

EFFECT OF ACTIVITY-BASED INSTRUCTIONAL METHOD ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN ECOLOGICAL CONCEPTS IN ASABA EDUCATION ZONE

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Abstract

The study explored the effect of activity-based instructional method (ABIM) on secondary school students' academic achievement in ecological concepts. The study is a quasi-experimental study adopting the non-randomized control group design. 82 (39 males and 43 females) senior secondary year one (SS1) students drawn from the 6922 SS1 students in the zone, using multi-stage sampling procedure, constituted the sample size. The sampled students who were in two intact classes were randomly assigned to experimental and control groups using a flip of a coin. The instrument for data collection was an Ecology Achievement Test (ECAT), adapted by the researcher, from compiled biology past questions. ECAT was validated by three experts and its reliability, which yielded 0.86 reliability coefficient, was that of internal consistency, established using Kuder-Richardson 20. Mean and standard deviation were used in answering the research questions while analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 alpha levels. The findings of the study revealed that, irrespective of gender, ABIM enhanced students' academic achievement in learning ecological concepts more than conventional lecture method. Also, there was no interaction effect of gender and teaching methods on students' academic achievement in ecology. Based on the findings, the study concluded that ABIM is a gender friendly approach that enhances students' academic achievement in ecology and recommended among others that ABIM should be adopted by biology teachers in schools to improve students' academic achievement in ecology.

Keywords: Academic Achievement, Activity-Based Instructional Method (ABIM), Ecology, Gender.

Introduction

Science is a crucial endeavour on which nations rely to make technological progress. Nwuba, et al. (2023a) defined it as the step-to-step study of nature acquired through the use of scientific method. As a field of study, Christian-Ike et al (2024) asserted that science has been recognized as a tool relevant to life and society as its applications to every sphere of life ranging from agriculture, health, bioengineering, technology, communication, and transportation has made it an indispensable tool for national development. At the secondary school level, science is broken down and taught as basic subjects such as biology, chemistry, geography, physics and agriculture.

Biology is a branch of science which studies various forms of life. Nwuba et al. (2023b) defined it as a branch of natural sciences that focuses on living organisms, their life styles and relationships with each other. As a subject, which deals on flora and fauna of the environment, its importance to man cannot be overemphasized. Obialor et al (2022) stated that the knowledge of biology is brought into play in areas of manufacturing and processing industries, biotechnology, genetics, engineering, agriculture and horticulture, environmental pollution, tourism, medicine and pharmacy. Supporting the premise,

Mbaegbu et al (2023), in their study, summarized that biology is an important and useful subject for development in a socio-political and economic sector of every country, as it is the key to technology along with other sciences.

Despite this central and important position of biology among other science related disciplines, available data from the West African Examinations Council (WAEC) Chief Examiners' Report (2017/2021) indicates that, students' achievement in biology at the senior secondary school level in Nigeria continue to dwindle. Although there was a slight increase in students' achievement in biology in 2020, there has not been a significant increase for the past five years from 2017 to 2021. Research from findings revealed that a vast number of factors are responsible for the students' poor performance in biology which include: poor teaching methods and negative attitude of teachers towards teaching, abstractness, complexity and misconception of topics, unavailability of instructional materials, poor attitude of teachers to teaching, lack of practical classes and poor students study habits (Aderogba, 2012; Etobro & Fabinu, 2017; Nwuba, 2021; Nwuba & Osuafor, 2021). In their study, Etobro and Fabinu stressed that the topics students find difficult in biology that negatively influence their motivation and achievement in the subject include nutrient cycling in nature, ecological management, conservation of natural resources, pest and diseases of crops as well as reproductive system in plants.

Ecology is an important aspect of biology. Egwu and Okigbo (2021) defined it as the scientific study of interaction among organisms and their environment. Just like biology, the importance of ecology cannot be underestimated as through the study of ecology, awareness is created for conservation of natural resources needed for nation building through avoidance of acts that degrade the environment (Jaiswal, 2018). Supporting the premise, Egwu and Okigbo (2021) noted that there are many practical applications of ecology, ranging from conservation biology, wetland management, natural resource management (agroecology, agriculture, forestry, agroforestry, and fisheries), city planning (urban ecology), community health, economics, basic and applied science, to human social interaction (human ecology), which aim at maintaining a healthier and more productive biosphere for the life of humans and other living organisms.

Ecology gives students an opportunity to understand some of the most important ecological issues affecting the environment, equipping them with the information, knowledge and skills needed for effective environmental management. McDonald et al (2016) pointed out that improving the understanding of how biodiversity affects ecological function remains the important focus for ecologists as the concept of ecology seeks to explain: life processes, interactions, and adaptation, the movement of materials and energy through living communities, the successional development of ecosystem, and the abundance and distribution of organisms and biodiversity in the context of the environment. Taking into cognizance the importance of ecology to man, it becomes of utmost importance that teachers employ approaches that can expose students to hands on minds on practical experiences of the environment during classroom instruction to help students to not just understand the concept of ecology but also apply the knowledge gained in solving environmental problems. In this light, the study advocated for the use of activity-based instructional method to ascertain its effect on students' academic achievement in ecological concepts.

