

Effect of Context–Based Instructional Approach on Academic Performance in Biology among Secondary School Students in Gombe Metropolis, Gombe State, Nigeria

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Abstract

This study investigated the effect of Context-Based Approach on Students' Academic Performance in Biology among Senior Secondary School Two Students in Gombe metropolis, Gombe State, Nigeria. Four research questions and Six null hypotheses were formulated and tested in the study. The design of the study was quasi experimental of pretest- posttest and control groups. One hundred and forty (140) students were selected from two schools and the students were assigned to experimental and control groups from a population of 24,526 students in 19 schools. The groups were exposed to lesson treatment of six weeks. The experimental group was taught using Context-Based Instructional Approach while the control group was taught using conventional method on same Biology contents of Respiratory system. The instruments were validated by three experts and reliability coefficient obtained was 0.72. Descriptive statistics of mean and standard deviation were used to answer research questions while inferential statistic of ANCOVA was used to test the hypotheses at 0.05 level of significance. The results of the study showed significant difference in mean performance scores of students taught Biology concepts using context-based approach over students taught same biology concepts using conventional method. No significant effect of the treatment and gender on student's academic performance difference while a significant interactive effect was shown between treatment and group on retention with ($p=0.00 < 0.05$) with 97.8% of the variance in retention. based on the findings of this study some recommendations were offered among others; Context-Based Instructional Approach to teaching Biology be used in teaching respiration adopted at all levels of Biology education because it enhances academic performance. Context-Based Instructional Approach can help Biology teachers to disseminate knowledge to the best of their ability by making use of all available resources rather than resorting to the use of conventional method.

Keywords: Context based, Achievement, Respiratory system

Introduction

Education is widely regarded as one of the key tools for individual and societal development (Adeosun, 2021). In today's rapidly evolving, science driven world, biology holds a prominent place among the sciences because it deepens our understanding of the natural world and various life processes (Osborne & Dillon, 2021). Its relevance spans multiple sectors, including agriculture, medicine, pharmacy, and industry, with applications ranging from plant breeding for improved food production to processes like brewing, bread making, and milk processing (Joda & Abel, 2017; Ibe, 2019). Furthermore, biology opens career opportunities in diverse fields such as food technology, medicine, and veterinary science.

Despite its importance, academic performance in biology at the senior secondary school level in Nigeria has been below expectations, with the problem equally prevalent in Gombe Metropolis. According to the West African Examinations Council (WAEC), only 57.2% of candidates nationwide obtained credit and above in biology in 2023, and this declined to 54.6% in 2024 (WAEC, 2024). In Gombe Metropolis, the trend mirrors the national pattern, with failure rates in biology consistently higher than in other science subjects (Gombe State Ministry of Education, 2024). This persistent underachievement has raised concerns among educators, parents, and policymakers.

The traditional lecture method commonly used in Nigeria has been criticised for being overly teacher-centred, promoting rote memorisation, and presenting abstract concepts with little connection to students' everyday lives (Gilbert, 2018; Fensham, 2019). These limitations often result in low student interest and poor understanding of topics such as respiration, cell division, photosynthesis, and ecology, which have been identified as challenging for learners (Mumini, Dike, & Nwogwu, 2017; Kilic, Taber, & Winter, 2021).

To address these challenges, researchers have increasingly advocated for context-based instructional approaches (Bennett, Lubben, & Hogarth, 2019; Okeke & Nwafor, 2021). This method connects scientific concepts to real-life situations, making learning more relevant, engaging, and meaningful. By emphasising practical applications and everyday contexts,

Context-based approach has emerged as an alternative that aims to address these challenges by linking scientific concepts to real-life experiences (Okeke

and Nwafor, 2021). This approach emphasizes the application of biological knowledge to everyday contexts, making learning more relevant, engaging, and meaningful for students (Bennett *et al.*, 2021). By doing so, the context-based approach seeks to improve both academic performance and retention of biological knowledge (Gilbert, 2018). Research shows that students are more likely to engage with the material when they see its relevance to their personal and social environments (Fensham, 2019). This approach has been successfully implemented in several countries and has shown significant improvements in students' understanding, interest, and retention of scientific concepts (Bennett *et al.*, 2021).

