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EFFECTS OF EXPERIENTIAL LEARNING APPROACH ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN BIOLOGY IN UDI EDUCATION ZONE OF ENUGU STATE

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Abstract

This study investigated the effects of Experiential Learning Approach (ELA) on secondary school students' academic achievement in biology in Udi Education Zone of Enugu State. The study adopted a quasi-experimental, non-equivalent pretest-posttest control group design with a 2x2 factorial structure. The population of the study comprised of 1784 (792 males and 992 females) senior secondary school two (SS2) biology students in all the government co-educational secondary schools in Udi Education Zone of Enugu State. A total of 84 (44 males and 40 females) SS2 biology students from two co-educational secondary schools were purposively selected and randomly assigned to experimental group and control group. The study was guided by two research questions and three null hypotheses, tested at a 0.05 level of significance. The instrument used for data collection was Biology Achievement Test (BAT), validated by three experts with reliability coefficients determined using Kuder-Richardson 20 (KR-20) and yielding a value of 0.82. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses. Findings revealed that students taught Biology using ELA significantly outperformed those taught using LM in their academic achievement in Biology. Gender did not significantly influence achievement in Biology and there was no significant interaction effect between teaching method and gender on achievement of students in Biology. The study concluded that ELA enhances students' achievement in biology more effectively than lecture method. Based on the findings, it was recommended that biology teachers should integrate ELA into instructional practices and those curriculum developers and education stakeholders consider ELA to improve science education outcomes.

Keywords: Achievement, Biology, Experiential Learning Approach, Gender

Introduction

Nations globally appear to prioritize the production of individuals with great workforce, those who will contribute greatly to national growth and economic development. This priority, however, is attainable through effective education and training of their citizens. Chukwunyelu & Okigbo (2025) averred that education is the process of facilitating learning, skills acquisition, values, beliefs and habits leading to individual transformation. Such training comprises a range of experiences through formal or informal learning through everyday life with the aim of shaping individuals and societies and empowering people to reach their full

potential in life as well as contribute positively to the nation. This points to the need for a solid foundation of scientific literacy for students at their secondary level of education.

Science is a systematic discipline which builds and organizes knowledge from testable explanations and predictions about the universe. Erik (2024) defined science as any system of knowledge that is concerned with the physical world and its phenomena and entails unbiased observation and systematic experimentation. Ihejiamaizu and Ochui (2016) defined science as a problem-solving systematic process to improve man's living, his natural existence and his daily activities. In general, science is the pursuit of knowledge covering general truth or the operation of fundamental laws. This is knowledge that is acquired through experimentation and systematic process of enriching humans through the revelation of the rules of how nature and the universe work spontaneously. Some of the core disciplines of science are physics, chemistry, mathematics and biology.

Biology is a branch of science that studies living organisms, encompassing their structures, functions, evolution, distributions and interactions. Susan and Edna (2024) defined biology as the study of living things and their vital process. It occupies a very unique position in the secondary education curriculum as one of the science subjects required in many science-related courses such as medicine and surgery, pharmacy, biochemistry, and nursing. Just like other science subjects, biology is activity-oriented and student-centered subject. Supporting this premise, Rum (2021) stated that learning biology allows students to gain a better understanding of their body, the purpose of each human organ and how human system functions. Fiona (2024) opined that learning biology equips students with the knowledge of ecosystems, biodiversity and the impact of human activities on the environment. Supporting this assertion, Weber (2016) added that Biology plays an important role on how humans interact with the biotic and abiotic components of their environment. It is a branch of science that studies and analyses the existing life with its surrounding.

Despite the significance of biology to everyday life, students' academic achievement has shown a consistent dwindling projector in both internal and external examinations. For instance, WAEC Chief Examiners' report shows that for a period of five years (2019-2023), students' achievement in Biology were not satisfactory in the school certificate examination. The Chief examiner's observations include students' wrong spelling of biological terms, inability to present points in a coherent order, lack of in-depth knowledge of some basic topics and poor interpretation of questions among others. Researchers such as Dike & Salisu (2024); Nwankwo, Ugwu, Ukala & Ozichi (2024) and Darmawan (2020) in their independent studies

identified teachers' ineffective teaching approaches as the major reason responsible for poor achievement of students in Biology.

