Enhancing Students' Academic Performance in Basic Science and Mathematics through Inquiry Pedagogy in Calabar Education Zone

[1]Ekon, Esther E., [2]Ezenwa-Nebife, Dorothy C., [1]Ekwueme, Cecilia O. & [1]Anditung, Peter A.

[1]University of Calabar, Calabar, Nigeria

[2] Federal Government Girls' College, Calabar, Nigeria

Email: olunwa1@yahoo.com;esthyl.rhemacare@gmail.com

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Abstract

This research investigated the effect of inquiry pedagogy on academic performance of students in Basic Science and Mathematics in Calabar Education Zone of Cross River State, Nigeria. Improving on students' academic performance requires that students should be provided with learning strategies that could enable them create knowledge themselves to enhance retention. This article explains how inquiry method of teaching could be used to communicate some basic concepts in Basic Science and Mathematics in the lesson to improve students' academic performance. The sample of the study consisted of one hundred and sixty (160) Junior Secondary School Three (JSS3) students in Calabar Education Zone. The instrument: Basic Science and Mathematics Achievement Test (BSMAT) developed by the researchers were used to gather data for analysis. One research question and one null hypothesis guided the study; a non-equivalent, pre-test, post-test quasi experimental design was employed. Two intact classes were used (though not all were used as sample) from four different schools purposively sampled, two as experimental and the other two, control group. The experimental group received treatment with the use of inquiry method, while the control group was taught conventionally. Independent t-test statistical analysis was used in the study. The result indicated that, there was significant difference in the mean achievement scores between the control and experimental groups. This finding shows that the students taught Basic Science and Mathematics using inquiry method had higher mean achievement scores than their counterparts in the control groups. This implies that knowledge can easily be gained if the students are actively involved in the lesson and given opportunity to investigate a given problem. The researchers recommended among others that Government and other Education Stakeholders should encourage teachers to employ inquiry method in their teaching and learning processes in secondary schools.

Keywords: Enhancing, Basic Science, Mathematics, Inquiry method and Academic Performance

Introduction

Science and Mathematics play vital roles in the National development of any country. The study of Science and Mathematics help us to interact effectively with nature and have control over the course of events in our daily lives. Science can be defined as the body of knowledge acquired through systematic experimentations which involves the process of learning by doing through applying the sensory media (Ekon and Eni, 2015). Uche and Umoren (1997) as cited in Mandor (2004) defined Basic Science as an approach to teaching Science aimed at enabling students gain the concepts of the fundamental unity of Science and also gain an understanding of the roles and functions of Science in every life. On the other hand, Mathematics can be defined as a body of knowledge, collection of techniques and methods for solving problems in a wide range of context (Ekwueme, 2013). Mathematics plays a great role in the development of Science and technology in Nigeria and beyond.

It has been conceptualized as a culture which affords man the opportunity to know, access things and objects within his immediate and remote environment (Harbor-Peters, 2000).

Maliki, Mgban and Julie (2009), see Mathematics as a subject that affects all aspects of human life at different degrees. Ezenwa-Nebife (2014), defined Mathematics as a Science of measurement which plays a great role in the development of mental activity. The social, economic, political, geographical, Scientific and technological aspects of man are centered on numbers.

The importance of Basic Science and Mathematics to national development cannot be overemphasized as cited in Mandor (2004) these subjects provide the tools of industrialization and national development as well as economic and social stability of the citizen. Despite this importance, students are not performing up to expectations in Basic Science and Mathematics at both internal and external examinations such as (Basic Education Certificate Examination, (BECE). This has been a source of concern to parents, students' educators and professional bodies in the society. This poor performance could be attributed to many factors including teachers', students' and societal problems. To be precise, Ekwueme, Ekon and Ezenwa-Nebife (2016) found that the ineffectiveness of instructional approaches used by teachers in secondary schools contribute immensely to students' poor performance in Basic Science and Mathematics.

Many learning strategies have been suggested such as learning by doing, problem solving, constructivism and inquiry method as one of the ways through which these problems could be reduced (Mandor, 2004). Okebukola (2000) observed that the best approach to learning Basic Science and Mathematics is through inquiry method. Scientific inquiry is an investigative approach to teaching and learning where students are provided with opportunities to investigate a problem and search for possible solutions, make observations, ask questions, test out ideas, think creatively and use their intuition (Njoku, 2000). Inquiry method requires that students be engaged in some mental and physical processes that involved finding out or discovery through problem solving. Inquiry also requires that students be exposed to suitable amount of background information that will enable them to be more practicable and participatory in classroom settings.

