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EFFECT OF LABORATORY STRATEGY ON ACADEMIC PERFORMANCE AND INTEREST IN ECOLOGY CONCEPT AMONG SECONDARY SCHOOL STUDENTS IN MANI ZONE, KATSINA STATE- NIGERIA

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Abstract

The study investigated the effect of laboratory strategy on academic performance and interest among secondary schools Biology Students in Mani Zonal Education Quality Assurance katsina state. Quasi-experimental research design was employed. Four objectives, four research question were formulated and four hypotheses in null form were formulated to guide the study. A population of four thousand and seven (4,007) senior secondary students (SSII) was used for the study. 72 students were randomly selected as the sample size of the study, EPT and EIQ are the instruments for data collection both instruments were pilot tested and reliability co-efficient of 0.68 and 0.86 were obtained, Two groups were used, one experimental and one control group. The experimental group was taught using laboratory strategy while the control group was taught using conventional lecture method. All the groups received treatment for a

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Ecology Concept, Labotatory Strategy, Academic Performance, Secondary School Student, Mani Zone.

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period of six (6) weeks. At the commencement and completion of the instruction a pre-test, and post-test of (EPT) were administered respectively to collect the data on students' performance and also (EIQ) were also administered to collect data of interest of the students mean and standard deviation was used to answer the research question and independent sample t-test was used to test the null hypotheses at 0.05 level of significance. The result of the pretest indicated that there is no significant difference between the performance scores of the students in the control group and the experimental group while the result of the post-test indicated that there exists a significant difference between the performance scores of students in the experimental and control group. Thus, laboratory strategy enhances students' performance and interest in ecology. The conclusion drawn from the findings of this study was that laboratory strategy is more effective which could be used in the teaching and learning of ecology and other aspects of biology in senior secondary schools. It recommended that further research should be conducted in various content areas of biology and at different levels of learning.

Introduction

Science is the foundation of all technological growth and the basis for the development of a nation. For any country, and especially a developing country like Nigeria, to attain a meaningful level of advancement in science and technology, much priority must be given to the promotion of scientific knowledge and skills. Eze (2020) viewed that in Nigerian educational system generally, science subjects are taught in different ways at primary, secondary and tertiary levels. . One of the main reasons for having science subjects at the secondary school level is to create awareness on the effect of scientific knowledge in everyday life and to promote technological and socio-economic development.

Biology is the natural science that studies life and living organisms, including their physical structure, chemical processes, molecular interactions, physiological mechanisms, development and evolution. According to the national policy on education (Federal Republic of Nigerian, 2013), learning of biology will provide the

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students with suitable laboratory and field skills in biology. Biology as a branch of life describes the characteristics and behavior of an organism; how the organism comes into existence and interaction it has with others and with the environment. The word "bio" which means 'life and "logy" which means "study". Thus biology is the study of life. Biology is the scientific study of life, encompassing organisms from the molecular level to entire ecosystems. It seeks to understand the diverse forms and functions of living organisms, as well as the underlying mechanisms that govern their behavior (Campbell, 2017). The study of life is an inherently complex endeavor, as it encompasses the examination of living organisms at various levels of organization from molecular interactions to ecosystems is biology (Smith, 2018). According to Johnson (2019), biology can be defined as the scientific study of living organisms and their interactions with the environment. To make objectives of teaching and learning of biology achievable, emphasis should be placed on field studies, guided discovery, laboratory techniques and skills (Musa, 2016). He further stated that teaching and learning of biology motivate students to develop practical techniques and process skills, acquire knowledge and develop understanding of fundamental biological principles, concepts, terms and facts to show understanding of the applications and uses of biological knowledge in daily life develop and understanding of current issues and developments in biology.

The evolution of ecological definitions has undergone a significant transformation from its roots in natural history to its current state as a rigorous scientific discipline. One of the seminal works that contributed to this evolution was Charles Darwin's "On the Origin of Species" published in 1859. In this influential book, Darwin proposed the theory of evolution and introduced the idea of natural selection as the driving force behind it (Darwin, 1859). While Darwin's focus was primarily on the evolutionary aspects of ecology, his work laid the foundation for a broader understanding of the interconnectedness of organisms and their environment. This marked a critical turning point in the development of ecological thought, shifting the discipline from a descriptive nature to a more analytical and quantitative approach.

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Ecology as defined by Odum (2017) encompasses the study of relationships and interactions between organisms and their environment. It recognizes the intricate web of interdependencies that exist within ecosystems. These interdependencies involve not only the interactions between organisms themselves but also their interactions with the physical and chemical factors of the environment. Odum, charls and Anorld (2019) defined ecology as the interconnectedness of all living organisms and their environment, underscoring the importance of understanding these relationships for the conservation and management of ecosystems.

