IMPACT OF LABORATORY METHOD ON STUDENTS' ACADEMIC PERFORMANCE IN BIOLOGY AMONG SENIOR SECONDARY SCHOOLS IN KATSINA STATE, NIGERIA

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Abstract
This study examined the influence of laboratory method on students‟ academic Performance in Biology among Senior Secondary Schools in Katsina State Nigeria. The study was guided by two research objectives, from which two research questions, and two null hypotheses were analyzed. The objectives achieved were to: Examine the impact of laboratory method on Academic performance of students taught Biology concepts using laboratory method and those taught using conventional method in senior secondary schools of Katsina State. Determine the impact of laboratory method on Academic performance between male and female senior secondary school's Biology students in Katsina State. The research design of the study adopted was quasi-experimental pre-test – post-test design. The study, had two groups; experimental group was taught biology concept using laboratory method and the control group was taught the same biology concept using conventional method. The population of the study was made up of twelve thousand, six hundred and twenty-four (12,624) students composing, five thousand nine hundred and sixty-five (5,965) male students and six thousand six hundred and fifty-nine (6,659) female students. The sample size for the study consists of one hundred and fifty-eight (158) students purposively drawn from two (2) schools in Katsina State, Nigeria using an intact class. Biology Performance Test (BPT) with reliability coefficient of 0.887 was used for data collection. Mean and standard deviation was used to answer the research questions. All the hypotheses were tested using independent sample t test at an alpha level of 0.05. The findings of the study showed that students from experimental group performed better than control group; there is no significant difference in the mean academic performance scores of male and female students taught biology using laboratory method. The study concluded that the use of laboratory method improved performance of Biology students better than conventional method and was found gender friendly. Based on the findings of the study, the researcher recommends that there is need for Katsina state government to expose biology teachers to workshops on effective use of laboratory method in teaching to improve academic performance of students.

Keywords: Laboratory method, Academic performance, Retention

Introduction

The future progress and development of Nigeria lies in the quality of education given to its citizens. For Nigeria to attain and sustain national development, a well-planned and implemented Biology education remains the essential tool for her national development. This was because individuals who acquire Biology education

literally think innovatively and rationally. This will enable the students to conduct themselves within the global acceptable standard. Biology is therefore, an integral part of every educational endeavor. This was the main reason why the Federal Republic of Nigeria in its national policy on education (FRN, 2014) emphasized the teaching and learning of Biology at all levels of educational system (Garba, 2021).

Justiny (2016) stated that, Biology is an integral part of human development that focuses on living things (Plants and Animals). Biology is a branch of science and prerequisite subject for many fields of learning. It contributes immensely to the technological growth of Nigeria as country. This includes Medicine, Agriculture, Forestry, Nursing and Biotechnology. The study of Biology in Senior Secondary Schools will equip the students with useful concepts, principles and theories that will enable them to face challenges before and after graduation. A place where laboratory activities are taking place is known as laboratory. Teaching and learning in the laboratory does not only mean practical activities taken place in the laboratory, but in addition to a conducive atmosphere of learning that will give way to achieve an effective and satisfactory of such laboratory practical activities in secondary schools. Laboratory method of teaching according to Chibabi, Umoru, Onah and Itodo (2018) is a process where the students are in direct contact with the concept or processes they are learning. This includes; any activity involving students in real situations using genuine materials and properly working equipment. The authors added that the use of laboratory method of teaching aids the development of visual, perceptual and manipulative skills. It also makes learning permanent (retention) among students.

Laboratory method in Biology provides opportunities for students to learn the actual Biology skills and ideas through participating in the laboratory experiment (Justiny, 2016). Blosser (2020) maintained that, laboratory method of teaching is a hands-on, inquiry-based approach that allows students to explore concepts and processes through direct experimentation and observation. The use of laboratory method in teaching Biology concepts was inevitable rather than option to biology teachers, as we hope to produce students with necessary knowledge, skills and competence needed to meet the scientific and technological demands of the country (Goji, 2018).

