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EFFECT OF ADAPTIVE LEARNING APPROACH ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN BIOLOGY IN AWKA EDUCATION ZONE OF ANAMBRA STATE

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ABSTRACT

Despite significance of biology to society, there are many flaws and variations in Secondary School Students' achievement in Biology, which is why this study focused on effect of adaptive learning approach on the secondary school students' academic achievement in biology. The study was guided by three purposes, two research questions and three hypotheses that were examined at 0.05 alpha level. The design was quasi-experimental (the pre-test, posttest nonequivalent control group design was used). A population of 1942 (1021 males and 1011 Female Senior Secondary Two (SS2) biology students from all public Secondary Schools in Awka education zone made up the Study's population. A sample size of 109 (60 males and 49 females) SS2 Students offering biology in the education zone was drawn using multi stage sample procedure. Validation was done by experts in measurement and evaluation and science education. Reliability was established using Kuder Richardson 20 formula which yielded coefficient of 0.87. Mean and S.D was used to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses. The findings revealed that Adaptive learning approach (ALA) improved Students' achievement in Secondary School Biology than conventional Lecture method (CLM). The findings of study also discovered that Female Secondary School Students achieved better than their male counterparts when taught with ALA. Regardless of gender, the study advised educators and government to leverage the Zone's strengths by customizing content language support, train teachers, encourage schools to invest in adaptive learning platforms and establish collaboration with Local Schools to pilot, refine and scale ALA with fidelity.

Keywords: Adaptive Learning Approach; Secondary School; Students; Achievement; Biology

Introduction

Education is an ongoing process starting from the pre-historic men and times, springing into the recent times. It is a process of acquiring knowledge, skills values and attitudes through various methods including formal schooling informal learning and life experiences. Moreso, is the cornestone of personal and social cohesion and drives innovation (Adonu, C.T, Nwagbo, C.R. Ugwanyi, U.S and Okeke C.I.O 2021)

Offor and Nwankwo (2024) Opined that education shapes minds, fosters curiosity

and builds the foundations for thoughtful citizenship. A strong education system supports creativity, collaboration and resilience, helping people pursue meaningful carriers and contribute effectively to their communities. IT also plays a crucial role in reducing inequality by providing path ways for underserved groups and encouraging lifelong learning through discovery and discovery fuels progress in Science. (Achufusi and Obikwelu (2024); Falemu, Ogunjobi, Olofin and Akinwumi 2023). Science in other hand is important in the development of any nation because Science is directly linked to the tackling of problems of humanity.

The contributions of Science and technology to the overall development of nations cannot be overemphasized. The importance of science and technology to modern development in Science technology and Mathematics STEM education was introduced in 2001 by the Science Administrators at the United State National Science Foundation (NSF) with goals among which is capable workfarce and increase in STEM literacy for students as well as pursue STEM related carrere in STEM disciplines (Yeping, ke, yu and Jeffery 2020) Iheagwuba, Nzewi, Ifeagwu, Chinweuba and Nduji (2020) asserted that Science subjects in Secondary Schools in Nigeria are Biology, Chemistry and Physics. Biology is a branch of natural science that deals with study of living Organisms, structures, evolutions, distribution and Interrelationships. Biology covers all life processes such as movement, respiration, nutrition, irritability, reproduction and ecology. (Achufusi and Ezeobi, 2024). inspite of all these importance of Biology to man, Secondary School Students offering Biology do not perform well enough and there are evidences of underachievement in Biology.

The Chief Examiners Report 2019-2024 reported that raw means scores for each year have never been up to 50 mean score. The report 2024 outlined a number of reasons for students' weaknesses in Biology as why a Rhesus negative man should not marry a Rhesus Positive to avoid losing pregnancy, poor grasp of genetics, diseases etc. The inability to grasp the genetics questions properly. Biology classroom are dominated by lecturers and rote drills leading to shallow understanding compare to students' center like adaptive learning, exploratory leaning that could foster critical thinking and applied reasoning. Achufusi and Ona (2022) asserted that innovative learning approach such as problem-based, inquiry-led, adaptive learning approach consistently improve engagement and learning outcome when thoroughly implemented. Equally Achufusi and Obikwelu (2024) identifies Sex-role sterotyping and masculine image of Science as the Origin of the difference between males and female students' achievement in Science Education. Achufusi and Obikwelu (2024) found gender differences in favour of male students to female counterparts.

