

EFFECTS OF 5E LEARNING CYCLE INSTRUCTIONAL STRATEGY ON SECONDARY SCHOOL STUDENTS' INTEREST IN BIOLOGY IN ADAMAWA STATE, NIGERIA.

BY

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Abstract

This study investigated the effects of the 5E Learning Cycle Instructional Strategy on secondary school students' interest in Biology in Adamawa State, Nigeria. A quasi-experimental pre-test, post-test, non-equivalent control group design was adopted. The population comprised 18,259 Senior Secondary II Biology students during the 2025/2026 academic session. A sample of 391 students drawn from three public secondary schools was selected using multistage sampling techniques. Data were collected using the Biology Interest Inventory (BII), which had a Cronbach Alpha reliability coefficient of 0.86. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses at the 0.05 level of significance. The findings revealed that students taught Biology using the 5E Learning Cycle Instructional Strategy demonstrated significantly higher interest than those taught using the conventional lecture method. The instructional strategy had a significant positive effect on students' interest in Biology. Although no significant gender difference was found in students' interest, the strategy proved effective for both male and female students. The study concludes that the 5E Learning Cycle Instructional Strategy is an effective learner-centred approach for enhancing students' interest in Biology in secondary schools. Its adoption can contribute to improved classroom engagement and increased interest in Biology among learners.

Keywords: 5E Learning Cycle Instructional Strategy; Biology Education; Students' Interest in Biology; Constructivist Teaching; Secondary School Students; Science Education; Adamawa State, Nigeria.

Introduction

Biology is the scientific study of life and living organisms, including their structure, functions, evolution, distribution, and interactions with one another and the environment (Hillis et al., 2020). As one of the core science subjects offered in Nigerian secondary schools, Biology provides learners with the knowledge and scientific skills required to understand natural phenomena and address real-life environmental and health-related challenges. Despite its importance, students' interest in Biology has remained relatively low in many secondary schools, thereby affecting learning outcomes and academic achievement.

Biology is one of the science subjects studied in Nigerian Secondary Schools. Biology as a natural science which studies the existence (evolution, morphology and physiology) of living things, as well as their interactions with non-living components of the earth. Hence, it is that branch of science that studies living things and their interactions with the environment.

Interest simply entails willingness to acquire skills, knowledge, attitude, and values. It is the eagerness to learn a set out task or activity for positive and near mastery of the skills and knowledge related to the activity. Interest is an emotionally oriented behavioral trait that determines a students' urge and vigor to tackle educational programs or other activities. Likewise, the meaning of interest may vary based on the colloquial uses of the term. Interest is also confused with engagement, attention, and curiosity (Kingsley & Chigozili 2022). Interest is described most simply as a relationship between a person and an object.

Hence, interest in the context of this study, may be defined as a personal attribute of a student towards a learning situation usually exposed as like or dislike. Udoh (2021) stated that meaningful learning depends on interest and how motivated learners are during the teaching and learning scenarios as when students feel passionate about lesson content and its method of instruction, the students' interest is aroused, and fosters achievement and retention. When students' are allowed to pursue their own interests, they participate more, stay involved for longer periods and exhibit creative practices in doing science at the same time, interest has also being found to influence future educational training and career choices therefore, constructing science curricula that enable young people to engage in science-related issues that are likely to be of interest and concern to them is critical to encouraging learning as this can ignite in students the ability to identify own interests in biology which may be used to contextualize and personalize some of the formal biology curriculum.

Several studies have investigated the causes of poor interest to Biology by students which may also lead to poor achievement in senior secondary schools (Prokop, et al. 2019). The causes were identified as lack of motivation, inadequate instructional materials, poor teaching strategies, poor

science facilities and poor teacher pedagogical content knowledge, Usak, et, al. (2022) found out that most students attitude towards biology is negative; and recommended that improving students attitude towards studying Biology may lead to better learning outcome. Usak, etal (2022) opined that boys showed more positive attitudes than girls towards the study of Biology. These imply that findings on students interest to biology is still inconclusive and therefore there is need to determine whether methods such as 5E learning cycle instructional strategies may improve students' academic achievement in senior secondary schools of Adamawa state.

Previous studies have also shown that practical and activity-based Biology instruction enhances students' learning outcomes, classroom engagement, and interest in the subject (Adamawa State University Journal of Scientific Research, 2024).

