EFFECTS OF BIOLOGY PRACTICAL ACTIVITIES ON STUDENTS' PROCESS SKILL ACQUISITION IN MINNA, NIGER STATE

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Abstract

The study investigated the effects of biology practical activities on students' process skill acquisition in Minna, Niger State. The design of the study was quasi-experimental; specifically the Pre-test, Post-test, Non Equivalent Control Group Design. The sample consisted of one hundred and eleven senior secondary one biology students (60 males and 51 females) randomly drawn from two senior secondary schools in Minna, Niger State. Three research questions and three hypotheses guided the study. The treatment consisted of teaching a selected biology concept-"Animal nutrition" to the experimental group using practical activity method while the control group was taught the same concept using the lecture method. The Science Process Skill Acquisition Test (SPSAT) designed by the researcher, was the instrument used for data collection. The data collected were analyzed using mean and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.5 level of significance. The results revealed that practical activity method was more effective in fostering students' acquisition of science process skills than the lecture method. The interaction effect between teaching methods and gender of the subjects was not significant. Based on the findings of this study, the use of practical activity method to foster the acquisition of science process skills in biology students was recommended to biology teachers.

Introduction

Science is a great enterprise in which nations depend on, in-order to advance technologically. Science therefore, is receiving much emphasis in education because of its significance and relevance to life and society. Opinions have differed significantly as to the exact meaning of science. Okeke (2007) asserted that there is no specific definition of science and so, viewed science as a systematic process of obtaining testable and verifiable knowledge about nature and natural occurrences, utilizing careful observation and experimentation. Science is basically concerned with answering questions about how the universe works (Ige, 2001). Therefore, from science flowed a stream of knowledge, skills and inventions for the improvement of human life. Ali (2006) stated that science is both process and product derived from experimentation. This means that science involves doing experimental and laboratory-oriented work. Broadly speaking, Science is made up of practical and theoretical aspects. While the practical aspect is activity loaded, the theoretical aspect emphasizes content exposition using the "chalk and talk" method, thereby presenting the lesson in abstraction to the students.

Biology is a branch of science that deals with the study of living things. Odigie (2001) explained that biology is the prerequisite subject for many fields of learning that contributes immensely to the technological growth of the nation. This includes medicine, forestry, agriculture, biotechnology and nursing. It is taught in senior secondary school as provided in group A, (as one of the core subjects) of the National Policy on Education. The study of Biology in senior secondary school can equip students with useful concepts, principles and theories that will

enable them face the challenges before and after graduation. This is in line with the broad goals of secondary education which is to prepare individuals for useful living within the society (Federal Republic of Nigeria (FRN), 2004).

Nzewi (2008) asserted that practical activities (approach) can be regarded as a strategy that could be adopted to make the task of a teacher (teaching) more real to the students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters. Nzewi (2008) maintained that practical activities (approach) should engage the students in hands-on, mind-on activities, using varieties of instructional materials/equipment to drive the lesson home.

The search for a more effective approach for the teaching and learning of biology that will enhance the acquisition of process skills has persisted over the years. This is because, the acquisitions of science process skills are the bases for scientific inquiry and the development of intellectual skills and attitudes that are needed to learn concepts. Nwosu (1991) maintained that science process skills are abilities which can be developed by experience and used in carrying out mental and physical operations. Acquisition of science process skills can enhance students' achievement of science subjects. Also, the acquisition of science process skills will help the child to explore his environment and solve certain scientific problems. These process skills have the enduring quality that will contribute to the students' ability to solve problems even when the information base of science and technology changes. Nwosu (1991) emphasized that education for the future therefore, should be the type that will equip the individual with the power to adapt to change. This should be the most important goal of any society that wants to progress.

However, Nwagbo (2001) reported that a number of factors have been identified as contributing to the non-acquisition of skills by secondary school students which invariably leads to poor performance. One of such factors is the teacher variable, that is, the teacher's method of teaching. Research reports (Nwosu, 1991; Nwagbo, 1999 and Okoli, 2006) indicate that many science teachers prefer the traditional expository/lecture method of teaching that is, a teaching technique in which one person, the teacher, presents a spoken discourse on a particular subject and shy away from activity-oriented teaching methods which are student centered (such as inquiry method, discovery method, investigative laboratory approach). The problem is compounded by the fact that most students in senior secondary schools offer biology, resulting to high student - teacher ratio. Consequently, the teachers have too much work load as a result of large class size (Ajayi, 1998). Ajayi further pointed out that large class size, poor materials in terms of laboratory space and equipment, mixed nature of biology class, over loaded syllabus and inadequate number of periods allocated to biology, pose a serious problem to teaching the practical aspects of biology.