Teaching methods are general techniques for organizing instructions and implementing curriculum (Abah, 2020). It is the general principle, pedagogy and management strategies used for classroom instruction. These methods and strategies are often rooted in educational theories which predict behaviours under certain pedagogical conditions. Researches over the years have shown that teachers have been depending on excessive use of words to convey ideas and facts, otherwise referred to as the conventional teaching methods. In instructional process, the conventional teaching method is the traditional teaching method which is referred to as the talk-chalk method of classroom teaching. Sinha (2025) and Zaharah & Azid (2022) asserted that it is a teaching method that is teacher-centered which promotes the supremacy of the teacher within the classroom setup. The Lecture Method (LM) of teaching is an example of conventional teaching method, in which the teacher delivers information directly to the students, often in a one-way format (Kapur, 2020). Shuaibu, Ibrahim & Ezekiel (2024) asserted that it is a teaching method that is characterized by a teacher-centered approach where information is presented verbally to students. It is therefore the opinion of the researchers to try out other innovative teaching method such as Experiential Learning Approach (ELA), to ascertain its effect on students' academic achievement in biology in Udi Education Zone in Enugu State.

The experiential learning approach is a learning approach that emphasizes hands-on experience and students' direct involvement in the learning processes. Okuakaji & Sukolatmbaya (2020) described ELA as learning by doing and reflecting. Morris (2020) added that, it includes collaborative and reflective practices that ensure learners' better understanding and skill development. ELA is an approach that involves learners' active participation in experiences that permit them to explore and reflect on their learning (Nwuba et al., 2024). According to Alkan (2016), experiential learning is a learning process that creates knowledge which enables the students to embrace their professional identities, question their actions and note the importance of their suspicions. On the other hand, Morris (2020) further emphasized that experiential learning encompasses a variety of processes that give students a hands-on, group-based and reflective learning experience which aids in their acquisition of new knowledge. Particularly, when biology is taught through experiential learning, this approach does not only aim to boost students' participation, but also motivates them to gain a deeper understanding of biology concepts, ultimately leading to improved academic achievement.

Academic achievement is the amount of academic content a student learns in a determined amount of time. Suleiman (2023), described it as the performance outcome that indicates how far a learner has progressed in specific goals of activities in any instructional setting. Similarly, Nelson & Owodunni (2024) opined that it is excellence in all academic disciplines in class as well as in extracurricular activities that is measurable by tests. This simply means achievement in school subjects could be represented by achievement scores in a test. More so, Francois & Juan (2017) asserted that academic achievement is the level of achievement in biology were higher scores indicate better understanding. In this regard, the study investigated if the use of experiential learning approach enhanced students' academic achievement in biology regardless of their gender.

Gender is referred to as the state of being male or female. Coleman, Radix & Bouman (2022) opined that gender is a socially constructed role, behaviour, expression and identity of being girls or boys. It is a cultural or social influence which varies from culture to culture. The influence of gender on academic achievement has been investigated by some researchers with widely varying conclusions. Gibney, (2016) asserted that males exhibit a higher level of retention throughout their career path and the research output of males was higher than females. Umoru (2016) in a study noted that gender was not a significant factor in students' achievement, since there is an improvement in both male and female achievement scores. However, Fatokun & Adeniji (2015) established that there was no significant difference exists between male and female students in achievement when taught in a way that favours their learning styles. This necessitated the present study which tries to attend to such a gap that has been introduced in literature. This study, therefore, determined the effect of Experiential Learning Approach (ELA) on students' academic achievement in biology, particularly in Udi Education Zone of Enugu State.

Purpose of the Study

The study determined effect of Experiential Learning Approach on Secondary School Students' Academic Achievement in Biology in Udi Education Zone of Enugu State. Specifically, this study determined:

1. Difference between the mean achievement scores of the students taught concepts in biology using Experiential Learning Approach (ELA) and that of those taught using Lecture Method (LM).
2. Difference between the mean achievement scores of male and female students taught concepts in biology using ELA.

Research Questions

The study was guided by the following research questions:

1. What is the difference in the mean achievement scores of students taught biology using Experiential Learning Approach (ELA) and that of those taught using Lecture Method (LM)?
2. What is the difference in the mean achievement scores of male and female students taught biology using Experiential Learning Approach (ELA)?