The 5E (Engage, Explore, Explain, Elaborate and Evaluate) learning cycle requires the students to do more than merely report on a topic but, go beyond the simple memorization of facts and regurgitation of information to the realm of creating new and deeper understanding. The problem of this study is to find out whether 5E learning cycle can change the interest of students in biology for better in Adamawa State, Nigeria.

Purpose of the Study

The objectives of this study is to investigate the effects of 5E (Engage, Explore, Explain, Elaborate and Evaluate) Learning Cycle Instructional Strategy on Secondary School Students' Interest in Biology. Specifically, this study intends to determine:

- I. The effects of 5E learning cycle instructional strategy on Secondary School Students' Interest in Biology in Adamawa State.
- II. The interaction effects of 5E learning cycle instructional strategy with respect to gender on Secondary School Students' Interest in Biology in Adamawa State.

Research Questions

Based on the specific objectives of the study, researcher formulated research to address the objectives:

- I. What are the pre-test and post-test mean interest scores of Secondary School Students in Biology when taught using the 5E learning cycle instructional strategy in Adamawa State?
- II. What are the pre-test and post-test mean scores of students' in Biology when taught using the 5E learning cycle instructional strategy with respect to gender on Secondary School Students' Interest in Biology in Adamawa State?

Research Hypotheses

The following null hypotheses are formulated and will be tested at 0.05 level of significance:

H₀₁: There is no significant effect of 5E learning cycle instructional strategy on Secondary School Students' Interest to Biology in Adamawa state.

H₀₂: There is no significant interaction effect of 5E learning cycle instructional strategy on gender of Secondary School Students' Interest in Biology in Adamawa State.

Significance of the Study

The findings of this study will be made available to general public through Journal Publications, Seminars, Textbooks, Workshops and Academic Conferences. The study will be of benefit to Teachers, Students, Curriculum planners, Government, Ministry of Education, and researchers in Curriculum and Instruction.

Scope of the Study

The area of the study is Adamawa State, which is located in the North-Eastern zone of Nigeria. The study was restricted to Senior Secondary Two (SSII) male and female Biology students in three (3) Senior Public Secondary Schools in Adamawa State.

The period of study covered within the period of the 2025/2026 academic session. The content of study includes five topics namely: digestion, transport system, excretory system, respiratory system and nutrient cycle in nature.

Concepts

The 5E Learning Cycle is a philosophy of teaching and learning with strong constructivist foundations (Vygotsky, 1978). Corujo (2023) defined 5E learning cycle (Engage, Explore, Explain, Elaborate, Evaluate) as a constructivist instructional model guiding students through phases to build deep conceptual understanding, starting with sparking interest (Engage), then hands-on investigation (Explore) formalizing concepts (Explain), applying knowledge (Elaborate) and assessing learning (Evaluate), effectively fostering scientific inquiry and critical thinking. Corujo (2023) further explained that the 5E model encourages learners to actively construct knowledge through engagement, exploration, explanation, elaboration, and evaluation, thereby fostering inquiry, critical thinking, and meaningful learning experiences.

The 5E Learning Cycle consists of five phases: engagement, exploration, explanation, elaboration and evaluation (Bybee, 2023). Each phase has a specific function and contributes to the learner's coherent instruction and to the learners' formulation of a better understanding of scientific and technological knowledge, interest and skills. The BSCS 5E Instructional strategy was builds on the work of other social constructivist. Hence, learning results from an interaction between what

information is encountered and how the student process that information based on perceived notions and personal knowledge. The 5E Learning Cycle is widely recognized as an inquiry-based instructional model that promotes conceptual understanding through learner-centred classroom activities (Bybee, 2023).

Iyekekpolor, Tsue (2010) opined that students' interest and achievement in Mathematics are heavily influenced by teaching methods. Research indicates that poor teaching approaches lead to negative attitudes, while active engaging strategies – such as computer – assisted instruction or using improvised materials- significantly improve students' interest, retention and performance.

Concepts of Interest

Interest is educational concepts that determine some aspects of students' effective domain which is very important in the teaching and learning process. Okekeokosili and Okigbo (2021) defined interest as an emotionally oriented behavioral trait that determines a students' urge and vigor to tackle educational programs or other activities.