Activity based instructional method (ABIM) is a method of teaching whereby students are engaged actively in class activities with the use of their hands and intellect under the guidance of the teacher

(Abudullai, 2013). It is a hands-on, minds-on activity in which a learner uses his/her hands in carrying out activities that could enhance his/her experiences (Tile, 2013). Ajayi and Ogbaba (2017) defined ABIM as any activity that allows the learner to handle or manipulate a scientific process. Hence, ABIM can simply be defined as an innovative instructional method that involves a series of hands-on minds-on activities employed by the teacher and the students to bring about efficient learning experiences.

In their study, Razia and Abdul (2019) asserted that ABIM creates an ideal situation for teaching science subjects as it: improves innovative part of experience by encouraging the acquisition of information, experience, abilities and qualities; builds students self-confidence and creates understanding through works; creates cheerful relationship and enthusiasm for them as well as; inspires the learners to apply their innovative ideas, information and minds in solving problems. Supporting the premise, Mehmood, Kanwal and Shaheen (2021) posited that the approach requires students to find opportunities for meaningful conversations and to listen, write, read, and reflect on the content, ideas, problems, and concerns of academic topics, fostering their interest and in the long run their academic achievement.

Academic achievement is the end product of any academic setting. Nwuba et al (2023b) defined it as the product of one's time, hard work and devotion after being exposed to a learning program, usually measured in grades. In every academic setting, academic achievement is considered as paramount since it informs education stakeholders the effectiveness of instruction. In this light, and for sustainable development of individuals, it becomes imperative that appropriate approaches be employed to foster meaningful learning, for improved academic achievement, irrespective of gender.

Gender is a biological characteristic assigned to males and females. Obikezie et al. (2023) defined it as a universally accepted attribute assigned to individuals based on their sexual differences. In recent times, problems concerning gender and its influence on academic achievement of students in biology have drawn a lot of attention from education stakeholders based on the number of studies done to this effect. For instance, while some researchers' (Asuzu&Okoli, 2019; Nwuba et al, 2024) in their respective studies in biology reported that females achieve higher than males, some found in favour of the males (Egwu&Okigbo, 2021; Nwuba&Osuafor, 2021) and others (Nwuba et al., 2023b; Pat-Anyaeji&Okeke, 2019) in their study, reported that no significant difference exists in the mean achievement scores of male and female students in biology. From the findings above, it can be deduced that the issue of gender difference in students' academic achievement in biology is still far from being conclusive. Hence, as a result of this inconclusiveness, this study set out to investigate the effect of activity based instructional method on secondary school students' academic achievement in ecological concepts, irrespective of gender.

To achieve the purpose of the study, the following research questions were formulated, and null hypotheses tested at 0.05 alpha level:

1. What is the difference in the mean achievement scores of secondary school students taught ecological concepts using Activity-Based Instructional Method (ABIM) and those taught using the Conventional Lecture Method (CLM)?
2. What is the difference in the mean achievement scores of male and female secondary school students when taught ecological concepts using ABIM?
3. There is no significant difference in the mean achievement scores of students taught ecological concepts using activity-based instructional method and that of those taught using the CLM.

4. There is no significant difference in the mean achievement scores of male and female secondary school students taught ecological concepts using ABIM.
5. There is no interaction effect of gender and teaching methods (ABIM and CLM) on secondary school students' academic achievement in ecology.

Methods

In this quasi-experimental study, a non-randomized control group design was employed.

Participants

6,922 senior secondary year one (SS1) students offering biology in the 64-government owned secondary schools in Asaba Education Zone, Delta State, Nigeria, made up the population of the study. The sample consists of 82 SS1 biology students (39 males and 43 females) drawn from two government co-educational secondary schools, in the zone under study, using multistage sampling procedure.

Instrument

Ecology achievement test (ECAT) was used for data collection. ECAT, is a 50-item multiple choice questions with four options A-D, adapted from Senior Secondary School Certificate (SSCE) past questions. The instruments were validated by three experts and administered to an intact class of 20 SS1 students in Agbor Education Zone of Delta State, outside the study area, for pilot testing. Using Kuder Richardson 20 (KR-20), a reliability coefficient of 0.86 was obtained showing that the instruments is highly reliable.