Traditional teaching methods have long been the cornerstone of education, providing a framework for instruction that has been widely accepted throughout history. Smith (2019) delves into the definitions of various teaching methods and their implications for effective classroom practice such includes; discussion method, conventional method, project method, demonstration method and laboratory strategy.

The laboratory strategy is a widely recognized and practiced educational approach that involves engaging students in hands-on experiments and activities to enhance their understanding of scientific concepts. Laboratory method involves the utilization of raw data or material things to produce a better understanding of the subject matter or a lesson. It can also be the act of learning by doing. It involves the use of reality instead of symbols (Smith, 2019). He further stated that laboratory is traditionally known as a hands-on learning environment where students acquire practical skills and apply theoretical knowledge to real-life scenarios; this approach emphasizes practical application of theoretical knowledge, allowing students to actively participate in the learning process. A study conducted by Smith and Johnson (2014) revealed that laboratory strategy has positive effects on interest and academic performance among senior secondary school students. One commonly used laboratory strategy is the inquiry-based approach. This method encourages active participation and critical thinking by allowing students to explore concepts through hands-on experimentation and problem-solving (Schneider, 2014).

In a normal education setting, teachers are concerned about their students' grade. Most teachers hope their students will succeed. Whenever the word interest is mentioned, it signifies having attention or being committed to something (Usman, 2021). However interest is another variable to consider in this study a part from academic performance. Obodo (2014) described interest as the attraction which forces or compels a student to respond to particular stimulus. It points out the fact that, student develops interest if a particular stimulus is attractive and arousing or stimulating. According to Deci and Ryan (2014), interest can be defined as a state of cognitive and affective engagement that arises from the individual's perception of the task as enjoyable, valuable, and personally significant.

Academic performance is a crucial factor in determining an individual's success in education. Whether it is in high school or at the college level, a strong academic performance is often a prerequisite for accessing higher education opportunities and achieving future career goals. Academic performance is defined by Oludipe (2015) as the exhibition of knowledge attained. Butter (2017) found home-work to be a correlate of academic performance. The author has stated that homework bear positive relationship with learning outcomes when it is relevant to the learning objectives. Academic performance can be defined as the extent to which a student achieves desired learning outcomes in an educational setting (Damon, 2018). Lockheed (2019) indicated that lack of motivation and professional commitment produce poor attendance and lack of interest towards students which in turn affect the performance of students academically. Academic performance is not solely about receiving high grades, but also encompasses the development of critical thinking skills, the ability to solve complex problems, and the acquisition of knowledge and understanding in various subjects (Lawal, 2019 & Lakpini, 2021).

Statement of the Problem:

The negative trends in the interest and academic performance of students towards science subjects in general and Biology in particular have been the concern of science educators and all those who care about the subjects. The students' performance in senior school certificate examinations like WAEC and NECO has

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been persistently poor especially in Biology. Despite the important roles Biology play in various disciplines such as medicine, anatomy, physiology and many others, the rate of students' low interest and poor academic performance is increasing. More so, the chief examiner's reports of WAEC conducted from 2015 to 2021 were not encouraging with regard to the performance of students in Biology. The reports are summarized in the Table below.

Table 1: Students WAEC Biology Results in Nigeria (2015 - 2021).

Year	Number of Candidates in Attendance	Number of Candidates that passed	Number of Candidates that Failed	%Passed (A1-C6)	%Failed (D7-F9)
2015	1,260,000	427,644	832,356	33.94	66.06
2016	1,340,489	383,112	957,377	28.58	71.42
2017	1,300,630	645,633	654,997	49.64	50.36
2018	1,505,409	579,432	925,977	38.49	61.51
2019	1,646,225	587,044	1,059,181	35.66	64.34
2020	1,698,187	564,138	1,134,049	33.22	66.78
2021	1,692,535	529,425	1,163,110	31.28	68.72

Source: WAEC Office, Lagos (2022) in Usman, (2022).

Table 1 show that the total number of students that failed Biology over the years has relatively remained on the increase as the total number of students that sat for the examination increases. Based on the reports in the table, it indicated that 65.08% of candidates on the average could not pass Biology at Credit level to meet the minimum requirements for admission into science related courses at higher institutions. In addition the observed failure rate according to Usman (2022) is mostly attributed to improper exposure to laboratory activities, poor science background at junior secondary school and lack of problem solving ability which affects students interest towards the subject.

