Impact of Discovery Method on Academic Achievement of Ecology Concept among some Selected Polytechnic Students in Kaduna State

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Abstract: Education is the process of interaction that taught people how to adapt to and control their circumstances as necessary. More so, it is a process of developing of individuals. There is rate of failure in ecology in our polytechnics and this may be connected with some biology lecturers in tertiary institutions were taught ecology using lecture method which led to poor academic performance of the students especially in Ecology. This study was attempted to find out the effect of discovery method on Biology students' academic achievement in Ecology concept in Nuhu Bamalli Polytechnic and Federal Polytechnic Kaduna, Kaduna state-Nigeria. The study used a quasi-experimental research design and comprised of 226 students from the Nuhu Bamalli Polytechnic and Federal Polytechnic Kaduna. Entirely whole classes of 141 females and 85 males were purposeful sampled. To direct the investigation, two research questions and two hypotheses were developed. Two instruments were duly validated. The Ecology Achievement Test (EAT) and Ecology Interest Questionnaire (EIQ), and test-retest results showed that the reliability coefficients for the two instruments were 0.81 and 0.71, respectively. To answer the study questions, mean and standard deviation were employed, and Z-test was used to test the hypotheses at a 0.05 level of significance. According to the findings, those who taught ecology concept using discovery method have high mean academic achievement scores than those students who are taught ecology concept using the traditional method. Similarly, the findings showed female students have high academic scores than male students. The study concluded that the use of discovery method in teaching Ecology concepts improves students' academic achievements, as indicated there is significant difference in the academic achievements between experimental group and control group in favour of the experimental group. The study contributed in establishing that discovery method improves students' academic achievement in Ecology with the mean achievement score higher than the mean academic achievement score of the control group. The study recommended that Biology teachers should use discovery method of approach while teaching ecology so as to improve students' interest during the teaching and learning procedure.

Keywords: Academic achievement, Discovery, Ecology-concept, Ecology Achievement Test.

INTRODUCTION

Education is a basic need or right of every individual to acquire right from born to death and an essential aspect of any country in order to have prosperity, peace, as well as stability (Mohammed, 2019). Education can be seen of as the full process of interaction that teaches people how to adapt to and control their circumstances as necessary. More so, it is process of developing the cognitive, emotive, and psychomotor capacities of individuals as well as organizations to provide them with the information and abilities necessary (Jumare, 2016). Access to education lead growth and development. Edet and Beyin (2018) stated that currently, the concentration of education in polytechnic schools in Nigeria is mostly on raising young graduates with technical skills in order to prepare them for occupation or self-reliance as well as independent. The Federal Polytechnic Acts (Federal Republic of Nigeria, 2015) state that the Polytechnic system was appeared with a target of 70% science and technology education to guide students for new technological ideas-the Federal Polytechnic Acts. Okoro (2013), view science as special disciplines of core subjects like biology, chemistry, physics, and mathematics. Biology

is interrelation between an organism and their immediate environment. According to Obeka (2010), State ecology is process or way organism move on both terrestrial and aquatic environment. The causes of poor performance can be as a result of incapability and used of outdated instructional methodologies in teaching and learning process (Ali *et al.*, 2014).The findings of this study would be significance in teaching and learning ecology since the general belief is that, the use of appropriate teaching methods contributes to poor academic performance of students in Biology. If discovery teaching methods are identified and implemented by Biology or science teachers, students' academic performance will be improved.

METHODS

Research Design

The designed for this study was quasi experimental including pretest, posttest. Two schools were used (Nuhu Bamalli Polytechnic as experimental group and Kaduna Polytechnic as control group). The students in both experiment and control group were pretest to determine the student's academic equivalency. The experimental group received treatment using discovery method and control group received no treatment by used of lecture method. Post test was administered using ecology Achievement test. Below is a diagram that shows the design:



Figure 1: The design of the research illustration
Where:
EG= Experimental Group
CG= Control Group
O_1= Pretest administration for both the two groups
O_2= Posttest administration for both the two groups
X_1 = Treatment (Treatment teaching with only Discovery Method)
X_0 = Teaching with only Lecture Method

The study sample size

As stated earlier, Students from two Polytechnics in Kaduna State, Nigeria, made up the population. In accordance with official statistics gathered in January 2022 from the institution's examination offices, consisted of 226 students between the two polytechnics, including both males and females. Table 1. The population distribution of HND Biology students by institutions shows the distribution of students from the two polytechnics based on the official data collected in January 2023 from the institution's examination offices.