Experimental Procedure

The manipulation of variables started with the biology teachers from the two sampled schools, who functioned as research assistants, being briefed on three contacts before the treatment procedure. The control group teacher was given the topics with the lesson plans and then asked to teach the students as usual using the Conventional Lecture Method (CLM) developed by the researcher, while the research assistant in the experimental group was briefed on Activity Based Instructional Method (ABIM) and its implementation process. Following the briefing, the research assistants administered the ECAT as pretest to the two drawn intact classes, that were assigned into the control (17 males and 23 females) and experimental (22 males and 20 females) groups. Following the pretesting, the two groups began a four weeks treatment (teaching) activity. After the instructional session, both groups were administered a post-test, which was used to calculate the post-test scores.

Data Analyses

In analyzing the collected data, mean and standard deviation were used to answer the research questions while ANCOVA was employed at the 0.05 alpha level for testing the null hypotheses.

Results

Research Question One: What is the difference between the pretest and posttest mean achievement scores of students taught ecology using Activity Based Instructional Method (ABIM) and that of those taught using conventional Lecture Method (CLM)?

Table 1: Mean Achievement and Standard Deviation scores of students taught Ecology using ABIM and CLM

Groups	N	Pretest		Posttest		Gain in Mean
		Mean	SD	Mean	SD	
Experimental (ABIM)	42	36.17	2.40	65.38	2.19	29.21
Control (CLM)	40	32.90	2.26	33.80	2.16	0.90
Mean Difference		3.27		31.58		28.31

Table 1 shows that the experimental group taught with ABIM had the mean achievement scores of 36.17 and 65.38 in their pretest and posttest respectively while their counterparts taught with CLM had achievement mean scores of 32.90 in their pretest and 33.80 in their posttest. The mean difference of the gains in mean for ABIM and CLM, revealed that the experimental group achieved higher than the control group, with a mean difference of 28.31. The result indicates that teaching the concept of ecology using ABIM increased students' academic achievement more than CLM.

Research Question Two: What is the difference between the pretest and posttest mean achievement scores of male and female students taught ecology using Activity Based Instructional Methods (ABIM)?

Table 2: Mean Achievement and Standard Deviation Scores of Male and Female Students taught Ecology using ABIM

Gender	N	Pretest		Posttest		Gain in Mean
		Mean	SD	Mean	SD	
Male	22	34.64	3.55	62.91	3.23	28.27
Female	20	38.10	3.30	68.10	2.75	30.00
Mean Difference		3.46		5.19		1.73

Table 2 shows that for the experimental group, the male students had a mean achievement scores of 34.64 and 62.91 in their pretest and posttest respectively while their female counterparts had 38.10 in their pretest and 68.10 in their posttest. The mean difference in the gains in mean, for male and female students taught ecological concepts using ABIM, is 1.73. From the gain in means, it can be deduced that female students achieved higher than their male counterparts when both are taught ecological concepts in biology using ABIM.

Null Hypothesis One: There is no significant difference between the mean achievement scores of students taught ecology using ABIM and that of those taught with CLM.

Table 3: ANCOVA Test of Significant Difference between the Mean Achievement Scores of Students Taught Ecology Using ABIM and those Taught Using CLM.

Dependent Variable: PREECAT						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	9064.206 ^a	4	2266.051	19.409	.000	
Intercept	40.943	1	40.943	.351	.555	
POSTECAT	8327.474	1	8327.474	71.327	.000	
METHOD	3455.299	1	3455.299	29.595	.000	Sig.
GENDER	2.314	1	2.314	.020	.888	
METHOD * GENDER	21.153	1	21.153	.181	.672	Not. Sig.
Error	8989.855	77	116.751			
Total	116069.000	82				
Corrected Total	18054.061	81				

a. R Squared = .502 (Adjusted R Squared = .476)

The result of the ANCOVA test from table 3 shows that at an F-value of 29.595, the P-value is 0.00. Since the P-value is less than 0.05 level of significance at df 1 and 77, the null hypothesis is rejected. This shows that there is a significant difference between the mean achievement scores of students taught ecological concepts using ABIM (experimental group) and that of those taught using CLM (control group) in favour of those in the experimental group. This indicates that the use of ABIM in teaching ecological concepts in biology is a significant factor in academic achievement of students in the experimental group.

Null Hypothesis Two: There is no significant difference between the mean achievement scores of male and female students taught ecology using ABIM.

Table 4: ANCOVA Test of Significant Difference between the Mean Achievement Scores of Male and Female Students Taught Ecology using ABIM

Dependent Variable: PR						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	2342.098 ^a	2	1171.049	5.899	.006	
Intercept	6.154	1	6.154	.031	.861	

POSTECAT	2216.417	1	2216.417	11.164	.002	
GENDER	5.376	1	5.376	.027	.870	Not. Sig
Error	7742.474	39	198.525			
Total	65384.000	42				
Corrected Total	10084.571	41				

a. R Squared = .232 (Adjusted R Squared = .193)

ANCOVA test from table 4 shows that at an F-value of 0.027, the P-value is 0.870. Since the P-value is greater than 0.05 level of significance at df 1 and 39, the null hypothesis is not rejected. Showing that, there is no significant difference between the mean achievement scores of male and female students taught ecological concepts in biology using ABIM. This indicates that the use of ABIM in teaching students' promotes their academic achievement irrespective of gender.