Nwosu (1991) and Mandor (2002) reported a very poor performance on science process skills among secondary school students in Nigeria. So, this study is set out to investigate the extent of the students' acquisition of some of these process skills, to join in the debate. Some studies have shown that some innovation strategies like guided inquiry, cooperative learning can enhance students' performance in science Nworgu (1999) and Nwosu and Nzewi (2000). The researcher therefore considers it necessary to explore the field of science process skills with regard to the level of their acquisition, using practical activities and the conventional method (lecture method) of teaching biology in secondary schools. The researcher also look into gender

as a factor of variability among students to ascertain if such factor can influence the acquisition of science process skills of observing, classifying, measuring, communicating and experimenting.

Purpose of the Study

The purpose of this study is to determine the effects of biology practical activities on students' process skill acquisition in Minna, Niger State. Specifically, the study examined:

1. the differential effects of biology practical activities and lecture method on the level of acquisition of science process skills,
2. the extent to which gender influences the acquisition of science process skills,
3. the extent the instructional methods interact with gender to affect students' acquisition of science process skills.

Research Questions

1. Which of the two teaching methods (practical activity and lecture) better fosters the acquisition of science process skills, as measured by the students' mean science process skill acquisition test (SPSAT)?
2. What is the influence of gender on students' mean score when exposed to practical activity or lecture method on a science process skill acquisition test SPSAT?
3. How does gender interact with teaching method to influence students' acquisition of science process skills?

Hypotheses

The following null hypotheses will be tested at 0.05 level of significance.

$HO_{1:}$ There is no significant difference in the mean science process skill acquisition test score of students taught biology using practical activity method and those taught using lecture method.

HO_2: There is no significant difference between male and female students' mean score on a science process skills acquisition test (SPSAT)

$HO_{3:}$ The interaction effect between teaching methods and gender of the subjects is not significant.

Methodology

Research Design: The design of this study was Quasi-Experimental. According to Kurumeh (2007), this design is often adopted when it is not possible to have complete randomization of the subjects. Consequently, the researcher has to use his subjects as groups already in existence. Intact classes were therefore used for the study. The specific design was Pre-test, Post-test, Non-Equivalent Control Group Design.

Research Instrument: The scores obtained from the trial testing were used to determine the reliability coefficients of the instruments. Split-half reliability technique was used to estimate the reliability of SPSAT. The split-half was done by splitting the test into two equal halves using odd and even numbers. 40 scripts used in the trial testing were scored by the researcher. The scores awarded were correlated using Spearman Rank Order Coefficient of Correlation. The split-half reliability coefficient was found to be 0.93.

Experimental Procedure: Firstly, permission was sought from the principal before the test instrument was administered to the subjects in the two schools. The first teaching method was the practical activity method while the second teaching method was the conventional (lecture) method. The practical activity method was used for the treatment group while the lecture method was used for control group. Lesson plans for both the treatment and control groups were the same in terms of content, basic Instructional objectives, length of time for teaching and mode of evaluation except for the practical activities in the treatment group. Pre-test was administered to the two groups before the treatment. This is to determine the students' initial group equivalence. The class teacher taught the biology concept (Animal Nutrition) following the procedures that were involved during lessons. The researcher kept on monitoring the control and the experimental group teachers, to ensure that they did not deviate from the procedures of instruction they were using. The treatment lasted for four weeks.

At the end of the four (4) weeks of twelve periods, the teacher administered the post test to the subjects in the two groups using Science Process Skill Acquisition Test (SPSAT). The scripts from both pre-test and post-test of the two groups were marked and scored using the marking guide. The data collected were then used to answer the research questions and test the hypotheses stated for the study. The scores obtained from the pre-test and post-test were analyzed using Mean and Standard Deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Research Question 1

Which of the two teaching methods (practical activity and lecture) better fosters the acquisition of science process skills, as measured by the students' mean science process skill acquisition test (SPSAT)?

Table 1: Mean and standard deviation for the experimental and control groups

Groups	N	Pretest		Posttest	
		Mean	Std. Deviation	Mean	Std. Deviation
Experimental	41	8.1463	2.91171	17.3659	2.74551
Control	70	7.1571	2.31339	10.6714	2.67420
Mean Difference		0.98920		6.69443	

Table 1 shows that the experimental pre-test and post-test mean scores are 8.1463 and 17.3659 with standard deviation scores of 2.91171 and of 2.74551 respectively. However the control group has pre-test and post-test mean scores of 7.1571 and 10.6714 with standard deviation scores of 2.31339 and 2.67420 respectively. The mean difference for pre-test is 0.98920 and that of posttest is 6.69443.

Research Question 2

What is the influence of gender on students' mean scores when exposed to activity or lecture method on science process skill acquisition test (SPSAT)?

