

Some Considerations in Achieving Effective Teaching and Learning in Science Education

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Abstract Three research questions with null hypotheses guided the study with the aid of a quasi experimental research design. These students were randomly assigned to two groups (treatment and control group). Treatment group were those taught biology using the sensitized inquiry teaching method while conventional method (lecture) was used for the control group. (1) Biology Achievement Test (BAT) was developed on the following units in biology, flower pollination, muscle structure and function, and seed germination. All these were drawn from anatomy and physiology of flowering plants and animal physiology in the biology textbook of SS1, to measure the initial and terminal academic achievement of the students. (2) Lesson notes were prepared on the above mentioned units using the inquiry teaching method and the conventional method using a pre – test, post – test experimental treatment. Thus, it is the contention of the author that the inquiry approach would enhance students' achievement in biology, hence the thrust of this study.

Keywords: *Inquiry teaching method, conventional method, achievement, biology, gender, location.*

Introduction

The importance of inquiry in the science process can not be overemphasized; the National Research Council (NRC) created the standards around a central theme 'science standards for all students'. This theme emphasizes the importance of inquiring in the science process, allowing students to describe objects and events, ask questions, construct explanation test those explanations against current scientific knowledge, and communicate their ideas to others. In teaching science with an inquiry emphasis, the assumptions of the diverse populace are considered, and critical and logical thinking skills are fostered. According to the NSES (National Academy Press, 1996), inquiry-based classrooms should include: A multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results.

Inquiry allows students to learn and experience biology firsthand, by taking on the roles of scientists. The students use the inquiry process to develop explanations from their observations (evidence) by integrating what they already know with what they have learned. They learn discrete biology concepts and skills, and how to solve problems using practical approaches. Incorporating inquiry into biology classrooms empowers students. They play an active role in their learning rather than the passive role commonly seen in traditional classrooms. Teachers can foster better experiences with inquiry in various ways and ultimately positively affect students' biology process skills and understanding of biology, whether the inquiry activity is structured, guided, or open. To know that inquiry can be challenging for some students and be prepared to provide more guidance to those students when signs of frustration appear (Institute for Inquiry, 1995; Washington Virtual Classroom, 2005)

Statement of Problem

Despite the emphasizes and importance of inquiring in the science process, there is still a high rate of failure in biology as revealed by the analysis of the May/ June SSCE result of 2006- 2008. Educators are seeking for alternative ways to teach biology so as to change this situation. The problem is, how can inquiry method of

teaching improve student's academic achievement in biology? And what are some considerations for implementing inquiry in biology

Purpose of the Study

The study is concerned with the analysis, comparison and examination of implementing inquiry in biology. Accordingly, the objectives were:

- (1) To compare the mean achievement scores of students taught through inquiry teaching method and those taught using the conventional method.
- (2) To compare the mean achievement scores of male and female students taught using inquiry teaching method.
- (3) To compare the mean achievement scores of students taught using inquiry teaching method in the urban and those in the rural schools.

Research Questions

- (1) What are the mean achievement scores of students taught using inquiry teaching method and those taught using the conventional method?
- (2) What are the mean achievement scores of male and female students taught using inquiry teaching method?
- (3) What are the mean achievement scores of students taught using inquiry teaching method in the urban and those in the rural schools?

Hypothesis

Ho1: There would be no significant difference in the mean achievement scores of students taught using inquiry teaching method and those taught using the conventional method

Ho2: There would be no significant difference in the mean achievement score of the male and female students taught using inquiry teaching method.

Ho3: There would be no significant difference in the mean achievement scores of students taught using inquiry teaching method in the urban and those in the rural schools.

Methodology

Quasi experimental design method was employed for this study using two groups (experimental and control group). The Pre – testing, Experimental treatment and Post – testing research design was adopted in this study of implementing inquiry in biology using some senior secondary school (SS1) students in Ogba/Egbema/Ndoni Local Government Area of Rivers State. The instruments used were the stratified random sampling technique considering the type of school, urban/rural and gender in which four secondary schools were drawn from the fifteen secondary schools in Ogba/Egbema/Ndoni Local Government Area of River State (ONELGA). From each of the four schools, fifteen (15) SS1 biology students were picked up randomly into two classes. Therefore the study was made up of thirty (30) Students from each school. This amounted to a total of one hundred and twenty (120) Students from the four schools representing the sample of the study. These students were randomly assigned to two groups (treatment and control group). Treatment group were those taught biology using the sensitized inquiry teaching method while conventional method (lecture) was used for the control group. (1) Biology Achievement Test (BAT) was developed on the following units in biology, flower pollination, muscle structure and function, and seed germination. All these were drawn

from anatomy and physiology of flowering plants and animal physiology in the biology textbook of SS1, to measure the initial and terminal academic achievement of the students. (2) Lesson notes were prepared on the above mentioned units using the inquiry teaching method and the conventional method.

Analysis of Data and Interpretation of Results

The data collected were analyzed based on the three research questions. The results obtained are as follows.