Studies in Biology, such as Brewer and Smith (2020) has revealed that, students learn lesson more from practical aspect in the laboratory, when they were given an opportunity to learn by doing rather than being passive. Students enjoy measuring and classifying data, observing specimens, manipulating apparatus, designing experiments, interpreting data, testing of hypothesis and making inferences. These mental processes can only be developed and acquired when students were allowed to participate in practical activities (Garba, 2020). The laboratory method is usually less formal than conventional classroom teaching. Biology practical class provide students with hands-on experience, allowing them to develop problem-solving skills, critical thinking and creativity promoting learning which can determine the academic success in the subject (Kuhn, 2020).

According to Abaidoo (2018), students' academic performance is a key feature in education. It is considered to be the centre around which the whole education system revolves. Narad and Abdullah (2016) opined that, the academic performance of students determines the success or failure of any academic institution. Goji (2018), attributed the source of students' poor performance in practical biology to the

following: "The high conceptual nature of biology practical which make it difficult to understand, lack of interest in the subject on the part of the students and inadequate laboratory work, shortage of qualified and pedagogical trained teachers". The neglect of the laboratory aspect of biology in secondary schools has been blamed on such factors as inability of the school authority to provide materials and equipment for laboratory work and teacher's failure to recognize the importance of laboratory functions in their school. Lamas (2015) revealed that; unsatisfactory academic performance is the one that is below the expected performance. Sometimes it can be related to teaching methods which affects the level of the students' retention ability of the new concepts learned.

Retention on the other hand, refers to the ability of the learners to recall information, ideas or learning activities at a later time which he/she may be ask to mention, write or remember after some times. In the context of Biology education, retention is critical as it enables students to build upon previously learned concepts and develop a deeper understanding of complex biological processes (Brewer & Smith, 2020). Ebeling (2020), defined retention as the ability to maintain and later recall information or knowledge gained after learning. Alake (2015) sees retention as the ability to store information which can be easily recalled from the short term memory and long term memory. Therefore, retention is a very important aspect of students learning or rather an aspect of measuring the cognitive ability of learners. Additionally, research has shown that students who are motivated and engaged in the learning process tends to retain more information over time (Kuh et al., 2020). A retention test occurs after learning has taken place, usually the subject is brought back at varying time periods usually days, or weeks after the learning the task to determine how much the students has retained. Therefore, level of concept retention determines the level of students' performance (Cepeda et al., 2020).

Academic performance refers to the extent to which a student achieves their academic goals, typically measured by their grades, test scores and other academic achievements (Kuh et al., 2020). Poor performance of students in Biology examinations and aptitude tests (WAEC 2018) and the importunity of students who are admitted to pursue degree and diploma in life science disciplines in Nigeria tertiary institutions is on the high side (Researchwap, 2022). Goji (2018) declared the major objective of teaching biology in schools is to ensure that students acquire skills of Biological science that will help them attain to any level of education in natural Science.

Lawal (2024) posited that, students' abysmal performance in Biology examination among senior secondary schools in Katsina State has been linked to so many factors like the non-availability of the needed laboratory teaching and learning equipment and facilities. This performance can also be linked to the method of teaching. According to Habu (2015), teaching method is a mode of organization of the instructional content, materials, the manner of presentation to the learner and the activities that learners and teachers carryout. There are a number of methods of teaching which are available for the teacher's use in teaching Biology. These methods are classified under two major groups; traditional and contemporary methods. The traditional method popularly called teacher-centered is where the teacher dominates in teaching and learning process. Examples are Lecture method, demonstration method, and descriptive method among others. Contemporary teaching method is also referred to as students-centered teaching approach. Here students are actively

involved in knowledge generation. Examples are Laboratory method, computer based approach, concept mapping, and cooperative learning among others.

