



Effect of Laboratory Activity on Academic Achievement in Ecology Concepts among Secondary School Biology Students in Kaduna State

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ABSTRACT

The study investigated the effect of laboratory activity on Academic Achievement among Secondary School Biology Students in Sabon Gari LGA, Kaduna State. Two objectives, research Questions and Hypotheses guided the research. The population comprised all 1986 senior secondary school Biology students in Sabon Gari LGA. A sample comprised of 116 students randomly selected from two coeducation schools in Sabon Gari LGA was used for the study. Pretest and posttest, experimental and control group design was used for the study. One validated instrument called Biology performance Test (BPT) with $r=0.76$ was used to gather data. Data were collected by the researchers from the sample schools using BPT. The experimental group was taught Ecology concepts using the Laboratory method while the control group was exposed to the lecture method. Data collected were analyzed using *t*-test statistics. The hypotheses were tested at a $p \leq 0.05$ level of significance. The study results revealed that differences exist in performance when students have been exposed to laboratory and lecture teaching methods in favour of the experimental group. Based on the findings, the following recommendations were made; the use of laboratory instruction should be encouraged among teachers of Biology to improve students' performance. The laboratory method should also be encouraged to promote the learning of Biology by both male and female students.

INTRODUCTION

Biology is one of the core science subjects offered in Nigerian secondary schools and it is the most highly subscribed among the science subjects of the Nigerian senior secondary school curriculum by both schools and students. Majority of the students offer it at the Senior School Certificate Examinations (SSCE) because the knowledge of Biology is needed in the fields of medicine, nursing, pharmacy, agriculture, engineering and other related disciplines. It is a subject that requires the processes and skills of science, through laboratory experiences, to understand its

theoretical concepts and application of such concepts in practical and similar situations in everyday life. Such practical experiences encourage critical thinking which can enhance innovation and productivity (manufacturing) that are highly needed in Africa as a developing continent.

Laboratory work is seen as an integral part of most science courses, including Biology. However, a significant proportion of laboratory activities remain highly prescriptive and fail to challenge secondary school students (Fisher, Harrison, Handerson, and Hofstein, 2018). The laboratory has been given a central and

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distinctive role in science education. Science educators have suggested that rich benefits in learning accrue from using laboratory activities (Hofstein and Lunetta, 2013). According to Hofstein (2013), science laboratory activities are learning experiences in which students interact with materials and/ or with models to observe and understand the natural world. This leads to metacognition which Gunstone and Champagne (2017) suggested is an elaboration and application of one's learning which can result in enhanced understanding. The challenge therefore is to help learners take control of their own learning in the search for understanding. In the process, it is vital to provide opportunities that encourage learners to ask questions, suggest hypotheses and design investigations. There is the need to provide students with frequent opportunities for feedback, reflection, and modification of ideas (Barron, Schwartz, Vye, Moore, Petrosino, Zech, and Bransford, 2018). Research has not provided evidence that such opportunities exist in most schools in Nigeria.

The teaching and learning of Biology demand laboratory activities in an environment that is inspiring, encouraging and challenging to learners to enable them acquire and utilize the necessary science process skills in the subject. Such process skills which are either generic or integrated include observing, classifying, measuring, reporting, analyzing, communicating, using numbers and recognizing spatial relations. Others are inferring, predicting, defining operationally, hypothesizing, identifying and controlling variables, experimenting, interpreting data and using models. Science process skills are fundamental to science, allowing every category of learner to conduct investigations and reach conclusions. A good laboratory environment, according to Aladejana and Aderibigbe (2017), promotes curiosity in students, reward creativity, encourages the spirit of healthy questioning, avoids dogmatism and also promotes meaningful understanding. In line with the above, Metzenberg (2015) suggested that students need to develop necessary social and learning skills so that they can collaborate

effectively, share, debate, defend their ideas and be able to work in groups. In this way they can interact and help one another to acquire process skills needed in learning especially the sciences like Biology.

Modern Science is the firm base upon which modern advances in Technology depends. Many breakthroughs that man has recorded in the quest to improve his life were achieved through the knowledge of science, it therefore became pertinent that science be taught at all levels of education. At the senior secondary level science is departmentalized into Biology, Biology and Physics. Biology which is the study of different forms, their evolution, structures, functions, growth, distribution and taxonomy occupies a unique position in the secondary school science curriculum. It serves as a pre-requisite to the study of other lucrative and challenging professions like; medicine, nursing, pharmacology, biochemistry, agriculture among others. The vital role of the study of this discipline in the economic, industrial and public life of the learners and the general humanity cannot be overstressed (Ibe and Ukpai 2013; Akambi and Kolawole, 2014).