Hypotheses

The following hypotheses were stated to guide the study at 0.05 level of significance:

1. There is no significant difference in the mean achievement scores of students taught biology using Experiential Learning Approach (ELA) and that of those taught using Lecture Method (LM).
2. There is no significant difference in the mean achievement scores of male and female students taught biology using Experiential Learning Approach (ELA).
3. There is no interaction effect of gender and teaching methods on students' academic achievement in biology.

Methods

The researchers adopted pre-test-post-test non-randomized control group quasi-experimental design. Thus, intact classes were used in each school. The study was conducted in Udi Education Zone of Enugu State, Nigeria. The population consisted of 1,784 senior secondary class two (SS 2) students (792 males and 992 females) offering biology in all the public secondary schools in the Udi Educational Zone. The sample of the study consisted of 84 (44 males and 40 females) SS 2 students offering biology, selected from two out of the 49 co-educational public secondary schools in the Zone. A multistage sampling procedure was used to sample the participants namely: purposive sampling, simple random sampling and flip of coin techniques. Out of the two selected schools, one was randomly assigned to the experimental group (ELA) and the other to the control group (LM). The experimental group consists of 36 (14 boys and 22 girls) SS2 students while the control group consists of 48 (30 boys and 18 girls) SS2 students making the total sample number of students 84 as stated earlier.

Biology Achievement Test (BAT) was used for data collection. The BAT contained 50 item multiple choice objective questions with options A – D adapted from Senior Secondary School Certificate (SSCE) past questions for the years (2017 – 2024)and compiled based on the topics that were taught during the period of the research using a well-planned table of

specifications to ensure even coverage of content. Three experts validated the instruments, two from Departments of Science Education and one from Educational foundations (Measurement and Evaluation Unit), from Nnamdi Azikiwe University, Awka. The reliability of the BAT was established using Kudder-Richardson 20 Formula. The coefficient of internal consistency obtained was 0.82.

The regular biology teachers in the sampled schools were briefed on how to apply the treatment by the researcher and to serve as research assistants, the briefing lasted for one week in three contacts. Research assistants who are the regular biology teachers taught the students in each groups using researchers' developed lesson plans on ELA and LM reflecting the same learning objectives for the experimental and control groups respectively. They taught their students in each school using regular school time table, of two contacts per week. The groups were evaluated at the appropriate time with the same test instrument (BAT). The instrument was used as pretest before the commencement of the treatment to determine the students' prior knowledge and academic equivalence. After the pretest administration, the instrument was reshuffled and used as posttest to determine the effect of Experimental Learning Approach on students' achievement in those selected topics. The interval between the administration of the pre-test and post-test were 4 weeks. Students were required to answer all the questions by ticking the correct option out of the four options (A-D) provided. On the scoring of the test items BAT, a score of 2 marks was awarded for the correct answer and zero for the wrong answer making it a total of 100marks

Mean and Standard deviation were used to answer the research questions while the hypotheses were tested using Analysis of Covariance at 0.05 level of significance to addresses the imbalance of non-equivalence in groups caused by non-randomization of participants. The p-value and alpha level ($\alpha = 0.05$) were compared to determine whether to retain or reject the null hypotheses tested. When the precise probability value was less than or equal to the 0.05 level of significance, the null hypothesis was rejected; but, when the exact probability value was more than the 0.05 level of significance, the null hypothesis was not rejected.

Results

Research Question 1: What is the difference in the mean achievement scores of students taught biology using Experiential Learning Approach (ELA) and that of those taught using Lecture Method (LM)?

Table 1: Mean Achievement and Standard Deviation scores of students taught Biology using ELA and LM

		Pretest		Posttest		
Groups	N	Mean	SD	Mean	SD	Gain in Mean
Experimental (ELA)	36	23.44	1.21	89.11	1.35	65.67
Control (LM)	48	27.60	1.32	73.96	1.10	46.36
Mean Difference		4.16		15.15		19.31

Table 1 shows that the experimental group taught with ELA had the mean achievement scores of 23.44 and 89.11 in their pretest and posttest respectively while their counterparts taught with LM had achievement mean scores of 27.60 in their pretest and 73.96 in their posttest. The mean difference of the gains in mean for ELA and LM, revealed that the experimental group achieved higher than the control group, with a mean difference of 19.31. The standard deviation (SD) scores obtained in the posttest for ELA (1.35) and LM (1.10) also reveals that the achievement scores for the experimental group are more spread out from the mean, than those in the control group. The result indicates that teaching biology using ELA increased students' academic achievement more than LM.