Based on the above issue the researcher intends to find out effect of laboratory strategy on interest and academic performance in secondary school Biology students in Mani Zonal Education Quality Assurance.

Objectives of the Study

The main objective of the study is to find out the effect of Laboratory strategy on Interest and Academic performance in ecology among Secondary school Biology Students in Mani Zonal Education Quality Assurance.

The specific objectives are to:

i. Determine the effect of laboratory strategy on academic performance in ecology among secondary school Biology students in Mani zonal Education Quality Assurance.
ii. Examine the effect of laboratory strategy on interest in ecology among secondary school Biology students in Mani Zonal Education Quality Assurance.
iii. Find out the effect of laboratory strategy on academic performance in ecology among male and female secondary school biology students in Mani zonal Education Quality Assurance.
iv. Investigate the effect of laboratory strategy on interest in ecology among male and female secondary school Biology students in Mani Zonal Education Quality Assurance.

Research Hypotheses:

Based on the research objectives raised, the following four (4) research Null Hypotheses are formulated for testing at 0.05 level of significance:

Ho1: There is no significant difference between the mean performance scores of students taught ecology with laboratory strategy and those taught using conventional method in secondary schools in Mani Zonal Education Quality assurance.

Ho2: There is no significant difference between the mean interest scores of students taught ecology with laboratory strategy and those taught using

conventional method in secondary schools in Mani Zonal Education Quality assurance.

Ho3: There is no significant difference between the mean performance scores of male and female students taught ecology with laboratory strategy in secondary schools in Mani Zonal Education Quality assurance.

Ho4: There is no significant difference between the mean interest scores of male and female students taught ecology with laboratory strategy in secondary schools in Mani Zonal Education Quality assurance.

Research Methodology

The study employed Quasi-experimental design involving pre-test and post-test. The pre-test was used to ensure that experimental and control group are not significantly different in their academic performance before the treatment. The post-test was used to measure students' performance at the end of the treatment.

Population of the Study

The population of the Study comprises of public senior secondary schools in Mani zonal education quality assurance. There are twenty two (22) public senior secondary schools in Mani zonal education quality assurance with the population of four thousand and seven (4,007) SS2 students offering Biology in the study area; two thousand two hundred and seventy nine (2,279) are male while one thousand seven hundred and twenty eight (1,728) are females. However in order to cater for the issue of gender only co-educational schools was considered in the study with the population of two thousand five hundred and seventy eight (2,578) and out of the population one thousand five hundred and twenty three (1,523) are male while one thousand and fifty five (1,055) are female.

The instruments used for this study were Ecology Performance Test (EPT) and Ecology Concept Interest Questionnaire (ECIQ). EPT was developed by the researcher based on the contents to be covered under ecology, while ECIQ was

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adapted from Mua'zu (2023) and it was been used to measure students' interest in Ecology.

The test instruments Ecology Performance Test (EPT), marking scheme and Ecology interest Questionnaire were validated by three lecturers of UMYU. One lecturer from Science and Vocational education Department, one from Biology Department and one from Psychology Department. All the validators were asked to check both face and the content validity for accuracy, clarity and level of phrasing of the test items.

The instruments were Pilot tested using 20 students from Government Senior Secondary School Bindawa (GSS Bindawa). The school is one of the Schools under population but not part of the sample schools for the study. Test-retest method was employed by administering the instrument (EPT). That is, the instrument was administered twice with an interval of two weeks between the first and the second administrations.

The reliability of Ecology Performance Test (EPT) was determined using Pearson Product-Moment Correlation (PPMC) statistic. The scores of the first test were correlated with the scores of the second test. The reliability coefficient value (r) of 0.68 was obtained. The reliability of the Ecology Interest Questionnaire (EIQ) was determined using split-half method. The test scores were splited into two equal halves, using odd and even numbers. Odd and even numbers were used to test the reliability co-efficient of the scores obtained and the (r) value obtained was 0.86 using Kronbach alpha. This shows that the test items are reliable and can be used for the study.

The study has two groups' experimental group (EG) and control group (CG). The Experimental Group (EG) was exposed to laboratory strategy, and the Control Group (CG) was exposed to conventional method. The two groups were pre-tested (O_1) to ensure group equivalence before treatment. Then the experimental group was taught using Laboratory strategy method while the control group was taught using conventional method for the period of six (6) weeks. After the treatment, post-test was administered to the two groups for answering. The researcher administer (EIQ) first after the time provided by the

instruction has elapsed, and then collect the copies of the instrument answered and kept aside. Then, the researcher administered the (EPT) and after answering the researcher also collect the copies and mark both (EIQ) and (EPT) according to the marking scheme demand. The scores or results obtained were subjected to analysis.