Biology as a science subject is based on practical and experiment. Its objectives as contained in the National policy on education (FRN, 2013) include among others to equip learners with meaningful and relevant knowledge of Biology, adequate laboratory and field skills. It is only through utilization of Biology laboratory equipment that the above objectives and goals can be achieved. Unfortunately, the teaching and learning of biology over decades is yet to adequately meet the expectation of the people in the above areas. This is evident in the overall poor performance of students in the subject in Nigeria.

In spite of the popularity of Biology among Nigerian students, performance at Senior Secondary School level had remained poor. A critical look at students' academic performance in Biology in Secondary School Certificate Examination over the years showed consistent low academic performance.



Table 1.1 Students' Performances in Biology Kaduna State WAEC May/June, 2012-2019

Year	Total Sat	No with A1-C6	% with A1-C6	No with D7-F9	% with D7-F9
2012	126,821	59657	47.04	67161	52.96
2013	134,852	56570	41.95	78282	58.05
2014	130,653	56155	42.98	74498	57.02
2015	150,925	72204	47.85	78722	52.17
2016	143,936	62008	43.08	81928	56.92
2017	149,162	61028	40.90	88134	59.10
2018	136,916	58284	42.60	78632	57.40
2019	178,932	88643	49.50	90289	50.50

Source: West African Examination Office, Kaduna Office (2020).

The performance of students in Biology in Table 1.1 May/June 2012-2019 West African Examination S.S.C.E. is an evidence of the poor performance in Biology. Nwokolo, (2013), observed that part of the reasons for failure of students in examination is attributed to the methods of teaching adopted by teachers for teaching Biology, which is mostly lecture method. Adanyi (2019) reported poor skills acquisition when lecture method is used to teach Biology concepts and other science related subjects. However, teachers still prefer using the 'chalk and talk' method in instructing learners (the lecture method approach) and this method does not promote performance and skill acquisition.

Objectives of the Study

The specific objectives of this study are to:

1. Find the effect of laboratory on academic performance among secondary school Biology students' in Sabon Gari Local Government area of Kaduna State
2. Determine the difference in academic performance by gender among secondary school Biology students' in Sabon Gari Local Government area of Kaduna State

Research Questions

1. What is the difference in the effects of laboratory on academic performance among secondary school Biology students' in Sabon Gari Local Government area of Kaduna State?
2. What is the difference on academic performance by gender among secondary

school Biology students' in Sabon Gari Local Government area of Kaduna State?

Research Hypotheses

- HO₁:** There is no significant difference in the effects of laboratory on academic performance among Biology students' in Sabon Gari Local Government area of Kaduna State.
- HO₂:** There is no significant difference in the effects of laboratory on academic performance among Biology students' in Sabon Gari Local Government area of Kaduna State.

METHODOLOGY

This research employed quasi-experimental design in investigating the effect of Laboratory Academic Performance among secondary school Biology students in Sabon Gari Local Government Area of Kaduna State. The population of this study comprised of seven thousand five hundred and eleven (7,511) secondary school students in Sabon Gari Local Government Area of Kaduna State from the eight (8) secondary schools in the study area.

Simple random sampling technique was used in the selection of 2 secondary schools out of 8 secondary schools in the study area. The sample size of this study is 116 secondary school Biology students. Biology Performance Test (BPT). The instrument was adopted by the researcher using WAEC 2016-2019 past standardized questions. The Biology Performance Test (BPT) comprised of forty choice objective test items each with four alternatives (A – D) from which the students selected the correct answer. Two marks were



allocated for each question answered correctly. The test items covered the content units of the topics selected for the study. The Instrument was given to experts who are senior lecturers in the

Department of Biology, Ahmadu Bello University, Zaria and two experienced Secondary School Biology teachers to validate the test items.

RESULT PRESENTATION

Table 1: Summary of Posttest Mean Scores of Academic Performance of Students in Experimental and Control Group.