Sample Size

The sample size was made up of two institutions: School A, which had 95 students, was assigned as the experimental group; 35 of them were male students, and 60 were female students; School B, which had 131 students, was assigned as the control group; 50 of them were male students, and 81 were female students. A total of 226 participants (226) were used for the study. Eighty-five (85) of them are males, and one hundred forty-one (141) are Females. Because the HND NBTE curriculum covered the topic of ecology, and because HND II students already had some background knowledge in ecology from their ND the researcher decided on using them to conduct the study.

Table 1: Population Distribution of HND Biology

S/N	Name of School	Status	Total
1.	Nuhu Bamalli polytechnic	(HND I)	95
		(HND II)	52
2.	Kaduna Polytechnic,	(HNDI)	131
		(HNDII)	117
	Total		**395**

Source: Examination Offices (NBPZ and KADPOLY (2022)

Table 2: Study Sample Population.

S/N	Name of school	Gender M	F	Total
1	Nuhu Bamalli polytechnic	35	60	95
2	Kaduna Polytechnic	50	81	131
Total		**85**	**141**	**226**

Source: Examination offices (NBPZ and KADPOLY 2023)

Technique for Sampling

Purposive sampling was employed in the study to choose two institutions, the experimental and control groups were assigned at random. Consequently, experimental group consisted of HND Biology students from Nuhu Bamalli Polytechnic Zaria, and the control group consisted of Kaduna Polytechnic HND Biology students.

Data Collection Instruments

Ecology Achievement Test (EAT) and Ecology Interest Questionnaire (EIQ) were used as instruments for data collection. The Ecology Achievement Test (EAT) questionswase developed after the learning taking place via discovery, the questions were in line with NBTE curriculum. The achievement test contains 30 items objectives questions with four (4) options lettered A-D. One mark was assigned for each question from which the students were provided with a response. Following a two-week Ecology Achievement Test (EAT) administration, the test was redistributed to assess students' retention skills. The Ecology Interest Questionnaire (EIQ) was modified from Ahmad (2012), which was also used to measure students' interest in ecology, and a marking scheme for the Ecology Achievement Test (EAT) was designed to aid in obtaining the test. The EIQ includes a 5-point Likert scale with the following options: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (A), and Strongly Disagree (SD). The items received respective scores of 5,4,3,2, and 1.

Model of discovery method used in this study was adapted from Mahmud (2016) comprised of five phases as illustrated in Figure 2.

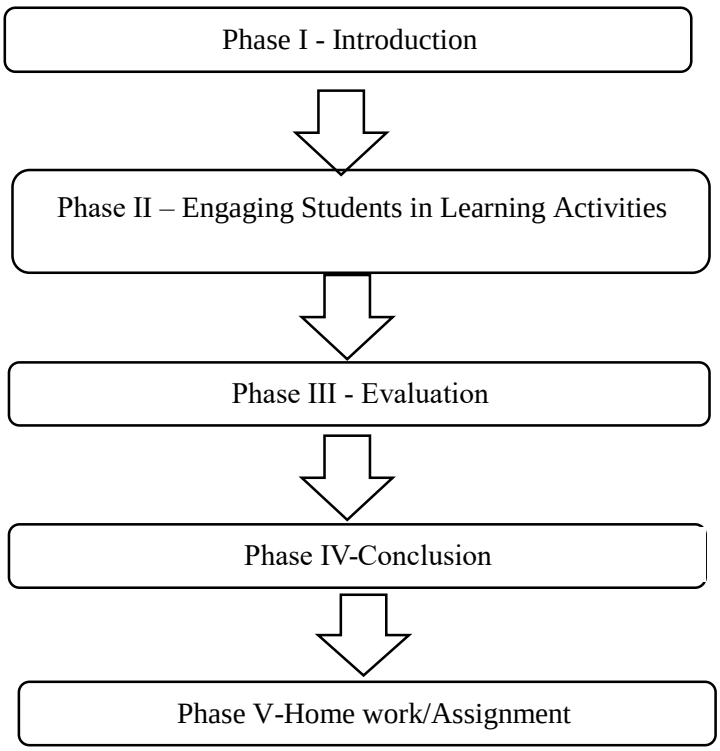

Figure 2: Phase Model of Discovery Teaching Method/Strategy Adapted from Mahmud (2016).