The data collected for this study was analyzed by using Statistical Package for Social Science (SPSS). Mean and standard deviation was used to answer research questions and independent sample test t-test was used to test the null hypotheses at 0.05 level of significance.

Result and Discussion.

Table 2: Summary of Independent Sample t-test of the Academic Performance Scores of Students in the Experimental and Control Groups.

S/N	Group	N	Mean	SD	t-value	df	p-value	Decision
1.	Experimental	21	71.24	4.94				
					4.83	58	0.001	*Significant
2.	Control	39	50.10	4.36				

***Significant at P ≤ 0.05, **SD**= Standard Deviation, **df**= Degree of Freedom

The Data in Table 2 indicated that the calculated t-value of 4.83 was obtained at the degree of freedom 58 and the p-value of 0.001 was obtained. Since the p- value of (0.001) is less than α-value of 0.05, the null hypothesis which states that there is no significant difference between the mean performance scores of students taught ecology with laboratory strategy and those taught using lecture method in secondary schools is rejected. Therefore there is a significant difference between the mean performance scores of students taught ecology with laboratory strategy and those taught using lecture method in secondary schools. The difference is in favor of experimental group. This shows that laboratory strategy has more effect on students' academic performance than lecture method.

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Table 3: Summary of Independent Sample t-test of the Interest Scores of Students in the Experimental and Control Groups.

S/N	Group	N	Mean	SD	t-value	df	p-value	Decision
1.	Experimental	21	68.24	4.94				
					4.74	58	0.011	*Significant
2.	Control	39	46.13	4.36				

***Significant at P ≤ 0.05, **SD**= Standard Deviation ,**df**= Degree of Freedom

The Table indicates that the calculated t-value of 4.74 was obtained at the degree of freedom 58 and the p-value of 0.011 is obtained. Since the p- value of 0.011 is less than α-value of 0.05. The null hypothesis which states that there is no significant difference between the mean interest scores of students taught ecology with laboratory strategy and those taught using lecture method in secondary schools is rejected. Therefore there is a significant difference between the mean interest scores of students taught ecology with laboratory strategy and those taught using lecture method in secondary schools. The difference is in the favor of experimental group. This shows that laboratory strategy method has more effect on students' interest than lecture method.

Table 4: Summary of Independent Sample t-test of the Academic Performance Scores of Male and Female Students in the Experimental Group.

S/N	Group	N	Mean	SD	t-value	df	p-value	Decision
1.	Male	14	67.14	6.21				
					0.87	19	0.39	*Not Significant
2.	Female	07	72.85	6.49				

***Significant at P ≤ 0.05, **SD**= Standard Deviation, **df**= Degree of Freedom

The Table indicated that the calculated t-value of 0.87 was obtained at the degree of freedom 19 and the p-value of 0.39. Since the p-value of 0.39 is greater than the α-value of 0.05, the null hypothesis which states that there is no significant difference between the mean performance scores of male and

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female students taught ecology with laboratory strategy in secondary schools is retained. Therefore there is no significant difference between the mean performance scores of male and female students taught ecology with laboratory strategy in secondary schools.

Table 5: Summary of Independent sample t-test of the Interest Scores of Male and Female Students in the Experimental Group.

S/N	Group	N	Mean	SD	t-value	df	p-value	Decision
1.	Male	14	54.14	4.86				
					4.81	19	0.000	* Significant
2.	Female	07	66.55	4.53				

*Significant at P ≤ 0.05 **SD**= Standard Deviation, **df**= Degree of Freedom

The Table indicated that the calculated t-value of 5 is obtained at the degree of freedom 19 and the p-value of 0.001 obtained. Since the P- value 0.001 is less than α-value of 0.05, the null hypothesis which states that there is no significant difference between the mean interest scores of male and female students taught ecology with laboratory strategy in secondary schools is rejected. Therefore there is a significant difference between the mean interest scores of male and female students taught ecology with laboratory strategy in secondary schools in Mani Zonal Education Quality assurance. The difference is in favor of Female students. This shows that female student has more interest in ecology than male student.

Discussion of Result

The result of the study shows that the use of laboratory strategy of instruction has a significant effect on secondary school biology academic performance and interest.

