Effects of Experimental Method of Teaching on Academic Performance of SS2 Science Students in Calabar Education Zone, Calabar, Cross River State

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Abstract
The study objective was to determine the "Effects of Experimental Method of teaching on academic performance of SS2 Science students in Calabar Education Zone of Cross River State. This is necessary because of poor performance of students in external examinations like WAEC, NECO, even including internal examinations. Null hypothesis was formulated to guide the study. The design adopted for the study was quasi-experimental research design and purposive sampling technique was used in selecting the schools. The research instrument used was science achievement test which comprises of thirty (30) objective tests. The reliability of the instrument was ascertained using Kudar-Richard's formula 20 which yielded a reliability coefficient of 0.84. The sample comprises of two hundred science students drawn from the study area. Data analyzed were collected using a 30 item achievement test on the concept of machine, Elasticity and wave. The hypothesis was analyzed using independent t-test and tested at 0.05 level of significance. Results of findings revealed that the students taught science concepts with experimental method performed significantly better than those taught with conventional method.
Keywords: Experimental based method, Performance, Effect, Teaching method, Conventional (traditional) method.

Introduction

Teaching and learning process is a two-way traffic where the teacher sends out the message while the student acknowledge through feedback, but this give and take process could only be effective when the teaching method applied is appropriate. Teaching methods refers to the process of transmitting facts, skills, information and knowledge by the teacher, so as to engage students in meaningful activities for learning and to achieve the objective of the lesson (Joe, 2004). According to Madugu (2005) teaching method consist of sequence of activities involved in instructing learners. Also, Ajoma (2009) expressed teaching method as a professional technique teachers adopt regularly in instructional exercise to enable them impact relevant knowledge and skills to the learner.

The study of science has been and will continue to be of tremendous importance to humanity for its ability to explain natural phenomena and everyday occurrences as well as its central role in the world's current technological development. The central purpose of teaching science at the secondary school level is to affect a positive outcome in the educational behavior of the learner.

Therefore, if the teaching method is right as well as the level of teaching and the subject to be taught is also right, the resultant effect should be positive. "Effect" therefore, is the mean difference on a variable experimental and control groups, divided by the standard deviation of that variable. Amon (2008) pointed out that effect indicate things which arise out of some antecedent or follows as a consequent. It is usually regarded as that which springs directly from something which can properly be termed as a cause. According to River (2007) students' academic performance is the ability of an individual to study, remember facts and successfully pass a given examination. He also added that being able to study effectively forms a larger pattern of knowledge. David (2007) says that students' academic performance involves the general mental capability to reason, solve problems, think abstractly, learn and understand new materials which in turn will be measured against the stated objectives. Academic performance denotes "attainment" which draws on a variety of mental processes including memory, perception, thinking and reasoning.

Therefore the study was aimed at determining the effects of experimental-based method of teaching on students' academic performance in science.

Purpose of the study

The general purpose of this study was to determine the effects of experimental-based method on academic performance of science students in Calabar Educational Zone, Cross River State.

Research Question:

What is the effect of experimental-based method on student's academic performance in science in Calabar Education Zone?

Hypothesis:

Experimental method has no significant effect on student's academic performance in science in Calabar Education Zone.

Literature Review:

Experimental based method and students' academic performance in science

Students by nature are investigators, having tendency to manipulate materials with curiosity to find out what happens. Most activities of young children are underlined by tireless curiosity and a desire to find out through exploration. Children are likely to acquire scientific and technological skills that will enable them solve problems associated with human needs and self-reliance by experiencing science through firsthand experience in handling concrete materials themselves during lessons.

Experiments are the basis and source of new knowledge and if well interpreted, they can be used to establish new theories, disapprove theories or re-define theories. This implies that to improve the teaching of science, experimental approach should be emphasized to promote the learners' understanding of concepts. Specifically, this enables students to develop skills to infer and interrelate with multiple concepts. Demonstrations and practical laboratory sessions has long been accepted as an integral part of the learning and teaching science and would be impractical to teach science without experiments (Abraham, 2005).

In principles and practice of education, what we hear, we forget, what we see, we remember, but what we take part in doing, we understand. Seeing should be regarded as being more important than hearing, and doing as being more important than seeing. To learn a thing in life through doing is much more cultivating, developing and strengthening than to learn it by verbal communicating. Experimental learning places a child in a situation where he is able to explore, manipulate on material, investigate and conclude.

Sanusi (2007) conducted a research work to determine 'the relevance of guided-discovery and demonstration methods on students' performance in physics in senior secondary schools in Kano State'. The objective of the study was to determine the difference in performance between students taught with guided-discovery and demonstration method of teaching. The design used in the study was quasi-experimental pre-test, post-test control group design with randomization. The population of the study was eight hundred and three (803) students offering physics in private senior secondary schools in Kano States. Four research questions are raised and three null hypotheses were formulated. Data through the use of teacher-made test were administered to students as pre-test and post-test treatments. The data collected were subjected to analysis of variance (ANOVA), based on this, all the three null hypotheses were rejected. The finding obtained among others was that students in demonstration group had a higher mean score than those in the guided discovery group. It was concluded that demonstration teaching method was more effective than the guided-discovery method in teaching physics. The researcher made some recommendations which include that both methods should be used in teaching because they make students develop principles of observation, inquiring and group work.