RESULTS

To determine whether the pre-test scores were comparable or not, the two groups' pre-test scores were compared using a descriptive statistic in the form of mean and standard deviation, and the results are shown in Table 1.3

Table 3: Analysis of Pretest Mean and Standard deviation scores of Experimental and Control groups before the treatment

Group	N	Mean ($\bar{x}$)	S.D	MD	Std. Error Mean
Control	131	11.10	2.66	0.41	.23
Experimental	95	10.69	2.01		.21

Table 3 displays the pre-test mean achievement scores for the experimental and control groups prior to treatment to assess the homogeneity of the two groups. Given that the experimental group's mean and standard deviation are 10.69 and 2.01 and the control group's mean and standard deviation are 11.10 and 2.66, respectively, with a mean difference of 0.41, it can be concluded that the two groups were comparable as well as suitable for the experiment.

Answers to Research Question and Hypotheses

Research Question One: What is the difference in the mean academic achievement scores of polytechnic students taught Ecology concept using discovery method and those taught same concept using Conventional method?

The descriptive statistics in form of mean and standard deviation was used to answer research question one and it is presented in Table 4.

Table 4: Mean achievement scores of Polytechnic students taught Ecology concept using discovery method and those taught same concept using conventional method of teaching.

Group	N	Mean ($\bar{x}$)	S.D	M.D	Std Error Mean
Control	131	17.05	2.71	6.36	.23
Experimental	95	23.41	2.38		.24

The average achievement score for students taught using the traditional way of instruction is 17.05, with a standard deviation of 2.71, whereas the average achievement score for students exposed to the discovery approach is 23.41, with a standard deviation of 2.38. The average difference between the two groups is 6.36, which amply demonstrates that students who were taught ecology using the Discovery technique had higher mean achievement scores than students who were taught the subject using the conventional technique.

Null Hypothesis One: There is no significant difference in the mean academic achievement scores of HND students Taught ecology concept using discovery method and those taught the same concept using Conventional method.

To test HO_1, Post test scores of the experimental and control groups were subjected to t-test. Summary of the analysis is shown in Table 5.

Table 5: Z-test for posttest achievement scores of HND students taught Ecology concepts using discovery method and those taught using conventional method of teaching

Group	N	Mean (X)	S D	D F	Z Value.	p-Value	Decision
Control	131	17.05	2.71	116	3.472	0.001	Rejected
Experimental	95	23.41	2.38				

The independent sample z-test analyses for post-test mean achievement scores of controls and experimental groups, the observed p-value is 0.001 which is less than 0.05 with df = 114, therefore the null hypothesis is hereby rejected because the observed p-value is less than the significant level p-value (0.05). Hence, there is significant difference between the mean achievement scores of secondary school Biology students taught using discovery method and those taught using conventional method of teaching, in favour of experimental group (z-cal = 3.472, df = 116, P=0.001<0.05).

Research Question Two: What is the difference in the mean academic achievement scores of male and female polytechnic students taught ecology using discovery method?

The descriptive statistics in form of mean and standard deviation was used to answer question one and it is presented in Table 1.6

Table 6: Mean achievement scores of Male and Female Polytechnic students taught Ecology concept using discovery method.

Group	N	Mean ($\bar{x}$)	S.D	M.D	Std Error of the Mean
Male	35	20.77	3.58	2.95	0.61
Female	60	23.72	1.68		0.22

Male students' mean achievement scores at the post-test stage were 20.77, while female students' mean scores were 23.72, with a standard deviation of 1.68. These mean achievement scores were compared between the two groups of students. Female students are in the lead by a mean difference of 2.95 between the two categories.