The results shown in Table 2 were presented to test the null hypothesis one. The results from the Table revealed that there is significance difference between the mean performance scores of students in the experimental and

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control groups, and the difference is in favor of the experimental group. This means that students perform better when taught with laboratory strategy. The findings of this study is in line with the findings of Ogbeba and Adagba (2013) whose results indicated that students taught using the laboratory strategy achieved a significantly better than those taught using conventional and discussion methods. The result of this study is also in line with the findings of Omiko (2015) which revealed that the use of the laboratory strategy of instruction helped chemistry students to develop scientific skills for practical's and problem solving more than the conventional lecture method. However the findings of this study is contrary to the finding of Norman and Iqbal (2020) who carried out a study on the effect of using Biology laboratory in teaching on students' performance in senior secondary two (SSII) school Biology in Pakistan. Their findings revealed that the use of laboratory teaching method in teaching some biological concepts reduces the performance in Biology.

Table 3 Shows that there is a significant difference between the mean interest scores of students taught ecology with laboratory strategy and those taught using lecture method in secondary schools in Mani Zonal Education Quality assurance. The difference is in the favor of experimental group. This is in line with the study conducted by Onwukwe (2021) who carried out a research to determine the effect of resource material type on students' interest and achievement in basic science and the findings of the study revealed that students exposed to resource materials developed more interest in basic science than those without resource materials. This result is also in line with the findings of Aksoy and Olgaz (2020) who found out that laboratory teaching method increases students' interest. The findings of this result agrees with that of Nadji (2024) who revealed that student centered approach such as the use of laboratory method of instruction enhances the students interest in chemistry. However, this finding is contrary to the finding of Katcha, and Wushishi (2015) who carried out a study on the Effect of laboratory equipment on secondary school students' performance and interest to biology learning in federal capital territory, Abuja, Nigeria. Their findings indicated that laboratory

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equipment has no significant effect on the interest of biology students exposed to adequately equipped laboratory and those exposed to inadequately equipped laboratory.

Table 4 Shows that there is no significant difference between the mean performance scores of male and female students taught ecology with laboratory strategy in secondary schools in Mani Zonal Education Quality assurance. This implies that using laboratory strategy in teaching ecology is gender friendly. This finding is in line with Jimoh (2017) whose finding showed that gender difference had no influence on student's performance in cell and genetics. However, the study is contrary to the study of Ofoegbu (2015) who investigated the effect of students' involvement in the laboratory method of instruction, on their academic performance in biology. His findings showed that the male students performed significantly better than female students.

Table 5 Shows that there is a significant difference between the mean interest scores of male and female students taught ecology with laboratory strategy in secondary schools in Mani Zonal Education Quality assurance. The difference is in favor of Female students. This is in line with study conducted by Muoneme (2022) whose result showed that that there is significant difference between the interest of male and female students. The females showed more interest than their male counterparts. It is also in line with study of Danjuma (2017) whose result of the study revealed that differences exist between the interest shown by male and female students when they are exposed to laboratory strategy in favor of the female students. However, this is contrary to the finding of Sajjad et al. (2013) who investigated the impact of peer group using laboratory and demonstration method on academic performance and interest in Chemistry among Secondary School in Peshawar of Pakistan. The result showed that gender difference has no effect on students' interest in using laboratory method in teaching chemistry.

Conclusions

The following conclusions were made based on the findings of this study:

1. Laboratory strategy has positive effect on Biology students' academic performance in Ecology. Therefore, academic performance can be enhanced significantly by using Laboratory strategy.
2. Meaningful learning can be promoted using Laboratory strategy which will promotes students, interest ability of learnt concept in Ecology. Therefore, it can be concluded that by using Laboratory strategy develop interest of students in Ecology.
3. Laboratory strategy is gender-friendly as is very effective in enhancing academic performance and interest ability among both male and female Biology students.

Recommendations

Based on the findings of this study the following recommendations have been proffered for effective laboratory strategy on secondary school students' performance and interest in Biology.

i. Teachers should be using laboratory strategy in teaching biological concepts since the findings indicated that laboratory strategy enhances the academic performance of students in ecology concept.
ii. The teachers should always apply an innovative method/strategy of instruction like the use of laboratory strategy. This will help the teacher to carry everybody along in the class during lesson delivery and this will lead to better understanding and actualizing of the objective of the lesson.
iii. Workshop and seminars should be organized by relevant professional bodies for teachers on the use of laboratory strategy in teaching science concept. This will help the teachers to acquaint themselves with the necessary skills needed for proper and effective science teaching.
iv. Government should provide well equipped biology laboratories in all the secondary schools since using of laboratory strategy is found to have the potential of enhancing students' academic performance and interest in ecology concept.

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