Nja and Neji (2013) in their study examined kitchen resources, reasoning ability level on academic performance of SS2 students in thermo-chemistry. Thermochemical activities in the kitchen (experimentation) such as, fermentation of samples of five different juice s (mango, orange, pineapple, grape and paw-paw), heating capacities of five samples of wood (mango, orange, quava, almond an drubber), induced thermal decomposition of five samples of shellfish shells powder (mangrove snail shell, fresh water periwinkle shell, fresh snail shell, clam shell and mangrove periwinkle shell) and dissolution of five samples of glucose (2g, 4g, 6g, 8g,and 10) were used for the study. The sample comprised 240 students drawn from four secondary schools in Calabar Education Zone of Cross River State of Nigeria. Quasi experimental factorial research design was used for this study. Chemistry Achievement Test (CAT), Chemistry

Retention Test (CRT) and Reasoning Ability Test (RAT) were used for data collection. Analysis of covariance (ANCOVA) was used in the analysis of data. From the findings, the use of kitchen resources enhanced the performance of students exposed to experimentation of kitchen resources during the teaching of thermo chemistry.

Owolabi (2007) worked on the use of analogy as a vehicle for achieving effective physics delivery in some selected senior secondary schools in Lagos state. The study sample consisted of 112 senior secondary school (two), SS2 physics students drawn from two randomly selected secondary schools in Lagos. The test was to find out specific information regarding the concepts of mirror and lenses which many students often confuse or use interchangeable. The result showed that the experimental group performed significantly better than the control group after a post test. It showed that there were statistically significant differences between the mean scores of experimental and control groups. This is an indication that there was a significant influence of analogy on student's performance in physics.

A study was carried out in Ogun State by Bimbola (2010), on the effects of constructivist-based teaching strategy on academic performance of students in integrated science at junior secondary school level. A quasi-experimental research design was used to conduct the research. The study involved 120 junior secondary school students in Ijebu-Ode Local Government Area of Ogun State, South-West Nigeria. Findings revealed that the constructivist instructed students had higher scores on the post test, compared to those exposed to conventional (lecture) method of teaching. It also puts that in a constructivist setting, knowledge is not objective, mathematics and sciences are viewed as systems with models that describe how the world might be rather than how it is. These models derive their validity not from their accuracy of any prediction which might be based on them. The research study recommends that if integrated science teachers incorporate constructivist based teaching strategy into their teaching method, there would be an improvement in academic performance of junior secondary school students in integrated science.

Experimental method is a method that has been described as problem solving, critical thinking, deductive thinking and not mere personal assumptions. It is a method of teaching that involves probing, finding out, investigating, analyzing, synthesizing, discovering, evaluating, questioning and thinking, Muhammad (2007).

Brunner's theory of learning and constructivism stated that learning is an active process in which learners construct new ideas based on discovery or experience. This theory is relevant to this study because emphasis is on helping learners discover meaning of concepts personally through the manipulation of the teaching materials provided by the teacher in the classroom. To this end teachers are expected to lay more emphasis on important concepts through experimentation which help learners to learn and apply whatever they have learnt beyond the classroom.

Research Methodology

The design for this study was quasi-experimental design, since intact classes were involved. It involves manipulation of independent variables in order to determine its effects on the dependent variables. The pre-test post-test non-equivalent control group

was adopted. The design was considered appropriate since the nature of the study will not allow for randomization of students into groups and the control group will be necessary to provide basis for comparison of the students' performance. The study was carried out in Calabar Education of Cross River State since the researchers are familiar with the area, and can adequately monitor and supervise the experiment. All the senior secondary two science students in the state-owned secondary schools in Calabar Education zone formed the population.

The sample was made up of 200 senior secondary II (SS2) science students randomly selected from 10 government secondary schools chosen for the study. A breakdown of the figure shows that twenty (20) students were randomly selected from each of the ten (10) government secondary schools for the study

The instrument used for this study was Science Achievement Test (SAT). The instrument was used in order to have a face-to-face contact with the respondents so as to access the data required in the study. The instrument has two parts; Part A seeks response on students' personal data such as name, school, sex and class, while Part B consisted of question items on the concept of Machine, Elasticity and Wave, which will measure students' performance. It is made up of 30 multiple choice items with four (4) options A, B, C and D. the researchers prepared notes of lessons that were used on the experimental group, The instrument was used in measuring the students' performance in the experimental group and control group respectively.

Table 1

Sample distribution table using 200 respondents selected in the urban and rural schools in the study area.