Biology, as a core science subject, requires the application of science process skills to bring about meaningful learning (Michael, 2021). However, its inherently abstract nature means that effective teaching demands strategies that make concepts concrete and relatable (Taştan *et al.*, 2021). The context-based approach bridges the gap between theory and application by linking biology content to students' immediate realities, thereby promoting deeper understanding and long-term retention.

Statement of the Problem

Despite its importance, academic performance in biology at the senior secondary school level in Nigeria has been below expectations, with the problem equally prevalent in Gombe Metropolis. According to the West African Examinations Council (WAEC), only 57.2% of candidates nationwide obtained credit and above in biology in 2023, and this declined to 54.6% in 2024 (WAEC, 2024). In Gombe Metropolis, the trend mirrors the national pattern, with failure rates in biology consistently higher than in other science subjects (Gombe State Ministry of Education, 2024). This persistent underachievement has raised concerns among educators, parents, and policymakers. The persistent decline in students' performance in Biology within Gombe Metropolis has become a major educational concern. Data from the West African Examinations Council (WAEC) indicate that a significant proportion of students fail to meet the expected performance standards in Biology, and this trend has shown little improvement over time. Beyond poor examination results, another critical challenge is students' inability to retain key biological concepts over extended periods.

Research Objectives

The objectives of the research are to determine:

1. The effect of context-based approach on students' academic performance in biology in senior secondary schools in Gombe metropolis.
2. The gender differences in students' academic performance when taught biology using context-based approach.
3. To determine the interaction effect of treatment and gender on academic performance

Research Questions

The research questions for this study are as follows:

1. What is the effect of Context-Based Approach on students' academic performance in Biology among Secondary School Students in Gombe state?
2. What are the gender differences on students' academic performance when taught biology using context-based approach?
3. What is the interaction effect of treatment and gender on academic performance

Research Hypotheses

The null hypotheses for this study are stated as follows:

- H₀₁: There is no significant difference between the academic performance of SS2 Biology students taught Biology concepts using context-based approach and those taught same concepts using conventional method.
- H₀₂: There is no significant gender difference in students' mean academic performance when taught biology using context-based approach.
- H₀₃: To determine the interaction effect of treatment and gender on academic performance

Methodology

Research design for this study is quasi- experimental design (Pre-test/post-test). Two groups of students were used for data collection (experimental group (EG) and control group (CG)). The two groups were pretested to determine their equivalence in ability before the commencement of treatment. The experimental group was taught biology concept using context-based approach and the control group was taught biology concept using conventional method. The diagrammatic illustration of the design is as follows:

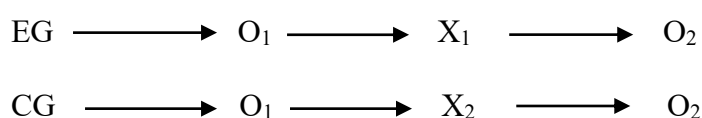


Figure 1: Research Design Illustration for the study.

The population for this study comprised all science secondary school students in Gombe metropolis. The number of science secondary schools within Gombe metropolis are 19 with 24,526 students which consists 14,612 males and 9,914 females. SS two biology students were selected in this study. Table 1 shows the names of science secondary schools in Gombe metropolis and their students' enrolment.

