scores were collected and subjected to analysis.

Data collected were analyzed using descriptive and inferential statistics. Research questions I and 2 were analyzed using mean and standard deviation, while hypotheses 1 and 2 were subjected to t-test analysis. All the hypotheses were tested at 0.05 level of significance.

Results

Research Question One: What is the difference in the mean performance score of students taught Basic science with inquiry-based teaching method and those taught with traditional teaching method?

Table 1: Mean ($\overline{X}$) and standard deviation (SD) of scores of students taught Basic Science using inquiry-based teaching method and those taught with traditional method.

Group	Number of students	Pre-test		Post-test		Mean gain score
		$\overline{X}$	SD	$\overline{X}$	SD	
Experimental group (Inquiry-based method)	58	17.58	2.42	26.72	2.63	9.14
Control group (Traditional method)	52	16.26	2.98	18.39	2.38	2.13

From the table 1, the data on the student's performance revealed that student taught Basic science with the inquiry teaching method had mean performance scores of 17.58 in the pre-test and 26.72 in the post-test while those taught Basic science with the traditional method had mean performance scores of 16.26 in pre-test and 18.39 in post-test. Therefore, students taught with the inquiry-based teaching method had a mean gain score of 9.14 while those taught with traditional method had a mean gain score of 2.13. So, students taught Basic science with the inquiry teaching method performed better than those taught with the traditional method.

Research Question Two: What is the difference in the mean performance scores of male and female students taught Basic science using inquiry teaching method?

Table 2: Mean ($\overline{X}$) and standard derivation (SD) scores of male and female students taught Basic science using inquiry-based teaching method.

Group	Number of students	Pre-test		Post-test		Mean gain score
		$\overline{X}$	SD	$\overline{X}$	SD	
Male	28	18.84	26.86	28.86	2.99	8.02
Female	30	20.14	28.12	30.12	2.38	7.98

From the table 2, the data on students' performance revealed that the male students had a mean performance scores of 18.84 on the pre-test and 26.86 on the post-test, while female students had a mean performance scores of 20.14 on the pre-test and 28.12 on the post-test. Male students had a mean gain score of 8.82 while female students had a mean gain score of 7.98. Therefore, male students had slightly higher performance score in the experimental group than female students.

Hypothesis One: There is no significant difference in the mean performance scores of students taught Basic science using inquiry-based teaching method and those taught using traditional method.

Table 3: Mean scores, standard deviation, and independent sample t-test of experimental and control groups.

Group	Number of students	Mean	Standard deviation	Degree of freedom	t-Calculated	t-Critical
Experimental group	58	26.72	2.63	108	6.24	1.96
Control group	52	18.39	2.38			

$P < 0.05$, significant result

Table 3 showed that t-calculated (6.24) is greater than the t-crucial (1.96) at 0.05 level of significance, therefore the null-hypothesis was rejected. Which implies that there was a significant difference

between the mean performance scores of students taught Basic science using inquiry-based teaching method and those taught using traditional method of the two groups in the post-test, which is in favour of the experimental group.

Hypothesis Two: There is no significant difference in the mean performance scores of male and female students taught using the inquiry teaching method.

Table 4: Mean score, standard deviation and t-test of male and female students taught Basic science using inquiry-based teaching method.

Groups	No. of students	Mean	Standard deviation	Degree of Freedom	t-Calculated	t-Critical
Male	28	26.86	2.99	56	1.63	2.01
Female	30	28.12	2.38			

From table 4 above, t-calculated (1.63) is less than the t-critical (2.01) at 0.05 level of significance, hence the null-hypothesis 2 was not rejected. This implies that there was no significant difference between the mean performance scores of male and female students taught Basic science using inquiry-based teaching method.

Discussion of Findings

The results of this study showed that students taught Basic science with inquiry-based method performed better than their counterpart students taught using traditional method. This finding was in agreement with the finding of Desmond (2018) who found out that students exposed to inquiry-based method performed better in Basic science than their counterpart students who were exposed to traditional method in Basic science. Also, the findings agreed with Harson and Nelson (2019) who found out that students taught using inquiry-based teaching method perform better in Basic science than their counterpart students who were exposed to traditional method.

In table 3, the result showed that there was a significant difference between the mean performance scores of students taught Basic Science using inquiry-based teaching method and those taught using traditional method of the two groups in the post-test which was in favour of the experimental group. This was in consonance with the finding of Nwena and Edan (2023) who found that there was a significant difference between the mean performance scores of students taught Basic science using inquiry-based teaching method and those taught using traditional method of the two groups in the post-test which was in favour of the experimental group. The likely explanation for this outcome might be connected to the fact that students taught with inquiry-based method had the opportunity to construct their own understanding of the concept taught in the class so deep learning occurred.

The study revealed that the male students performed slightly higher than their female counterparts using inquiry-based teaching method. The difference was very small (negligible) that it has no impact or significant. This was in consonance with the finding of Oluwatosin (2015) who found that there was no significant difference between male and female students taught Basic science using inquiry teaching method. Also, the finding was collaborated with the finding of Omolere (2017) who found out that there was no significant statistical difference between male and female students taught Basic science using inquiry-based teaching method. According to these findings, it mean performance in Basic science does not depend on gender. Inquiry-based method can therefore be used to bridge the gap in performance between male and their female counterparts.

Conclusion

It has been seen from the result obtained that students taught Basic science using the inquiry-based teaching method performed better than those taught using traditional teaching method. Also, there is no significant difference between the mean performance scores of male and female students taught Basic science using the inquiry-based teaching method. Hence, the study concluded that the inquiry-based teaching method is a very effective method of teaching that increases the academic performance of students in Basic science.

Recommendations

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

1. Basic Science teacher should be encouraged to teach their students using inquiry-based teaching method.

2. Curriculum developers should incorporate inquiry-based teaching method in curriculum guidelines for the performance of intended learning outcomes.

3. Facilities should be provided by the federal and state governments as well as Parent Teacher Association (PTAs) and Non-governmental organizations (NGOs) for the effective use of inquiry-based teaching method

4. There is need for training of Basic science teachers by teacher training institutions on the effective use of inquiry-based teaching method in teaching Basic science.

5. Teacher's emphasis should shift from teacher centered of teaching to more activity-based learning such as inquiry-based teaching strategy.

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