Interest has been measured in a number of different ways, including observations, neuroscientific techniques, facial expressions, class enrollment data, and questionnaires (Kingsley & Chigozili 2022). Each of these methods has its own unique benefits and limitations. Since the design of a questionnaire has to be tailored to address the research questions asked, the theory and definitions drawn from, and the context of the study, existing questionnaires concerning interest vary greatly. Some of the first questionnaires of interest were inventories of topics or activities (Kingsley & Chigozili 2022).

Concept of Gender

Gender is a socio-culturally constructed concept that ascribes certain characteristics and roles to sex such as male and female within the society. The concept of gender can be likened to class and race. Gender and age influence scientific interest, gender differences have been demonstrated- with boys being on average more interested in physics and girls in biology. In addition, age greatly influences general scientific interest, including in biology, primary school students tend to have considerable interest in science, but this declines once they start secondary school. Gender, as a concept, has captured the interest of science educators in Nigeria, especially now that gender equity is being emphasized in many quotas. Hence, gender in the context of this study may simply be defined as an attribute ascribed to male and female based on biological features.

Theoretical Framework

The theoretical review of this study is based on the theories that have direct relationship with the research topic. This study was anchored on three theories namely:

1. Leev Vygotsky's (1978) Theory of social learning.

2. John Dewey's view on interest in education (1913)

According to Dewey (1913), genuine learning occurs when instruction is connected to learners' interests and real-life experiences. He argued that students become more actively engaged and motivated when classroom activities are meaningful and relevant to their needs. This perspective supports the use of the 5E Learning Cycle Instructional Strategy, which actively involves learners in constructing knowledge through inquiry and exploration.

Methods

Research Design

The design for the study was quasi-experimental design, which involves pre-test, post-test, non-equivalent, control group, design. The use of a quasi-experimental design is appropriate when random assignment of participants is impractical in educational settings, making it particularly suitable for classroom-based educational research (Remler & Van Ryzin, 2025). Quasi-experimental design was employed when randomization is impossible and therefore intact classes was utilized and randomized into experimental and control groups (Remler, & Van Ryzin, 2025).

The independent variable is 5E Learning Cycle Instructional Strategy was used as treatment for the experimental group while lecture teaching method was used for the control group. The dependent variable is students' interest in Biology while gender served as the moderator variable. The experimental and control groups were pre-tested to determine the group equivalent.

Area of the Study

The area of the study of this research is Adamawa State, Nigeria.

Population of the Study

The Population of this study consisted of all the 18,259 SS II Students in Biology in all the 404 Public Senior Secondary Schools in Adamawa State for the 2025/2026 academic session. The reason for choosing SS II was because the students are stable, they are neither new as in the case of SS I nor in the case of SS III facing external examinations in the school.

Sample and Sampling

Sample of the study consisted of 391 SSII Biology students from three Education Zones of Adamawa State. A multistage sampling technique was used to select the sample by lucky dip to select three Education Zones from the five Education Zones in the State because it is suitable for educational studies involving large and geographically dispersed populations. This approach is consistent with the recommendations of Nzewke (2025), who advocated the use of multistage sampling in educational research where participants are drawn from different administrative zones.

Step One: The sample size was ascertained by the use of Taro Yamane (1967) formula as $n = \frac{N}{1+N(e)^2}$ where N= population size, N= sample size, e= margin of error.

Therefore,

$$n = \frac{18,259}{1+18,259(0.05)^2} =$$

$$n = \frac{18,259}{1+18,259(0.0025)} =$$

$$n = \frac{18,259}{1+45.648} =$$

$$n = \frac{18,259}{46.648} =$$

$$n = 391$$

Step Two: involved the use of purposive sampling technique in selecting three schools from the three Education Zones, one Public Secondary School from each zone. The basis for using purposive sampling technique was that the schools should have B.Sc. or B.Tech. (Ed) Biology teacher with at least five years Biology teaching experience, laboratory and the school should be co-education type.

Instrument for Data Collection

One instrument was used for data collection namely Biology Interest Inventory (BII) which consist of 25 items with four points rating scale to measure interest by developing a choice between positive and negative responses meaning no neutral option (Eren & Cetin 2022). Very Relevant (4), Quite Relevant (3), Fairly Relevant (2), and Just Manageable (1) to determine students' interest towards Biology.

Validity of the Instruments

The instruments were validated by three experts from Faculty of Education, Taraba State University, Jalingo.

Reliability of the Instruments

To establish the internal consistency of the instrument. The instrument was administered to thirty (30) SS II Biology students as trial testing. The trial testing was carried out in one of the government secondary schools in Mubi which lasted for one day in a different Education Zone which was not part of the study area. The reliability index 0.86 was obtained, meaning the instruments were reliable and suitable for the main study.