Table 1. The Mean Achievement Score of Students Taught Using Inquiry Teaching Method and Those Taught Using the Conventional Method

Teaching Method	Mean	SD	N	Standard Error	Z-Calculated	Z- Critical
Inquiry Method	54.3	10.54	60	1.503	19.96	1.96
Conventional Method	24.3	4.95	60			

From the table above, the mean score of the students taught using inquiry method was 54.3 with a standard deviation of 10.54 while the control group taught with conventional method had a mean achievement score of 24.3 with a standard deviation of 4.95

Since the Z calculated is greater than the Z critical of 1.96, the null hypothesis is therefore rejected. In other words, inquiry teaching method is considered to be superior to conventional method.

Table 2. The Mean Achievement Score of Male and Female Students Taught Using Inquiry Teaching Method

Inquiry Methods by Sex	Mean	SD	N	Standard Error	Z-Calculated	Z- Critical
Male	82.67	6.93	60	1.68	15.28	1.96
Female	57	11	60			

From the table above, the mean score of the male students taught using inquiry teaching method was 82.67 with a standard deviation of 6.93 while the female group taught with inquiry teaching method had a mean achievement score of 57 with a standard deviation of 11.

Since the Z calculated 15.28 is greater than the Z critical of 1.96, the null hypothesis is therefore rejected. This means that, the inquiry teaching method favours the males more than females in biology achievement.

Table 3. The Summary of the Mean Achievement Score of Students Taught using Inquiry Teaching Method in the Urban and those in the Rural Schools

Inquiry Methods by Location	Mean	SD	N	Standard Error	Z-Calculated	Z- Critical
Urban	60.3	11.7	60	1.79	26.7	1.96
Rural	16.3	4.12	60			

From the table above, the mean score of the urban students taught using inquiry teaching method was 60.3 with a standard deviation of 11.7 while the rural students taught with inquiry teaching method had a mean achievement score of 16.3 with a standard deviation of 4.12

Since the Z calculated 26.7 is greater than the Z critical of 1.96, the null hypothesis is therefore rejected. This means that, the inquiry teaching method favours the urban students more than those in the rural schools in biology achievement

Discussion

The study has shown that inquiry teaching method has a significant effect on student's achievements in biology. Inquiry teaching method has generally, greater positive effect on student interest, attitudes and achievement in science. With a well designed science laboratory activities focused on inquiry can provide learning opportunities that help students learn to investigate, to construct scientific assertions, and to justify those assertions in classroom community of peer investigators in contact with a more expert scientific community. Students who learned biology in small cooperative groups in the laboratory scored higher in achievement and on several inquiry skills than did students who learned in a large classroom setting. Though, the success or failure of the method will very much depend on the competence, enthusiasm and confidence of the teacher. Also, the relative effectiveness of the approach depends on the student ability and level of conformance. All in all, different approaches were good for different abilities.

The study identified that the use of inquiry teaching method favours the males more than the females in biology achievement. Boys' schools performed better than girls' schools and in co-educational schools, boys generally performed better than girls when teaching classes using the guided discovery method. Most authors of biology textbooks use masculine form of pronouns as sex neutral. Also illustrative diagrams and pictures in science books use male characters more than females as well as male role models than females which females consider science to be preserved of males. The textbooks should not be gender biased in terms to their use of pronouns, illustrative pictures and diagrams, role models etc. sex equity is necessary in our books. In view of the above, to improve interest and participation of girls in science there is need to adopt science books that represent male and female characters on equal bases.

In addition, the study has shown that students who were taught using inquiry teaching method in the urban schools had high rate of achievement in biology than those in the rural areas. This finding is in accordance with that of Njoku (2004), this is particularly true in rural areas where there are no science laboratories and public libraries and the schools often do not have their own libraries/laboratories to serve the teachers and the learners; and where such libraries exist, they do not stock journals. The rural schools in Ogba/ Egbema /Ndoni LGA are besieged with poor and potentially health threatening environments. Teachers and students are able to cope in such an environment by only accepting their faith if they do not have an alternative. Unfortunately most rural schools have poor buildings with leaking roofs, poor light, surrounded by bushes and overcrowding by using a variety of open and semi open teaching spaces. Other deficiencies, particularly lack of water and sanitary facilities and inadequate maintenances. The teaching and

learning environments here are far below what is required for comfort. In many cases the available laboratories are not equipped or are inadequately equipped (Ayodele, 2002) teaching resources are not just scarce, but no budget is planned to provide some of them. Most times, such schools could only retain unqualified or under qualified teachers.

Recommendations

Considering the findings of this study, it was recommended that:

- (1) Science teacher education should be emphasized, since the success or failure of the method will very much depend on the competence, enthusiasm and confidence of the teacher. It has been said that the apprentice or learner can only be as good as his/her master or teacher.
- (2) The teachers should be trained and retrained on the job to improve on the innovative strategies in inquiry training model in science classrooms. This could be done by the Government or relevant professional bodies like Science Teachers Association of Nigeria (STAN) organizing seminars, workshops and conferences
- (3) There should be proper provisions of facilities/equipment which are necessary for effective inquiry strategies. Inquiry through laboratory work is very necessary because science is best taught in well equipped science laboratories, and students learn science with much ease if taught using activities in the laboratory.
- (4) The nation's biological science curriculum should be made in view to accommodate an inquiry based science program for the students. In this, more time should be allocated to biology in the schools time table to provide for application of biology practical/ laboratory skills.

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