Adaptive learning approach can accelerate mastery, promote students' agency and personalize education at scale in science subjects (Wulschlefer, lindnier, Heinz, Man-wyder, vogt and master opitz 2022) on this, note, the study examined to know how effective adaptive learning could improve achievement when applied on Secondary

School Students' biology. The inconclusive opinions and findings of so many researchers thus prompted the study to see if adaptive learning approach is in favour of students against the conventional lecture method.
Equally the study will also look at the male and female students' achievement to see if males achieve better than the females and vice versa.

Propose of the Study: The purpose of this study was to investigate the effect of adaptive learnig on Secondary School Students' achievement in Biology in Awka Education Zone of Anambra State. Specifically, the study investigated the:

- The difference between the mean achievement scores of students' taught Biology using adaptive learning approach (ALA) and those taught using conventional lecture (CLM)
- The Difference between mean achievement scores of male and female students taught Biology using ALA.
- The interaction effect of teaching method and gender on the students' achievement in Biology.

Research Questions:

- What is the difference between mean achievement scores of students taught Biology using ALA and those taught using CLM.
- What is the difference between the mean achievement scores of male and female students taught Biology using ALA.

Hypotheses: The study tested the following null hypostasis at 0.05 level of significance.

- There is no significant difference between the mean achievement scores of students taught Biology using ALA and those taught using CLM.
- There is no significant difference between the mean achievement scores of Male & Female Students taught Biology using ALA.
- There is no Significant interaction effect of teaching method and gender on students' achievement in Biology.

Method: The quasi-experimental design specifically, the pretest, posttest nonequivalent control group design was used. The study was conducted in Awka Education Zone in Anambra State. A population of 1942 senior secondary two (SS2) biology students from Anambra State's Awka Education Zone made up the study. The sample size was 109 (50male 49 female) students drawn using multi stage. First, purposive sampling was used to select two L.G.A from five L.G.A of the zone (Awka North, Awka South, Anaocha, Dunukofia and Njikoka.)
Secondary, purposive sampling was used to select three co-educational schools from two L.G.A and simple random by replacement was used allocate the 3 schools to two experimental and one control group.

Instrument: 50 structured standardized questions BAT was selected from WASSE Exams for 7 years using the bloom's taxonomy as test blue print to guide ion level.

Research Q1: What is the difference in the mean achievement scores of students taught Biology using ALA and those taught using CLM.

TABLE 1: Mean and Standard Deviation, Achievement Scores of Students taught Biology using adaptive learning approach (ALA) and those taught using conventional lecture method (CLM).

		PRETEST		POSTTEST		
GROUPS	**N**	**MEAN**	**SD**	**MEAN**	**SD**	**MEAN Gain**
ALA	59	38.47	11.88	79.01	8.11	40.54
CLM	50	36.04	8.21	43.84	7.44	7.80

Result in table 1 reveals that pretest achievement scores for ALA and CLM are 38.47, 36.04 whole posttest were 79.01 and 43.84 respectively with SD scores of 8.11 and 7.44. this showed that LA improves students' achievement better than CLM.

2. Research Q2: What is the difference between the mean achievement scores of male and female students taught Biology using adaptive learning approach?

TABLE 2: Mean and S.D Achievement scores of male and female students taught Biology using adaptive learning approach.

		PRETEST		POSTTEST		
Group	N	Mean	SD	Mean	SD	Mean Gain
ALA Male	32	36.38	12.52	77.38	7.86	40.00
ALA Female	27	40.96	10.78	80.96	8.12	40.00

Table showed pretest and posttest mean achievement score of male Secondary School students' taught Biology using adaptive learning approach (ALA) were 36.38 and 77.38 while the S.D were 12.52 and 7.86 with mean gain score of 40.00. Also protest and posttest mean achievement score of female Secondary School Students taught Biology using adaptive learning approach were 40.96 and 80.96 while the S. Ds were 10.78 and 8.12 with mean gain scores of 40.00

This implies that female students' achievement better than their male counterpart when taught with ALA.

Hypothesis 1: There is no significant difference between the mean achievement scores of students taught Biology using Adaptive learning Approach (ALA) and those taught using conventional lecture method CLM.