Research Question 2: What is the difference in the mean achievement scores of male and female students taught biology using ELA?

Table 2: Mean Achievement and Standard Deviation Scores of Male and Female Students taught Biology using ELA

Groups	Gender	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gain in Mean
ELA	Male	14	21.86	1.79	87.29	2.36	65.43
	Female	22	24.45	1.61	90.27	1.62	65.82
	Mean Difference		2.59		2.98		0.39

Table 2 reveals that male students taught biology with ELA had a mean achievement scores of 21.86 and 87.29 in their pretest and posttest respectively while their female counterparts, taught with the same ELA, had a mean achievement score of 24.45 in their pretest and 90.27 in their posttest. The difference in mean gain, is 0.39. From the gain in means, it can be deduced that female students achieved slightly higher than their male counterparts, when both are taught using ELA. Also, the SD scores obtained in the posttest for the experimental groups for males (2.36) and females (1.62) reveal that the achievement scores for male students taught with ELA are more spread out from the mean, than that of the females.

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught biology using ELA and that of those taught with LM.

Analysis of hypothesis one is presented in table 3.

Table 3: ANCOVA Test of Significant Difference between the Mean Achievement Scores of Students Taught Biology Using ELA and those Taught Using LM.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	669.844[a]	4	167.461	2.421	.055	
Intercept	60.422	1	60.422	.874	.353	
Posttest_BAT	200.058	1	200.058	2.892	.093	
Method	621.325	1	621.325	8.982	.004	Sig.
Gender	67.798	1	67.798	.980	.325	
Method * Gender	.205	1	.205	.003	.957	Not. Sig.
Error	5464.478	79	69.171			
Total	62141.000	84				
Corrected Total	6134.321	83				

a. R Squared = .109 (Adjusted R Squared = .064)

The result of the ANCOVA test from table 3 shows that at an F-value of 8.982, the P-value is 0.004. Since the P-value is less than 0.05 alpha level at df1 and 79, the null hypothesis was rejected. This shows that there is a significant difference between the mean achievement scores of students taught biology using ELA (experimental group) and that of those taught using LM (control group) in favour of those in the experimental group. This indicates that the use of ELA in teaching biology is a significant factor in academic achievement of students in the experimental group.

Hypothesis 2: There is no significant difference between the mean achievement scores of male and female students taught biology using ELA.

Analysis of hypothesis two is presented in table 4.

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

Dependent Variable: Pretest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	94.988[a]	2	47.494	.900	.416	
Intercept	38.045	1	38.045	.721	.402	
Posttest	37.268	1	37.268	.706	.407	
Gender	40.424	1	40.424	.766	.388	Not. Sig.
Error	1741.901	33	52.785			
Total	21624.000	36				
Corrected Total	1836.889	35				

a. R Squared = .052 (Adjusted R Squared = -.006)

The result from the ANCOVA test in table 4 reveals that at an F-value of 0.766, the P-value is 0.388. Since the P-value is greater than 0.05 level of significance at df 1 and 33, the

null hypothesis is not rejected. Showing that, there is no significant difference between the mean achievement scores of male and female students taught biology using ELA. This indicates that the use of ELA in teaching students' biology promotes their academic achievement, irrespective of gender.

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

Analysis of hypothesis 3 is presented in table 2.

The result of the ANCOVA test from table 3 shows that at an F-value of 0.003, the P-value is 0.957. Since the P-value is greater than 0.05 alpha levels at df 1 and 79, 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 biology. This implies that academic achievement of students in biology in relation to the teaching methods employed is not influenced by their gender.