Statement of the Problem

The dwindling students' performance in science especially Biology has been a source of concern to all stakeholders in education. Many scholars have tried to find out various reasons for the poor performance in Biology among students in senior secondary schools. Despite the efforts by science educators, the performance of many students in science is still at abysmal level. This situation is easily attributed to factors such as teachers" teaching method, inadequate qualified biology teachers, lack of instructional materials and non-availability of laboratory facilities. Other factors such as wrong spelling of technical terms, wrong representation of view, poor drawing, inability to identify some illustrated organisms, inability to write brief and precise answers and poor grasp of the subject matter lead to failure of students in practical biology (Goji, 2018). Majority of secondary schools in Katsina State have laboratories, but most of them are poorly equipped. The learners, therefore, have to memorize laboratory work theoretically in order to pass the examination when they are writing practical biology papers. Most of the learners sit for examinations without being exposed to practical work

Objectives of the Study

The research study investigated on influence of laboratory method on student's academic performance and retention in Biology among senior secondary schools in Katsina State, Nigeria. Specifically, the objectives of the study are to:

1. Examine the impact of laboratory method on Academic performance of students taught Biology concepts using laboratory method and those taught using conventional method in senior secondary schools of Katsina State.
2. Determine the impact of laboratory method on Academic performance between male and female senior secondary school's Biology students in Katsina State.

Research Questions

The research raised and provided answers to the following questions:

1. What is the impact of laboratory method on Academic performance of students taught Biology concept using laboratory method and those taught using conventional method in senior secondary schools in Katsina State?
2. What is the impact of laboratory method on performance between male and female senior secondary school's Biology students in Katsina State?

Hypotheses

The following null hypotheses were formulated to guide the researcher in achieving the above stated objectives;

Ho_1: There is no significant difference in the performance of students taught Biology concepts using laboratory method and that of those taught using conventional method in senior secondary schools of Katsina State.

Ho_2: There is no significant difference between the mean academic performance scores of male and female students taught Biology using laboratory method.

Methodology

The research design of the study adopted was quasi-experimental- pre-test – post-test design. The study, had two groups; experimental group was taught biology concept using laboratory method and the control group was taught the same biology

concept using conventional method. The population of this study consisted of all public senior secondary school (SS2) students in Katsina state Nigeria. The Katsina State has twelve (12) senior secondary schools for male and female under ministry of education. The total population is made up of twelve thousand, six hundred and twenty-four (12,624) SS2 students composing, five thousand nine hundred and sixty-five (5,965) male students and six thousand six hundred and fifty-nine (6,659) female students. Purposive sampling technique was used to select two schools out of the entire twelve secondary schools, it was also used to sample out eighty-two (82) and seventy-six (76) SS2 students from the two sample schools; bringing the sample size to a total number of one hundred fifty-eight (158) students. Biology performance test (BPT) with reliability coefficient of 0.887 was used as instrument for data collection, the items for the BPT were adapted from (Goji, 2018) which were extracted from the past West African Examination Council (WAEC) questions for promotion examination from 2014, 2015, 2016 and 2017. The instrument BPT, is made up of two sections (A and B). The items on the test were all essay practical question. Section „A" constitutes students' personal information while section "B" Question1 constitutes; the classification of living things; Section „B" Question 2: classification of fruits and reproduction in flowering plants, and Section „B" Question3- nutrition in animal and digestion in bird. The students were required to demonstrate behaviours such as making careful and accurate measurements, observations, experiments, classifications and communication.

The experimental and control groups were pre-tested by administering Biology performance test before treatment. The treatment, was teaching using laboratory method for experimental group and lecture method for control group for a period of six weeks. This was followed by post-test to determine the influence of Laboratory treatments on students' academic performance in the content taught at the end of the six weeks' period. Mean and standard deviation was used to answer the research questions. All hypotheses were tested using independent sample t-test at an alpha level of 0.05.

Table 1: Sample of the Study

School	Group	Male Students	Female Students	Total
GDSS K/Yandaka	Experimental Group	43	39	82
GSSS D/Safe	Control Group	36	40	76
Total		78	79	158

Results

Answering Research Questions

Research Question One: What is the impact of laboratory method on Academic performance of students taught Biology concept using laboratory method and those taught using conventional method in senior secondary schools in Katsina State?

Table 2: Mean and Standard Deviation of Academic Performance Scores of Experimental and Control Groups

Group	N	Mean	Std. Deviation	Mean Difference
Experimental	82	52.33	8.600	4.948
Control	76	47.38	8.312	

Table 2 presented the mean and standard deviation of Academic performance of experimental and control groups. From the result, experimental group recorded a mean of 52.33 with standard deviation of 8.600, while control group recorded a mean of 47.38 and standard deviation of 8.312. The mean difference is 4.948. This implies that students from experimental group have higher mean score than control group.