Groups	N	Mean	Std	Std Err	Mean difference
Experimental	59	57.400	3.922	.716	20.13
Control	57	37.266	3.838	.700	

Table 1 showed the results of the mean score of the academic performance of students taught Ecology using laboratory method and those taught with lecture method. Their mean academic performance was 57.400 and 37.266 by experimental and control group, implying a

mean difference of 20.13 in favor of the experimental group. This shows that students who were taught with laboratory method performed academically higher than those taught with lecture method.

Table 2: Summary of Posttest Mean Scores of Academic Performance by Gender in Experimental.

Variable	Gender	N	Mean	STD	Mean diff
Mean Performance Scores	Male	22	24.2500	4.87889	0.083
	Female	18	24.3333	4.18330	

Table 2 showed that there is no significant difference in the mean performance scores of male and female students taught ecology laboratory method. The computed descriptive statistics showed that their computed mean performance scores are 24.2500 and 24.3333 by male and female students respectively when both are taught ecology using laboratory method this shows that it has the

same effect on both male and female scores in ecology concepts.

Hypotheses Testing

The hypotheses were tested using suitable statistical tools at $p \geq 0.05$ level of significance for retaining or rejecting the null hypotheses.

Table 3: Independent t test Statistics on Differences in the Mean Academic Performance of Students in Experimental and Control Group.

Groups	N	Mean	Std	Std Err	Mean difference	df	P	Remark
Experimental	59	57.400	3.922	.716	20.13	114	0.003	S
Control	57	37.266	3.838	.700				

$P \leq 0.05$



The result in Table 3 showed that the p-value of 0.003 was observed at df= 114. Since the p-value was less than the alpha value of 0.05, it means therefore that the difference in the academic performance of students taught Ecology with laboratory instruction and those taught with lecture method was significant in

favor of the experimental group. Therefore, the null hypothesis which states that there are no significant differences in the mean academic performance of students taught Ecology with laboratory instruction and those taught with the lecture method was rejected.

Table 4: Independent t test Statistics on Difference in the Mean Performance Scores of male and female Students Taught Ecology using Laboratory Method

Gender of experimental Group	N	Mean	STD	Mean diff	Df	t computed	t critical	p	Remark
Male	22	24.2500	4.87889	0.083	38	0.744	1.96	0.461	S
Female	18	24.3333	4.18330						

P > 0.05, t computed < 1.96 at df 38

Results of Table 4 showed that there is no significant difference in the mean performance scores of male and female students taught ecology concept using Laboratory method. Reasons being the calculated p value of 0.464 is higher than the alpha level of 0.05 and the computed t value of 0.744 is lower than the 1.96 critical t value at df 38. The computed descriptive statistics showed that their computed mean achievement scores are 24.2500 and 24.3333 by male and female students respectively when both are taught ecology using Laboratory method. This shows that it has the same effect on both male and female students. Therefore, the null hypothesis which state that there is no significant difference in the mean performance scores of male and female students taught ecology using Laboratory, is hereby retained.

DISCUSSION OF FINDINGS

This research work investigated the effects of laboratory on performance among secondary school biology students. Two hypotheses were stated and tested based on the scores of the subjects obtained in Biology Performance Test (BPT).

Analysis of the data obtained are presented in Table 1 to 4 in accordance with the stated hypotheses.

Hypothesis one tested for significant difference in the mean academic performance of

students taught biology using laboratory and those taught using lecture method. Students have significantly higher academic performance when exposed to laboratory activity. The results of the findings showed that there was significant difference in academic performance when SSS students were exposed to laboratory instruction and lecture method. It was observed that performances of students who were taught using laboratory instruction outperformed others taught using lecture method in favour of the experimental group. The null hypothesis was therefore rejected.

The findings conform to that of Chukwuemeka (2018) who came out with similar finding on the effect of practical activities on academic performance among Biology students in Delta State Capital Territory (DSCT) Nigeria. Chukwuemeka found out that the experimental group had a higher mean academic performance score than their counterpart taught using lecture method; this could be as a result of exposure to practical activities. This is in line with Mathew (2018), revealed that there is high academic performance in the group exposed to practical activities than those exposed to lecture method. While it disagrees with the findings of Opara (2018), (whose work was on heterogeneous subject i.e mixed ability student, not the slow learners). On academic performance of the

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male and female students jointly exposed to activity-based method.

CONCLUSIONS

On the basis of the findings from this study, the following general conclusions could be deduced:

1. Students have higher academic performance when exposed to laboratory instruction.
2. Laboratory instruction enhanced performance equally well in both Male and female students.

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