Table 2: Mean and standard deviation for the experimental and control groups across the Sex

Groups	Sex	N	Pretest Mean	Pretest Std. Deviation	Posttest Mean	Posttest Std. Deviation
Experimental	Male	23	8.2174	2.64500	17.5217	2.72813
	Female	18	8.0556	3.29835	17.1667	2.83362
	Mean Difference		0.1618		0.3550	
Control	Male	37	6.8378	2.23002	10.8919	2.13156
	Female	33	7.5152	2.38644	10.4242	3.19208
	Mean Difference		-1.3226		0.4677	

Table 2 shows that the pre-test mean scores and standard deviation score for the experimental male and female are 8.2174 and 2.64500; 8.0556 and 3.29835 respectively. Similarly, the post-test means scores and standard deviation scores for the experimental male and female are 17.5217 and 2.72813; 17.1667 and 2.83362 respectively. Also, the pre-test means scores and standard deviation scores for the control male and female are 6.8378 and 2.23002; 7.5152 and 2.38644 respectively. Also, the post-test means scores and standard deviation score for the control male and female are 10.8919 and 2.13156; 10.4242 and 3.19208 respectively. The mean difference for experimental pre-test and post-test are 0.1618 and 0.3550 respectively. Finally, the mean differences for control pre-test and post-test are -1.3226 and .4677 respectively.

Research Question 3

How does teaching methods interact with gender to influence students' acquisition of science process skills?

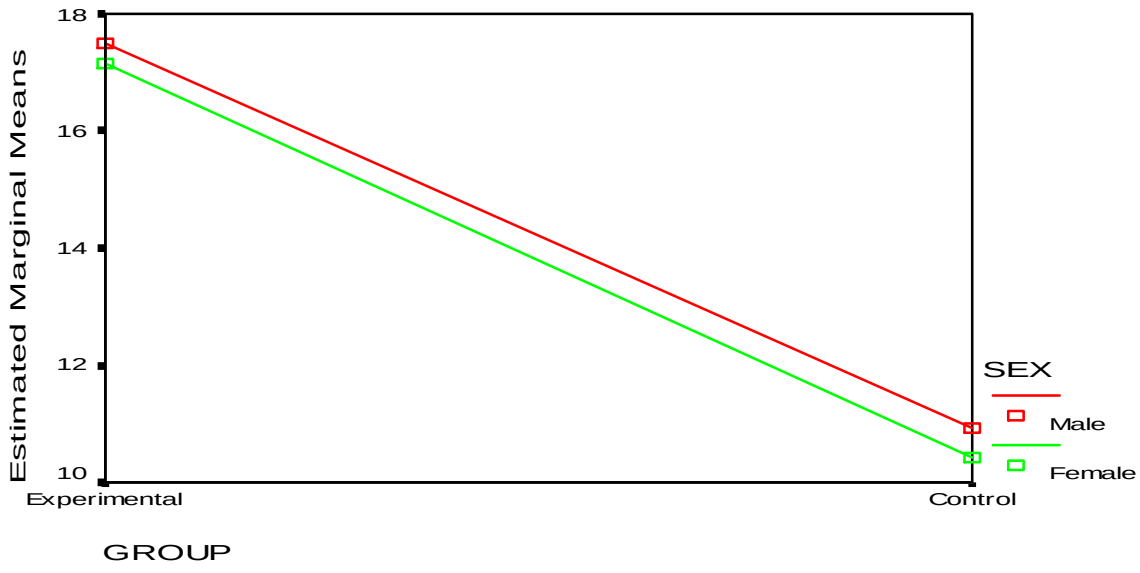

Fig. 1: Graph showing interaction between methods and gender

Figure 1 showed that there is no interaction between gender and the teaching methods. Therefore, there is no interaction between the teaching methods and gender to influence students' acquisition of science process skills.

Hypothesis 1

There is no significant difference in the mean science process skill acquisition test score of students taught biology using practical activity method and those taught using lecture method.

Table 3: Summary of ANCOVA table

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1164.896(a)	4	291.224	39.135	0.000
Intercept	2007.870	1	2007.870	269.821	0.000
Pretest	1.069	1	1.069	0.144	0.705
Group	1093.965	1	1093.965	147.009	0.000
Sex	4.532	1	4.532	0.609	0.437
Group * Sex	0.134	1	0.134	0.018	0.893
Error	788.798	106	7.441		
Total	21131.000	111			
Corrected Total	1953.694	110			

Table 3 shows that F (147.009) is significant at 0.000 for the methods, at 1 and 110 degrees of freedom (df). This is because, 0.000 is less than 0.05 significant level earlier set for the hypothesis. Hence, the hypothesis is not accepted. That is, there is significant difference between the science process skills acquisition test scores of students taught biology using practical activities method and those taught using lecture method.