Sola and Ojo (2007) opined that inquiry method is a teaching method which has positive effect on students' interest, attitude and achievement in Science and Mathematics. In- other words, learning through inquiry as an instructional strategy enhances better understanding which leads to meaningful learning and long term retention. The use of inquiry method of teaching could help to improve the academic performance of students' in these subjects. Conventional teaching methods used in secondary schools are defective because they involve verbal presentation of pre-planned lesson. This teaching method is teacher- centered. Students' are not given opportunity to participate actively in the lesson and this makes the students' to be passive listeners during the lesson.

Therefore, conventional teaching method does not promote students' higher level of thinking (Ekon, 2013). On the other hand, inquiry- based learning challenges students thinking by engaging them in investigating scientifically oriented questions where they learn to give priority to evidence, evaluate explanations and learn to communicate and justify their decisions.

In inquiry method of learning, the teacher excites the students' interest in the topic and then provides them with opportunities to undertake the investigation either by themselves or preferably in collaboration with other students. The teacher carefully guides the students as they begin to explore or investigate the topic, being careful not to dominate the conversation but allow students to develop responses or think about the issue more carefully. Njoku (2002) stated that inquiry based learning is a teaching method developed during the discovery learning movement of the 1960s as response to conventional form of teaching. Students are motivated to use the inquiry process to develop explanation from their observation by integrating what they already know with what they have learned. Inquiry pedagogy exposes students on how to solve problems in Basic Science and Mathematics using practical approach. A study by Obianwu (2013) on the effects of inquiry method of learning on male and female students' posits that inquiry method of teaching is more favorable to male than female students and echoed the notion that male students seem to be more inquisitive and outspoken than female students.

It has been shown generally from literature that students-centeredness in learning enhances understanding and retention of concepts by students. Therefore, it is worthwhile to investigate how inquiry pedagogy could be used to enhance students' academic performance in Basic Science and Mathematics in Calabar Zone, Cross River State, Nigeria. To provide the theoretical basis of this study, Jean Piaget's constructivist theory of cognitive development was considered which was propounded in the year 1920. His learning theory in the classroom is based on the stages that students go through in order to learn. He believed that a constructivist classroom must provide a variety of activities to challenge students to accept individual differences, increase the students' readiness to learn, discover new ideas and construct their own learning.

According to constructivist perspectives, learning occurs when individuals are actively engaged in the learning process and integrate new knowledge with existing knowledge (Biggs and Shermis, 2004). Learning is considered as an active process of constructing knowledge rather than receiving. This principle encourages teaching approach which emphasizes on active participation and interaction of students in the lesson. The students are engaged effectively to construct knowledge based on their personal and previous experiences. Therefore, Basic Science and Mathematics teachers should be well prepared for their lessons and ensure that Basic Science and Mathematics teaching strategies are interesting and stimulates students' interest for optimum result.

Methodology

Quasi-experimental research design was used for this study. The main purpose of this study was to investigate the effects of inquiry method of teaching on academic performance of students in Basic Science and Mathematics in Calabar Education Zones. Specifically, the study sought to: Investigate the mean achievement scores of students taught Basic Science and Mathematics with inquiry method and those taught with conventional method.

Research Question

What are the mean achievement scores of students taught using inquiry method and those taught using the conventional method in Basic Science and Mathematics?

Hypothesis

There is no significant difference in the mean achievement scores of students taught using inquiry method and those taught using the conventional method. This study was conducted in Calabar Education Zone of Cross River State of Nigeria which comprises of seven local Government Areas. A stratified random sampling technique was used for selecting both the two local government areas (Akamkpa and Odukpani) and the four schools out of 16 public schools used for the study. Experimental and control groups were randomly assigned to two intact classes though not all the students were used as a pre-test was given to ascertain the academic level of the students in Basic Science and Mathematics. A sample of 160 Junior Secondary School 3 (JSS) (80 for control and 80 for experimental group) was randomly assigned to either control or experimental group from the population of about 4,300 students in the zone. The lesson on total surface area of a cube in mathematics and investigation of air and water in Basic Science was delivered to the students in the two groups. The experimental group was guided by the teacher and allowed to investigate the problem until they arrived at the solutions.