Null Hypothesis Two: There is no significant difference in the mean academic achievement scores of Male and Female HND students taught ecology using discovery method.

To test HO_2, Post test scores of the male and female groups were subjected to t-test. Summary of the analysis is shown in Table 7.

Table 7: Summary of Analysis

Gender	N	Mean(X)	SD	DF	Z-Value	p-Value	Decision
Male	35	20.77	3.58	63	1.627	0.109	Retained
Female	60	23.72	1.68				

The independent sample z-test analysis of posttest means achievement of male and female biology students in experimental group, the observed p-value is 0.109 with df = 63 and significant p-value is 0.05. But the observed p-value (0.109) is greater than the level of significant p-value (0.05). The null hypothesis is therefore accepted, because the observed p-value is greater than the significant level, therefore there is no significant gender difference in mean achievement scores of the secondary school biology students when taught Ecology using discovery method of teaching (z-cal.=1.627, df = 63, p=0.109>0.05).

FINDINGS

The following are the study's main findings as determined by the findings of the analysis.

i. Students in polytechnics have a wide range in their mean academic achievement scores. In contrast to those who were taught in the normal manner, the experimental group (those who were taught utilizing the discovery technique) received the identical ecological concept instruction. Female students at the polytechnic who were taught ecology via the discovery approach had significantly higher mean academic success scores than male students.
ii. Female polytechnic students perform better than their male counterparts in terms of mean academic achievement scores when ecology was taught using the discovery approach.

DISCUSSION

The results of this study showed that polytechnic students' mean academic success scores differed significantly from one another. The experimental group (taught using the discovery method) performed better than those taught using the lecture Method in learning ecology concept. This suggests that the discovery method of teaching improves students' performance in polytechnics. The group has higher mean achievement than those taught using the conventional method corresponding to an analysis of the performance of the students taught using the discovery way of teaching. This result is consistent with Oyarole findings. However, it differs from that of Mabel, Adejoh, Iji, and Ochu (2017), though the researcher employed a discovery method. This is accurate because the experimental group was given the flexibility to interact, construct, contribute, discover, and find ways to address their own challenges in a group setting while actively engaged in learning by doing. The results also showed that there was a significant difference between the mean academic accomplishment scores of male and female polytechnic students who were taught ecology using the discovery method. The female students

had higher mean scores than their male counterparts. This result is in contrast to Abdurrahman's (2016) conclusion, which indicated that the problem-solving and discovery technique is gender-neutral because both male and female students shown comparable performance. The study's findings also showed a significant difference in favor of the experimental group (i.e., those taught using the discovery method) between polytechnic students taught Ecology concepts using the discovery method and those taught the same concepts using the conventional method. This study is consistent with those by Mabel, Adejoh, Iji, and Ochu (2017), Ayarole and Adeola (2017), and Gambari, Akawo, Eli, and Queen (2014). The study's results also showed a significant difference in favor of the experimental group (i.e., those taught using the discovery method) between polytechnic students taught Ecology concepts using the discovery method and those taught the same concepts using the conventional method.

CONCLUSION

The following conclusions were reached based on the study's findings.

Generally, it was confirmed that there was high significant difference between the mean achievement of the experimental and control groups in ecology concept. And there was also high significant difference between the mean achievement of the experimental and control groups in ecology concept. This further confirmed that the discovery teaching strategy has gained more than the traditional method of teaching. However, it was statistically, shown that discovery teaching method favoured students' experimental group in teaching ecology concept. Discovery teaching method favored the experimental groups was due to the fact that the pre-requisite steps of activities in teaching of ecology concept were followed. This has stimulated students' attention and interest, which led to good performance in ecology concept. The students on experimental group were taught with the strategy (Discovery Method) that required the used of basic science process skills i.e. observation, identification, classification and manipulation of substances in the natural surroundings. The students in this group became more active and creative since they can see and observe organism in their natural surroundings.

RECOMMENDATIONS

The following are the study's recommendations:

i. Biology teachers should use discovery method of approach while teaching ecology to encourage students' active participation during the teaching and learning procedure.
ii. Biology teachers should try as much as possible to guide their students in the interest on ecology concepts and how it influences their academic achievements.

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