Hypothesis 2

There is no significant difference between the male and female students mean scores on a science process skills acquisition test (SPSAT)

Table 3 shows that F (0.609) is not significant at 0.437 for the sex, at 1 and 110 degrees of freedom (df). This is because, 0.437 is more than 0.05 significant level earlier set for the hypothesis. Hence, the hypothesis is accepted. That is, there is no significant difference between the male and female student's mean scores on a science process skills acquisition test (SPSAT)

Hypothesis 3

The interaction effect between teaching methods and gender of the subjects is not significant.
Table 3 shows that F (0.018) is not significant at 0.893 for the interaction between groups and sex at 1 and 110 degrees of freedom (df). This is because, 0.893 is more than 0.05 significant level earlier set for the hypothesis. Hence, the hypothesis is not rejected. That is, the interaction effect between teaching methods and gender of the subject are not significant.

Summary of the Finding

From the results, the following are the summary of the findings

1. Practical activity method fosters the acquisition of science process skills better than lecture method.

2. The male students achieve better than the female students when taught with practical activity method.
3. There was no interaction between the teaching methods and gender.
4. There is significant difference between the science process skills acquisition test scores of students taught biology using practical activities method and those taught using lecture method.
5. There is no significant difference between the male and female student's mean scores on a science process skills acquisition test (SPSAT)
6. The interaction effect between teaching methods and gender of the students. are not significant.

Discussion of Findings

Effect of Teaching Methods on Students' Science Process Skill Acquisition

The result in table 1 revealed that the students in the experimental group had a higher mean Science Process Skill Acquisition Test (SPSAT) score in biological concept compared to their control group counterparts. This showed that practical activity method affected students' performance more positively than the lecture method (conventional method). This implies that practical activity method was more positive and effective in fostering and facilitating students' performance in biological concepts than the lecture method.

The result of this study is in consonance with the views of (Nwosu, 1991) who is of the opinion that active participation of the students gave rise to more meaningful and effective learning. However, Nwagbo (2001) observed that most of the conventional methods employed in teaching biology in secondary schools have never yielded much dividend judging from the poor performance of the students in West African Senior Secondary Certificate Examination (SSCE). This is so because the teaching method that involves active participation of the students motivates them to learn and active participation can make a very high impact in students' achievement (Okeke, 2007).

The Influence of Gender on Students' Process Skill Acquisition

The result from table 2 revealed that male and female students in the experimental group benefited much from practical activity method of teaching though, the male students had a higher mean score than their female counterparts in SPSAT. But the mean difference of .1618 proves that they performed equally. Hence, the hypothesis is accepted. That is, there is no significant difference between the male and female students' mean scores on a Science Process Skills Acquisition Test (SPSAT). This result is in conformity with the findings of other researchers (Ige, 2001; Mandor, 2002 & Odigie, 2001) who found no significant difference in the achievement of male and female in science subjects. This result is in compliance with the recent studies, Nzewi (2008) who found no significant difference in the mean achievement scores of male and female students taught ecological concepts using five E's constructivist instructional approach.

However, the findings of these studies indicated that when a good teaching method is used, male and female students will achieve equally. Teachers should therefore modify teaching environment with the help of instructional strategies to ensure that gender differences are eliminated.

The Interaction Effect between Teaching Methods and Gender on Acquisition of Science Process Skills

The graph result presented in fig. 1, revealed that there was no interaction between teaching methods and gender of the subjects to influence students' acquisition of science process skills. This result is in agreement with the findings of Nworgu (1999) who found no interaction effects between video and audio rolliograph and gender on students' achievement in science and retention. This finding is in consonance with the views of Okoli (2006) that there is no significant interaction between instructional method and gender on performance. That is, the interaction effect between teaching methods and gender of the students are not significant, implying that gender did not combine with teaching methods to affect the students' acquisition of science process skills. Any difference observed in students performance could therefore be attributed to the instructional method used which facilitated male and female students' acquisition of science process skills during treatment.

Conclusion and Recommendations

Based on the findings of the study on the effects of biology practical activities on students' process skill acquisition in Minna, Niger State, the following conclusions were made.

1. Teachers should involve students in practical activities by encouraging them to collect some of the materials needed for practicals from the environment which is the laboratory its-self.
2. Teachers should encourage students to develop interest in practical activities by conducting the practicals with them as well as providing instructional activities that will challenge students to be actively involved during practicals.
3. Ministry of Education and science educators should organize workshops, seminars and conferences from time to time for biology teachers. This is to prepare the teachers on the effective use of practical activities in teaching biology, in order to sustain students' interest and make their lesson more interesting.
4. Biology concepts should be taught with practical activity so that the students will do science instead of learning about science.

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