Research Question Two: What is the influence impactof laboratory method on performance of male and female in senior secondary school's Biology students in Katsina State?

Table 3: Mean and Standard Deviation of Academic Performance Scores of Male and Female Students in Experimental Group

Gender	N	Mean	Std. Deviation	Mean Difference
Male	43	53.05	9.092	1.508
Female	39	51.54	8.065	

Table 3 presented the mean and standard deviation of level of retention of male and female students in experimental group. From the result male students recorded a mean of 53.05 with standard deviation of 9.092 while female students recorded a mean of 51.54 and standard deviation of 8.65. The mean difference of 1.508 was recorded, in favour of male students.

Hypotheses testing

Ho_1: There is no significant difference in the performance of students taught Biology concepts using laboratory method and that of those taught using conventional method in senior secondary schools of Katsina State.

Table 4: t-test Analysis of Academic Performance of Experimental and Control Groups

Group	N	df	Mean	t	p	Remarks
Experimental	82	156	52.33	3.672	0.0001	Significant
Control	76		47.38			

Sig at $p<0.05$ level

From the result, t-value recorded is 3.672 and p-value observed at degree of freedom of 156 is 0.0001. p-value observed is less than alpha (0.05), therefore the hypothesis which states that there is no significant difference in the performance of students

is taught biology concepts using laboratory method and that of those taught using conventional method in senior secondary schools of Katsina State was rejected in favour of the alternate hypothesis. This means the two means are significantly different. Those taught using laboratory method performed better than those taught using conventional method.

Ho_2: There is no significant difference in the mean academic performance scores of male and female students taught biology using laboratory method

Table 5: t-test Analysis of Academic Performance of Male and Female Students in Experimental Group

Gender	N	df	Mean	t	p	Remarks
Male	43	80	53.05	0.791	0.431	Not Significant
Female	39		51.54			

Not Sig at p>0.05 level

From the result, t-value recorded is 0.791 and p-value observed at degree of freedom of 80 is 0.791. p-value observed is greater than alpha (0.05), therefore the hypothesis which states that there is no significant difference in the mean academic performance scores of male and female students taught biology using laboratory method was retained, against the alternate which means both the performance of male and female students are not significantly different.

Findings of the study

The first hypothesis analysis shows that experimental group recorded a mean of 52.33 while control group recorded a mean of 47.38 with p-value 0.0001. p-value observed is less than alpha 0.05 level of significant. This shows that there is significant difference in the performance of students taught biology concepts using laboratory method and that of those taught using conventional method in senior secondary schools of Katsina State

From the second hypothesis analysis male students recorded a mean of 53.05 while female students recorded a mean of 51.54 with p-value 0.791 which is greater than alpha 0.05 level of significant. This shows that there is no significant difference in the mean academic performance scores of male and female students taught biology using laboratory method.

Discussion

The finding shows that students from experimental group performed better than the control group. There is significant difference in the performance of students taught biology concepts using laboratory method and that of those taught using conventional method in senior secondary schools of Katsina State. From the result p-value was recorded 0.0001. which is less than alpha 0.05 level of significant. The null hypothesis was rejected. The finding of the study supports the study of Chibabi, Umaru, Onah, and Itodo (2018), who revealed that laboratory method enhances academic performance, knowledge and cognitive development of students when compared to lecture method.

There is no significant difference in the mean academic performance scores of male and female students taught biology using laboratory method. p-value observed was 0.791 which is greater than alpha 0.05

level of significant. The null hypothesis was accepted. This finding is in agreement with findings of Yakubu and Mohammed, (2018) who conducted a study on Effects laboratory and lecture methods on Student's Academic Performance in Mathematics in Kaduna State, Nigeria. The finding of the study revealed that there is no significant difference in Academic performance between male and female students taught using laboratory and lecture method in Mathematics.

Conclusion

This study examines the impact of laboratory method on students" Academic Performance in Biology among Senior Secondary Schools in Katsina State, Nigeria. Considering the findings of this study, it was concluded that: using laboratory method improve performance of Biology students better than conventional method, laboratory method positively affects female students' performance in the same manner as it affects male student's performance.