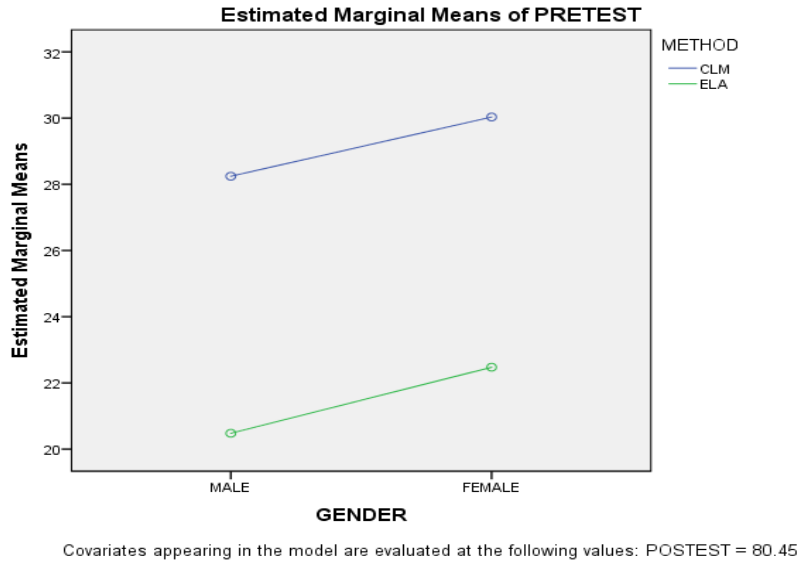

Figure 1: Profile Plot of Interaction Effect of Gender and Teaching Methods on Academic Achievement of Students in biology

Discussion

The findings of the study showed that there is a significant difference between the mean achievement scores of students taught biology using the Experiential Learning Approach (ELA) and that taught biology using the Lecture Method (LM) in favour of ELA. The students in the ELA group outperformed their counterparts in the LM group, this advantage in achievement can be ascribed to the ELA method, which promotes 'learning by doing', enabling students to engage in practical experience and insights from their activities. This approach

allowed students to encounter real situations, collaborate and apply their acquired knowledge to solve problems. The findings of this study align with those of Nwuba & Osuafor (2021) and Okukaji & Sukolatambaya (2020), who asserted that ELA is a valuable approach to enhance students' achievement in biology. And also consistent with Oladayo & Diri (2024) and Charles-Ogan & Onyeka (2023) in mathematics who reported that students taught mathematics using ELA performed better than those taught using LM.

Moreover, the finding of the study also revealed that there was no significant difference in the mean achievement scores of male and female students taught biology using ELA. Though the female students performed slightly above the male students but the difference was insignificant. In other words, both genders performed similarly when taught biology using ELA. This suggests that ELA is gender friendly. The finding is in line with that of Nwuba & Osuafor (2021), Ani *et al.* (2021) and Adeyemi & Awolere (2016) who reported that gender does not affect students' achievement when exposed to the same number of activities.In contrast, the finding of the study is inconsistent with that of Tshabala & Ncude (2016) who reported that significant difference exists in favour of the female students in their academic performance in mathematics. Also, the findings of the study also revealed that there was no significant interaction effect of gender and teaching methods (ELA and LM) on students' academic achievement in biology. This signifies that, there was no contributory effect between gender and teaching methods on academic achievement of students' taught biology using ELA. The finding of this study aligns with that of Anugwo *et al.* (2024), Obodo (2023) & Okwuduba, Offia & Madichie (2018), who observed in their independent studies that there was no interaction effect of gender and teaching methods on students' achievement.

Conclusion

Based on the findings of this study, it was concluded that the use of ELA in teaching Biology is more effective than LM in improving students' achievement in Biology. However. ELA is not gender biased as it relates to achievement in Biology.

Recommendations

Based on the study's findings, the following suggestions are proposed, that:

1. Government should organize seminars, workshops, and conferences, in collaboration with organizations like the Science Teachers Association of Nigeria (STAN), to help biology teachers learn about innovative teaching methods, such as ELA.
2. Provision of facilities in the biology lab should be made available by school heads to enable teachers to adopt ELA and help students learn properly.

3. Great focus should be placed on fostering interaction between students during lesson, as this encourages peer learning opportunities on topics that may not be covered during lesson period.
4. Curriculum planners and policy makers should create and implement policies that integrate ELA into the biology curriculum for secondary education.

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