Method of Data Analysis

The collected data were analyzed using descriptive statistics of mean and standard deviation to answer the research questions, while all the null hypotheses were tested using analysis of Covariance (ANCOVA) at 0.05 level of significance. The choice of ANCOVA is to reduce variances and therefore reduce the chances of committing errors.

Results

The results of the data analysis are presented in accordance with the research questions formulated for the study. Data related to each research question are presented in separate tables to aid clarity, understanding, and interpretation of findings.

Table 1

Administration and Retrieval of Research Instruments for the Study

Category	Number of Questionnaires	Percentage (%)
Number Distributed	391	100%
Number Retrieved	363	92.84%
Number Not Retrieved	28	7.16%
Total	391	100%

Source: Fieldwork (2026)

Table 1 presents the administration and retrieval of research instruments used in the study. A total of 391 questionnaires were distributed to respondents across selected secondary schools in Adamawa State. Out of this number, 363 copies were successfully retrieved (92.84%), while 28 copies (7.16%) were not retrieved, either due to incomplete responses or non-return by respondents. The retrieval rate of 92.84% is considered highly satisfactory and reflects strong participant engagement. According to Verma and Verma (2020), a response rate of 70% and above is deemed adequate for research generalization. The 92.84% return rate in this study, therefore, exceeds this benchmark significantly, suggesting that the data collected are sufficiently representative of the target population. The minimal non-retrieval rate of 7.16% is unlikely to introduce significant non-response bias into the findings. The high instrument retrieval rate strengthens the internal validity of the study and supports confidence in the generalizability of findings to secondary school students in Adamawa State.

Presentation and Interpretation of Results

This was presented in accordance with the Research Questions & testing of the Hypotheses formulated for the study.

Research Questions

Research Questions One: What are the pre-test and post-test mean interest scores of Secondary School Students in Biology when taught using the 5E Learning Cycle Instructional Strategy in Adamawa State?

Ho1: There is no significant effect of 5E Learning Cycle Instructional Strategy on Secondary School Students' Interest in Biology in Adamawa state.

Table 2

One way Analysis of Covariance (ANCOVA) on the Effect of the 5E Learning Cycle Instructional Strategy on Secondary School Students' Interest in Biology in Adamawa State

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial eta squared
Corrected Model	2984.646 ^a	4	746.162	16.878	.000	0.042
Intercept	49407.525	1	49407.525	1117.615	.000	0.450
GROUP	2901.737	1	2901.737	65.638	.000	0.002
Interest	18.569	2	9.285	.210	.811	0.141
Error	15826.467	358	44.208			
Total	1043785.000	363				
Corrected Total	18811.113	362				

a. R Squared = .159 (Adjusted R Squared = .149)

The Analysis of Covariance (ANCOVA) results presented in Table 2 indicate that the instructional group (GROUP) had a statistically significant effect on students' post-test interest scores, $F(1, 358) = 65.638$, $p < .001$, partial eta squared = 0.141. This result shows that there is a significant difference in interest between students taught using the 5E Learning Cycle and those taught using the Lecture Method. Based on the descriptive statistics presented earlier, students exposed to the 5E Learning Cycle demonstrated higher Post-test interest scores. The overall model was statistically significant, $F(4, 358) = 16.878$, $p < .001$, indicating that the combined effect of the

predictors significantly influenced students' interest. The model explained 15.9% of the variance in post-test interest scores ($R^2 = .159$; Adjusted $R^2 = .149$), suggesting a moderate level of explanatory power. However, the Interest subgroup variable (FR, QR, JM) was not statistically significant, $F(2, 358) = 0.210$, $p = .811$, implying that differences among the subgroups did not significantly affect post-test interest after controlling for instructional method. Therefore, the null hypothesis (H_{01}) is rejected, indicating that there is a statistically significant effect of the 5E Learning Cycle instructional strategy on secondary school students' interest in Biology in Adamawa State.

Research Question Two: What are the pre-test and post-test mean interest scores of male and female secondary school students in Biology when taught using the 5E Learning Cycle Instructional Strategy?

H₀₂: There is no significant interaction effect of the 5E Learning Cycle Instructional Strategy and gender on secondary school students' interest in Biology in Adamawa State.