The control group was taught conventionally, where the teacher does the talking alone and the students' passive listeners. After two weeks of study, the two classes were tested again to see the effect of the study. The instrument: Basic Science and Mathematics Achievement Test (BSMAT) developed by the researchers were used for the study. A 20- test items for BSMAT (10 items each for Basic Science and mathematics) were constructed and presented to two experts in Measurement and Evaluation in Faculty of Education, University of Calabar, Calabar for the purpose of face validation. The comments and recommendations of these experts helped in modifying the instrument. A reliability coefficient of 0.78 was established using Pearson Product Moment Correlation and Cronbach Alpha on 25 students used for pilot testing of the instrument.

This shows that the instrument exhibited adequate reliability validity for use in the study. The two groups, experimental and control were pre-tested before teaching the lesson.

The experimental group had the mean score of 41.05 while the control group had the mean score of 41.44. The pre- test result showed that there was no much mean difference between the two groups. The control group students were taught using the conventional method, while the experimental group students were taught using inquiry method where the teacher guided the students to investigate and explore the solutions to the problem. After the lesson, this same test was given to the students in the two groups as post-test. The post-test was administered to the two groups and the researchers collected and recorded the scores for data analysis. The research question was answered using the mean and standard deviation, while the research hypothesis was tested using independent t-test analysis at 0.05 significant levels.

Result and discussion

Research Question: What are the mean achievement scores of students taught using inquiry method and those taught using the conventional method in Basic Science and Mathematics?

Table 1: Mean and standard deviation of the Experimental and control Group students' performance in Basic Science test.

Variable	N	X	S.D	Mean Diff
Experimental group	80	46.10	9.885	
				8.000
Control Group	80	38.10	8.516	

From Table 1, the data on students mean difference in Basic Science revealed that the mean scores of students in the experimental group, taught with inquiry method was 46.10 with the standard deviation of 9.885 while those taught with conventional method had 38.10 with standard deviation of 8.516. Therefore, the students taught with inquiry method performed better than those taught with conventional method with mean difference of 8.000.

Table 2 Mean and Standard deviation of the Experimental and Control Group students' performance in Mathematics test.

Variable	N	X	S.D	Mean Diff
Experimental group	80	44.06	13.328	
				6.212
Control Group	80	37.85	10.808	

From Table 2, the data on mean difference in achievement revealed that the mean scores of students taught with inquiry method was 44.06 with the standard deviation of 13.328 while those taught with conventional method had 37.85 with standard deviation of 10.808. This implies that students taught with inquiry method performed better than those taught with conventional method with mean difference of 6.212.

HO1: There is no significant difference in the mean achievement scores of students taught using inquiry teaching method and those taught using the conventional method.

Table 3 Independent t-test analysis of the difference in mean performance between the experimental and control groups in Basic Science test.

Variable	N	X	S.D	df	F-Sig
Experimental Group	80	46.10	9.885		
				158	1.203
Control Group	80	38.10	8.516		

From Table 4: the students in experimental group had a mean score of 44.06 while their counterparts in control group had a mean score of 37.85. The result of the t-test analysis of the mean in table 4 showed that the probability associated with calculated value of F (5.807) for the mean score is .001. Since the probability value of .001 is less than 0.05 level of significance, the null hypothesis is not accepted. Hence, there is significant difference in the mean score of students taught with inquiry method and those taught using conventional method.

The result gotten from this study shows that the use of inquiry method significantly enhances students' performance in Basic Science and Mathematics. The students taught using inquiry method of teaching achieved more than their counterparts taught conventionally. This shows that inquiry method encourages teaching approach which emphasizes on active participation and interaction of students in the lesson. The students are given opportunity to investigate the solutions to the problem through the guidance of the teacher. This agrees with Jean Piaget's constructivist theory of learning where students are engaged effectively to construct knowledge based on their personal and previous experiences. To them, learning occurs when individuals are actively engaged in the learning process and integrate new knowledge with existing knowledge. This study confirms what Sola and Ojo (2007) discovered that, inquiry method has a positive effect on students' interest and also enhanced achievement in Science and Mathematics.

Conclusion and Recommendation

The result from this study showed that students' taught using inquiry method achieved better than their counterparts taught with conventional method. The greater difference in performance could be as a result of the opportunity given to the experimental students for application of inquiry method of learning. In-other words, learning through inquiry as an instructional strategy enhances better understanding which leads to meaningful learning and long term retention. Since the use of inquiry method of teaching was found to enhance achievement in Basic Science and Mathematics, it is therefore recommended that teachers should employ the use of inquiry method of teaching and learning processes in their lessons; and students should be given opportunity to learn Basic Science and Mathematics using inquiry method of teaching. Again, Government, Policy makers and other Education Stakeholders should encourage teachers to employ inquiry method in their teaching and learning processes in secondary schools.

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