No. of students	Male	Female	Total
School A 50	25	25	50
School B 50	25	25	50
School C 50	25	25	50
School D 50	25	25	50
Total	100	100	200

Table 2

Table of specification (test – blue print) on 30 – item Science Achievement Test (SAT)

S/N	Content	Knowledge	Comp	Appli	Ana	Syn	Eva	Total
1.	Machine	3	2	2	1	1	1	10
2.	Elasticity	2	3	2	1	1	1	10
3.	Wave	2	2	2	2	1	1	10
	Total	7	7	6	4	3	3	30

Validation of instruments

Validity of a research instrument is "the extent to which an instrument measures what it is designed to measure". A face validation of the instruments was ensured by experts in the test and measurement unit to ascertain the appropriateness of the items in the research instruments and their comments was used for modification of items in the instrument that were finally used.

The instruments were administered to the SS2 science students in Calabar Education Zone. They were pre-tested before the treatment and then a post-test after the treatment to determine the effect of the treatment. The regular teachers were coached on the lesson note prepared for the experimental class which was administered to the students by their teachers while the teachers in the control group were allowed to teach normally.

The scores obtained from the pre-test and post-test were analyzed using mean and standard deviation to answer the research question.

Reliability of the instruments

Reliability refers to the extent to which an instrument measures whatever it is measuring consistently (Joshua 2017).To ensure the reliability of the instrument, SAT was administered to 30 students from two schools which met the criteria but not part of the main study. Test retest method was used in generating data. Second test was administered to the group a week after the first test. Data generated was analyzed using Pearson Product Moment Correlation (PPMC). The results indicated that SAT had a reliability index 0.84 hence the instrument is considered reliable and capable of measuring the intended event.

Table 3

Reliability coefficient of Science Achievement Test (SAT) using Kudar-Richardson formula – 20

	K	Σ PQ	S_x^2	$\bar{x}$	SD	rH
PAT	30	1.03	3.26	2.11	0.48	0.84

Result and Discussion

The primary independent variable of the study was experimental based method .The dependent variable was students' academic performance in science.

Presentation of result

In this section, the null hypothesis is related and data analysis carried out using independent t-test statistics, result of findings presented thus:

There is no significant difference between students' taught science with experimental based method and those taught with conventional method.

Table 4
Mean and standard deviation of the difference between science students' academic performance taught with experimental based method and Conventional method in science

(N = 200)

Variable type	n	$\bar{x}$	SD	Cal-t
Experimental method	100	22.84	6.72	
				4.18
Conventional method	100	16.21	3.16	

P< 0.05,df.1.96;critical t-1.98

This sought to investigate the difference in science students' academic performance taught experimental based method in science and with conventional method. Result of data analysis revealed that the experimental group taught with experimental method had higher mean score of ($\bar{x}$ = 22.84) that the control group with ($\bar{x}$ = 16.21) taught with conventional method since the calculated t – value of (t = 4.18) is significant greater than the critical t – value of 1.96 at 0.05 level of significance. Therefore the null hypothesis is rejected and the alternate restate thus, there is a significant difference between science students' academic performance taught with and without experimental based method in science.

Discussion of findings:

Experimental based method of teaching and student' academic performance in science

This Hypothesis sought to find out if the use of experimental based method influenced students' academic performance in science. Finding revealed that there is no significant difference in the academic performance of students taught with experimental method and those taught with conventional method in science. This means that regular exposure of students in experiments have rewarding earning outcome and retention in students than the normal conventional method. This finding collaborate with Nja and Neji (2013) who opined that the use of kitchen resources enhanced the performance of students exposed to experimentation of kitchen resources during the teaching of science.

The work also agrees with Muhammad (2007) who says that experimental teaching method has been described as problem solving, critical thinking reflective inquiry, deductive thinking and not mere personal assumptions. It is a method of teaching that involves probing, finding out investigating, analyzing, synthesizing, discovering and thinking.

Summary, Conclusion and Recommendation

Summary

The study has examined the effect of experimental based method of teaching on the academic performance of 200 SS2 students in science drawn from 10 government secondary schools in Calabar Education Zone, Cross River State.

To achieve the purpose of the study, a research question and a null hypothesis was formulated to guide the study. Related literatures were extensively reviewed to support the study. Quasi-experimental research design was adopted for the study. The researcher used purposive sampling technique in selecting the schools.

Anull hypothesis was tested using independent t-test. The hypothesis was subjected to 0.05 level of significance. The data was used to analyze the following finding:

There is no significant difference in academic performance between students taught science with experimental method and those taught with conventional method.

Conclusion and Recommendations

There is a significant difference in academic performance of students' taught with experimental method and those taught with conventional method.

Based on the findings of this study and its implication on students, teachers, as well as the government, the following recommendations were necessary:

1. Science Teachers should always be sure to use reliable teaching method(s) so that students benefit maximally and achieve better.
2. Government should equip schools with standard science laboratories so as to enhance students' learning and academic performance in science.
3. Workshops, Seminars and short-term training should be organized more regularly.

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