The findings indicate that although students exposed to the 5E Learning Cycle Instructional Strategy recorded higher interest scores, the interaction effect of instructional strategy and gender was not statistically significant. This implies that the strategy was equally effective in promoting students' interest irrespective of gender.

Table 3

Two-way Analysis of Covariance (ANCOVA) of Gender Differences in Secondary School Students' Interest in Biology When Taught Using the 5E Learning Cycle Instructional Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial eta square
Corrected Model	3222.020 ^a	6	537.003	12.263	.000	0.000
Intercept	63750.508	1	63750.508	1455.837	.000	0.0671
GROUP	2805.867	1	2805.867	64.076	.000	0.606
GENDER * Interest	256.014	5	51.203	1.169	.324	0.159
Error	15589.093	356	43.790			
Total	1043785.000	363				
Corrected Total	18811.113	362				

a. R Squared = .171 (Adjusted R Squared = .157)

The ANCOVA results examining the interaction effect of gender and interest level on students' interest scores indicate that the interaction term (Gender $\times$ Interest) was not statistically significant, $F(5, 356) = 1.169$, $P = .324$, partial eta squared = 0.159. This suggests that the combined effect of gender and subgroup classification did not significantly influence students' interest in Biology. The instructional group (GROUP), however, remained statistically significant, $F(1, 356) = 64.076$, $p < .001$, indicating that the 5E Learning Cycle continued to have a strong positive effect on students' interest regardless of gender. The overall model was statistically significant, $F(6, 356) = 12.263$, $P < .001$, and explained 17.1% of the variance in interest scores ($R^2 = .171$; Adjusted $R^2 = .157$), reflecting a moderate explanatory capacity. Therefore, the null hypothesis (H_{04}) is retained, indicating that there is no statistically significant gender difference in students' interest in Biology when taught using the 5E Learning Cycle strategy.

Conclusion

The effects of 5E Learning Cycle Instructional Strategy on Secondary School Students' Interest in Biology in Adamawa State have been examined. The 5E learning cycle instructional strategy (Engage, Explore, Explain, Elaborate, and Evaluate) is a student-centered, constructivist approach that proved effective in enhancing interest in Biology compared to the conventional lecture method. In Adamawa State, students exposed to the 5E strategy showed higher Post-test mean scores in interest. The study submits that the 5E learning cycle instructional strategy is an effective tool for improving teaching and learning of Biology in Senior Secondary Schools in Adamawa state, Nigeria.

Recommendations

Based on the findings of this study, the following recommendations among others were proffered.

1. Biology teachers in Secondary Schools in Adamawa State should adopt the 5E learning cycle instructional strategy as the primary method for teaching Biology concepts to enhance students' interest.
2. The Adamawa State Ministry of Education, SUBEB, and other relevant agencies should organize regular workshops, seminars, and in-service training programmes for Biology teachers focused on the effective implementation of the 5E learning cycle and other student-centered instructional strategies,
3. Curriculum planners and developers should integrate the 5E learning cycle model explicitly into the secondary Biology curriculum to institutionalize its use across genders in schools,

Limitations

In spite of the zeal and determination with which this research was undertaken, the following unavoidable shortcomings have limited its findings and generalizations. The major limitation encountered was that, the sample was drawn from only three Education Zones out of five in Adamawa State. The inclusion of more zones or private schools would have ensured a more generalized result but, it was not possible in this study. The conclusion and generalization of the study is also limited to Public Senior Secondary Schools (SS II) in Adamawa State and the selected topics in Biology. However, the findings of this study cannot be generalized to the entire Nation or other science subjects because the present study focused only on Biology in public secondary schools in Adamawa State.

Suggestions for Further Studies

Further studies can be carried out on the following topics:

1. A study could be carried out to determine the effects of the 5E Learning Cycle on Students' Retention of Biology concepts,
2. A comparative study could be conducted to assess the effects of the 5E Learning Cycle Instructional Strategy on Students' Interest and Achievement in Biology in public versus private secondary schools,
3. An experimental study could be carried out to examine the effect of the 5E Learning Cycle on Students' Achievement in other science subjects such as Chemistry or Physics,

Contribution to Knowledge

The study added to the body of literature on the effects of the 5E Learning Cycle Instructional Strategy on Students' Interest in Biology specifically within Adamawa State, Nigeria, thereby filling a contextual gap in the existing research on student-centered pedagogies in senior secondary science education.

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