Recommendations

On the basis of findings, this study recommended the following:

1. There is need for Katsina state government to expose biology teachers to workshops on effective use of laboratory method in teaching to improve academic performance of students.

2. There is need for the government to properly equip secondary schools with necessary practical materials for the teaching of Biology and posting of qualified Biology teachers to secondary schools in Katsina State based on their area of specialization.

References

Akuto, G. W., Adoluju, M.O. & Odeh.R.C. (2012). General Teaching Methods and Strategies in Education.Gboko, Makurdi, Abuja; Cubanet Publishers, Nigeria Ltd.

Alake, E. (2015), Efficacy of laboratory method on students' geometry performance, retention and attitude among junior secondary schools, of Kaduna state, Nigeria.

Blosser, P. E. (2020). Laboratory experiences in science education. *Journal of Science Education*, 21(1), 23-35.

Brewer, C. A., & Smith, D. (2020). Biology laboratory methods. *Journal of Biological Education*, 54(3), 259-267.

Cepeda, N. J., Pashler H., Vul, E., Wixted, J. T., & Rohrer, D. (2020). Spacing effects in learning: A temporal rideline of optimal retention. Psychological Science, 21(11), 1095-1102.

Chibabi, A. A., Dr. Umoru, S.E., Onah, D. O., Itodo, E.E. (2018). Effect of Laboratory Method on Students' Achievement and Retention in Senior Secondary Schools Biology in Kogi East Senatorial Zone. *Journal of Research & Method in Education*(IOSR-JRME),8(6), 31-39.

Ebeling, D. (2020). Retention and transfer: An introduction. *Journal of Educational Psychology*, 112(5), 931-936.

Federal Republic of Nigeria, (2014). National policy on education. Abuja: NERDC

Garba. A, (2020). Effect of laboratory approach on students' Attitude and Achievement in physics Katsina Zonal Education Quality Assurance.

Goji, M. (2018). Effects of Biology practical activities on students' academic performance in senior secondary schools in Adamawa state, Nigeria.

Habu, R. (2015). Effect of Mode of Laboratory Work on Senior Secondary School Students' Achievement in Biology in Jalingo Local Government Area of Taraba State.

Justiny, C. R. (2016). Practical approach to effective teaching of local and majorbiotic communities (Biomes) to secondary school students, for sustainable Development. *Science Teachers' Association of Nigeria* (STAN) Biology PanelSeries 2008. 41 -55.

Kuhn, D. (2023). The skills of argumentation: A developmental perspective. Cognitive Development, 65, 1-13.

Kuh, G. D., Jankowski, N., Ikenberry, S. O., J. L., Shenoy, G.F., & Baker, G. R. (2020). Fostering student success: What works? Change: The Magazine of Higher Learning, 52(3), 30-37.

Lamas, H. (2015). School Performance. Propósitos y Representaciones, 3(1), 313-386. doi: http:// dx.doi.org/10.20511/pyr2015.v3n1.74

Lawal, S. (2024). Effect of multi-media usage on Academic performance and interest among senior secondary schools Islamic Studies students in Katsina State. Nigeria.

Narad, A., and Abdullahi, B. (2016). "Academic Performance of Senior Secondary School Students: Influence of Parental Encouragement and School Environment*", Rupkatha Journal on Interdisciplinary Studies in Humanities*, 8(2), 12-19.

Nwosu, A. A. (2014). The effect of teacher sensitization on secondary school students‟ Acquisition of science process skills". Unpublished Ph. D Dissertation, University of Nigeria Nsukka.

Ogundipe, A. F. (2013). History and philosophy of Science.Ijebu-Ode: Lucky Odeni Publication. Press.

Researchwap, S. (2020). Impact Of Biology Practical On The Effective Academic Performance Of Secondary School Students In Biology.https://researchwap.com/education/pr7BQt8vT4dIZ9

West African Examination Council (WAEC). (2018). Chief Examiner's Report. Lagos: WAEC Press Ltd

Yakubu, A., & Muhammed, A. (2020). Effects of laboratory and lecture method on student's Academic performance in Mathematics in Kaduna State, Nigeria. *Journal of Mathematics Education* 13(1), 1-12