TABLE 3: Analysis of covariance (ANCOVA) of students' mean achievement scores between students taught with ALA and those thought using CLM

Source	Type111 sum of square	df	mean square	F	Sig	decision
Corrected model	1203.420a	1	1203.420	11.884	.001	
Intercept	7108.173	1	7108.173	11.884	.001	
Learning Approaches	1203.420	1	1203.420	11.884	.001	
Error	10835.258	107	101.264			
Total	168524.679	109				
Corrected total	12038.679	108				

a. R squared = .100 (Adjusted R square = .092
b. Computed using alpha = .05

Table 3 reveals the ANCOVA results on the effect of adaptive learning approach (ALA) and conventional lecture method (CLM) on secondary school students' achievement in Biology. Results revealed a significant difference F (1,1203.420) = 11.884, P=0.001 < 0.05. since the obtained p-value is less than the stipulated 0.05 level of significance, the null hypothesis is rejected that there is no significant difference between the two groups. Implies that mean achievement scores of students taught Biology using ALA is greater than mean achievement score of students taught same concept using conventional lecture method.

Hypothesis 2: There is no significant difference between the mean achievement score of male female students taught Biology using adaptive learning approach.

TABLE4: Analysis of covariance (ANCOVA) of male and female students' means Achievement scores of students taught Biology using ALA

Source	**Type 111 sum of Squares**	**df**	**mean square**	**f**	**significant** decision
Corrected model	3788.303a	2	1894.157	24.116	
Intercept	865.360	1	865.360		11.018
Post ALA	3480.054	1	3480.054	44.308	
Gender ALA	16.091	1	16.091	.205	.653
Error	4398.409	56	78.543		
Total	95524.000	59			
Corrected total	8186.712	58			

a. R squared =.463 (Adjusted R Squared = .444)
b. Computed using alpha = .05

The results in Table 4 – Shows that there is no significant difference between the mean achievement scores of male and female students taught Biology using ALA F(r,16.091) = 0.653 >0.05. Since the obtained p-values is greater than the stipulated 0.05 level of significance the null hypothesis is upheld and retained.

Hypothesis 3: There is no significance interaction effect of teaching method and gender on students achievement in Biology.

TABLE5: Analysis of covariance (ANCOVA) of the teaching method and gender interaction on Pretest and Posttest Achievement mean scores in Biology.

Source	Types 111 sum of squares	df	means square	f	sig. decision
Corrected model	5394.802a	4	1348.701	21.112	
Intercept	249.025	1	249.025	3.898	.051
Posttest					
Teaching methods	4936.615	1	4936.615	77.275	
Teaching methods	3817.077	1	3817.077	59.751	
Gender ALA/CLM	88.904	1	88.904	1.392	0.241
Teaching method					
Gender ALA CLM	7.093	1	7.093	.111	.740
Error	6643.877	104	63.883		
Total	168524.000	109			
Corrected total	12038.679	108			

a. R squared = .448 (Adjusted R square = . 427)

The result displayed on Table5 – show that there is no significant interaction effect of gender and teaching method on the mean achievement scores of students in biology, F(1,7.093) = 0.111, P = 0.740 . Since obtained P.value of 0.742 is greater than stipulated 0.05 significant interaction effect of teaching method and gender in biology is thereby upheld.

Discussion of Findings

The findings of study revealed that the achievement of students taught Biology using adaptive learning approach there is a significant difference between mean achievement scores of students taught Biology using adaptive learning ALA is in favour and better than those taught using CLM. This supports finding of Ali, Agbo and Friday 2024, Offor and Nwankwo 2025, Achufusi Aka 2024 and many other researchers as in the introduction.

Furthermore, the findings reviewed a no significant difference in the achievement scores male and female students taught biology using ALA. This result finding aligns with Achufusi and Obikwelu 2024 and Offor and Nwankwo 2025 who reported that 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.

Implication of Findings: is that significant improvements in achievement with ALA over CLM suggest that personalized pacing, timely feedback and targeted practice effectively address diverse learner needs students should consider embedding ALA as a core instructional strategy to raise overall Biology outcomes.

Recommendations

Although female students outperformed males under ALA in achievement, there was no significant gender gaps within ALA.

All State holders should provide ongoing professional development focused on data driven instruction interpreting analysis from adaptive systems and designing culturally responsive biology relevant feedback for diverse learners.

Study could investigate effect of ALA on Secondary School Achievement and interest in Biology in any State in Nigeria.

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