Hypothesis 3: There is no interaction effect of gender and teaching methods on students' academic achievement in ecology.

The result of the ANCOVA test from table 3 shows that F-value is 0.181 and P-value is 0.672. Since the P-value is greater than 0.05 alpha levels at df 1 and 77, the null hypothesis is not rejected, revealing that there is no interaction effect of gender and methods of teaching on the academic achievement of students in ecology. This implies that the academic achievement of students in ecology in relation to the teaching methods is not influenced by students' gender.



Figure 1: Profile Plot of Interaction Effect of Gender and Teaching Methods on the Achievement of Students in Ecology

Discussion

The finding of the study revealed that students taught ecological concepts using ABIM gained in achievement more than those taught using Conventional Lecture Method (CLM). This difference in achievement was proved statistically significant by the test of null hypothesis in table 3 of the study.

This statistically significant improvement shown by the students in the experimental group could be attributed to the nature of the instructional approach (ABIM) which exposed students to concrete opportunities, encouraging them to experience things for themselves and obtain firsthand information. That is, in using ABIM, students are provided with activities that help them build their knowledge of science concepts and procedures, gives them opportunity to explore their own self, provides them with a similar set of experiences so that everyone can participate in classroom discussion despite their socio-economic status, encourages thinking by requiring understanding of the observed events rather than memorizing the correct responses, encourages questioning of the observed events and the resulting data, promotes cause and effect thinking and diminish dependence upon authority as usage of this instructional method in learning environments puts the students into the center and provides richer learning opportunities. The findings of this study lend credence to that of Halil (2018), Anwer (2019), Razia and Abdul (2019) and Oribhabor (2020), who reported in their respective studies in mathematics that ABIM improved students' academic achievement more than the conventional methods.

On the influence of gender, the findings of the study from table 2 revealed that female students taught biology using ABIM slightly achieved higher more than their male counterparts. This finding however proved statistically insignificant when hypothetically tested as seen in table 4. This statistically insignificant difference in gender maybe attributed to the nature of ABIM, which provided equal opportunities for both male and female to be actively engaged throughout the learning process boosting their confidence, self-esteem, foster their creativity, critical thinking and reducing their test anxiety. This finding supports the findings of Ajayi and Ogbeba (2017), Uzoma and Okoli (2019), Egwu and Okigbo (2021) and Nwuba and Osuafor (2021) who reported in their respective studies, on innovative approaches similar to ABIM, that gender had no statistically significant influence on academic achievement of students.

On interaction effect, the findings of the study revealed that there were no interaction effect of gender and teaching methods on students' academic achievement in ecology. This simply means that the joint influence of gender and method on students' academic achievement was consistent among the groups. The finding of the study agrees with that of Egwu and Okigbo (2021), Nwuba and Osuafor (2021), and Nwuba et al, 2024 who reported in their respective studies that gender and teaching methods had no significant influence on students' academic achievement.

Conclusion

The study investigated the effect of activity-based instructional method on students' academic achievement in ecological concepts. Based on the findings, the study concluded that ABIM, irrespective of gender, is an effective instructional approach that can be used to improve students' academic achievement in ecology and thus, could be adopted as an alternative instructional strategy. This implies that ABIM is a gender friendly approach that can be used to effectively teach the concepts of ecology.

In line with the findings, it was recommended that:

1. ABIM should be adopted by teachers in teaching ecological concepts in biology as this will help improve students' academic achievement.

2. Seminars, symposia, workshops, and conferences should be organized for biology teachers by the government, education stakeholders and professional bodies like Science Teachers' Association of Nigeria (STAN) to familiarize teachers with innovative instructional approaches such as ABIM.
3. School administrators and educational stakeholders should provide instructional facilities and materials that will help teachers adopt, and students learn using ABIM.
4. Curriculum planners and developers should redesign the biology curriculum (and make policies) to incorporate ABIM, during classroom activities, to foster the teaching and learning of biology in secondary schools.
5. Teacher training institutions should incorporate ABIM during the teaching and learning process to instill in pre-service teachers the knowledge and skills needed to effectively employ ABIM in the classroom.
6. Practical oriented textbooks should be approved for usage by curriculum planners as this will help teachers extensively plan and organize practicals that will expose students to hands-on minds-on activities that can increase their academic achievement and sustain their interest in learning ecological concepts.

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