Table 1: Population of the Study

S/N	Schools	Male	Female	Total Population
1	GAC Gombe II	367	284	660
2	GAC Gombe I	538	320	858
3	GCDSS Ahmadu Gombe	371	192	563
4	GCDSS Gombe	889	391	1,280
5	GDSS Bolari East	807	567	1,374
6	GDSS Gandu	1,216	974	2,190
7	GDSS Herwagana	1,237	615	1,852
8	GDSS Jalo Waziri	541	360	901
9	GDSS Nasarawo	495	270	765
10	GDSS Orji Estate	350	291	641
11	GDSS Pantami	1,225	938	2,163
12	GDSS Pilot Gombe	1,261	860	2,121
13	GDSS Shehu Abubakar	355	273	628
14	GCDSS Gabukka	944	901	1,845
15	GSS Gombe I	892	0	892
16	GDSSS (Science II) Gombe	1,128	1,005	2,133
17	Hassan Cent. Sen. Sec. School	1,035	1,049	2,084
18	Special Educ. Center Gombe	102	40	142
19	GSTC Gombe	850	584	1,434
TOTAL		14,612	9,914	24,526

Source: ASC 2020/2021, EMIS, MoE Gombe state.

Two (2) schools were selected out of the 19 secondary schools in Gombe metropolis, the schools selected are namely; GDSSS (Science II) Gombe as experimental and Hassan central senior secondary school as control sample, in each of the schools' SS II Intact class were used for the study. A total of 140 students, 78 experimental group and 62 control group. There are 36 males and 42 females in the sampled schools.

Table 2: Sample of the Study

S/N	School Code	Group	Status	Number of Students
1	GDSSS II	Experimental	Mixed	78
2	Hassan Central	Control	Mixed	62
Total				140

Purposive sampling technique was used in selecting two schools from the population. The intact classes from the ample schools were assigned into experimental groups and the other school for control group of the intact class in each school, the experimental group was taught using Context-based instructional approach while control group was taught with conventional method.

The Instrument for data collection in this research was Biology Performance Test (BPT) which contains fifty (50) structured multiple choice items with one correct answer and three distracters adapted from SSCE past questions. The items in the test covered the topic taught so as to generate information

The content of the instrument was validated by three (3) experts, from Gombe State University. after some modifications, suggestion and criticism to access content and face validity. The experts made corrections, after validation, no item was discarded, this is because all items were standard as adapted from past SSSCE questions. From the pilot testing result, the reliability coefficient in the Biology Performance Test (BPT) was found to be 0.72. The value was obtained using test re-test method by application of Pearson Product Momentum Correlation (PPMC) statistic. Thus, the instrument was considered reliable and was used for data collection.

The researcher collected introductory letter from the department of science education, Gombe State University and took it to the principals of the schools under study. Data for the study was collected through pre-test, post-test and retention test. On the first day of the visit, pre-test was administered to all the

groups in order to determine their equivalence with the help of research assistants which are biology teachers from various schools under study. Two assigned group were exposed to lesson (treatment) for six weeks using seventy minutes from their timetable. Descriptive statistics were used to calculate mean and standard deviation to answer the research questions and inferential statistics were used to test the six (6) null hypotheses formulated for this study using ANCOVA at 0.05 level of significance.

Results

Research Question One: What is the effect of Context-Based Approach on student's academic performance in Biology among senior secondary students in Gombe metropolis?

Table 3: Mean and Standard Deviation of the Experimental and Control Groups in Biology Performance Test

Groups	N	Mean Score		Standard Deviation	Mean Difference
		Pretest	Posttest		
EG	78	9.56	26.77	4.51	14.34
CG	62	9.04	12.43	3.21	
TOTAL	140				

Table 3 presents the mean performance scores of the experimental and control groups in the Biology Performance Test. The pretest results indicate that both groups started at a comparable level (EG = 9.56; CG = 9.04), suggesting no significant difference in prior knowledge before the treatment. However, after the intervention, there was a noticeable increase in the posttest scores. The experimental group, taught using the context-based instructional approach, had a posttest mean score of 26.77, while the control group, taught using the conventional method, had a mean score of 12.43. This results in a mean difference of 14.34 in favour of the experimental group. This is an indication that the experimental group, taught using the context-based instructional approach perform better than the control group, taught using the conventional method.

Research Question Three: What are the gender differences on students' academic performance when taught biology using context-based approach?

Table 4: Mean and Standard Deviation of Male and Female Students in the Experimental Group on Biology Performance Test

EG	n	Mean Score	SD	Mean Difference
Male students	36	27.01	4.03	1.10
Female students	42	25.91	4.42	
Total	78			

Table 4 revealed that gender had no influence on students' performance in the biology test after being taught using the context-based instructional approach, the mean difference obtained is 1.10. Therefore, both male and female students benefited equally from the context-based teaching strategy.

Hypothesis 1: There is no significant interactive effect of treatment and gender on academic performance

Table 5: ANCOVA Results Obtained on Interactive Effect of Treatment and Gender on Academic Performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	8691.000 ^a	17	511.235	795.255	.000
Intercept	259580.999	1	259580.999	403792.665	.000
Pretest	81.500	10	8.150	12.678	.000
Group	3.490	1	3.490	5.429	.000
Gender	3200.000	1	3200.000	4977.778	.025
Pretest * Group	2131.475	18	118.415	7.010	.000
Pretest * Gender	134.406	17	7.906	.468	.958
Group * Gender	10.328	1	10.328	.611	.437
Pretest * Group * Gender	38.353	7	5.479	.324	.940
Error	27.000	42	27.000		
Total	294378.000	60	294378.000		
Corrected Total	8718.000	59	8718.000		

Table 5 revealed the results of an ANCOVA analysis conducted to determine the interactive effect of treatment (instructional method) and gender on students' academic performance in Biology, controlling for pretest scores. The interaction term of interest is Group * Gender, which tests whether the effect of the instructional method (context-based and conventional) on academic performance differs by gender. Since the p-value (0.437) is greater than the 0.05 significance level, the result is not statistically significant. The result indicates that there is no significant interaction effect between treatment and gender on academic performance in Biology. That is, the effectiveness of the context-based instructional approach did not differ significantly between male and female students. Therefore, the null hypothesis (H_{03}) which states that "There is no significant interaction effect of treatment and gender on students' academic performance in Biology" is not rejected ($F(1, 42) = 0.611, p =$

0.437). This indicates that both male and female students responded similarly to the instructional methods used, and gender did not influence the effect of the treatment on academic performance.

Discussion

The findings from the analysis of students' post-test scores showed that those in the Experimental Group (EG), taught using the Context-Based Instructional Approach (CBIA), outperformed their counterparts in the Control Group (CG), who were taught using the conventional method. The mean performance score for the EG was substantially higher than that of the CG, with the difference being statistically significant. This indicates that the CBIA enhanced students' academic performance in biology. This finding aligns with Bennett and Lubben (2019), Imoko, and Ajai (2015), who reported that instructional methods that connect learning to real-life contexts foster deeper understanding, improve motivation, and enhance performance in science subjects. The improved performance of the EG could be attributed to the active, student-centred nature of the CBIA, which promotes critical thinking, problem-solving, and knowledge application—skills essential for mastering biology concepts.

The ANCOVA results indicated no significant interactive effect between treatment and gender on academic performance. This suggests that the superiority of the CBIA over the conventional method in enhancing academic performance was consistent across male and female students. This aligns with the findings of Ezeudu and Obi (2023), who noted that innovative instructional strategies tend to benefit all learners regardless of gender when learning is active and participatory. This result implies that teachers can implement CBIA without concerns about gender bias in performance outcomes.

Overall, the study demonstrates that the Context-Based Instructional Approach is superior to the conventional method in improving both academic performance and retention in biology among secondary school students in Gombe Metropolis. While the method benefits both genders equally in terms of performance, it interacts with gender to influence retention, highlighting the need for gender-sensitive pedagogical planning.

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