IMPROVING ACADEMIC ACHIEVEMENT IN SENIOR SECONDARY SCHOOL BIOLOGY THROUGH ANALOGY INSTRUCTIONAL STRATEGY IN ADAMAWA STATE, NIGERIA

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Abstract
*This study investigates the effect of analogy instructional strategy on students' academic performance in senior secondary school in biology in Adamawa State, Nigeria. Two research questions were raised and two null hypotheses were formulated and tested at a 0.05 level of significance the study. Quasi-experimental design of pre-test, post-test, non-equivalent, control group design was adopted. The population of the study was 25,375 SSII biology students across five education zone of Adamawa State. A sample of 172 SSII biology students from two intact classes were purposively selected for the study. A biology Performance Test (BPT) adapted from WAEC past questions from 2020-2024 and subjected to face and content validation was used to collect data for the study. The BPT scores were subjected to K-R 21 to determine the reliability of the instrument. The reliability index of 0.83 was obtained for BPT. Data collected were analyzed using descriptive statistics of mean and standard deviation and ANCOVA was used to test the hypotheses. The findings of the study revealed that: there was a significant effect of analogy strategy and traditional method on the mean performance score of students in biology ($F_{(1, 170)} = 147.350$, $P<0.05$). There was a significant interaction effect of treatment and gender on students' performance in biology (F**$(1, 170)$**$= 6.301$, $P<0.002$). Based on the findings it was recommended that, Biology teachers should be encouraged to teach biology content using analogy instructional strategy putting gender into consideration. Government should organized workshops for biology teachers to improve their teaching effectiveness.*

Key words: Analogy Strategy, Biology Students', Gender, Performance.

Introduction

It is generally accepted that a nation's socio-economic and technological progress largely depends on the quality of education provided in its schools. This may explain why the world's developed countries have attained prominence in science and technology. A key concern in Nigeria today is assessing the effectiveness of science education across all educational levels (Oniya & Adefila, 2020). Science, being an activity- based subject, needs practical activities regularly for the ultimate achievement and

attainment of the goals of science and science education as outlined clearly in the National Policy on Education (NPE, 2013). Science and technology utilize knowledge, skills and tools to enhance human capabilities, address real-world challenges, and transform our environment. Their positive impact is evident in the progress seen in sectors such as education, transportation, agriculture, and healthcare across the globe (Isioto, Philip-Kpae & Dickso, 2017). According to a study by Abimbola, as cited in Akintola (2019), science involves critical thinking and investigation aimed at gaining a deeper understanding of the natural world. This scientific knowledge fuels innovation with the goal of improving life, making it more comfortable, safe, and livable. However, student performance in science particularly in Biology within North-East Nigeria remains unsatisfactory.

Biology is a branch of science concerned with the study of life, subdivided into, botany and zoology. Biology promotes human life and animals' betterment, and enables individuals to know more about themselves and their physical environment. However, with low performance indices of students in Senior School Certificate Examination (SSCE) in Biology particularly in Adamawa state has been a concern to stakeholders and the state government. This may be attributed to parental low level of education, poor teacher quality, ineffective methodology during lesson delivery, poor education funding and poor interest to education and these have been critical issues surrounding the North-east Nigeria (Adesoji, 2018). Examination conducted by West African Examinations Council (WAEC), for a period of three consecutive years 2022 – 2024 showed that candidates failed biology (Adamawa State Ministry of Education, 2024). The available statistics indicated that in 2022 (47.08%), 2023 (43.23%) and 2024 (48.00%) obtained credit 1-6 in Biology, (WAEC Report, 2022-2024). This unfortunate trend agitated the minds of science educators in Nigeria. Therefore, calls for an urgent reevaluation of teaching strategies used in the teaching of Biology at the secondary school level. The poor performance in Biology is not only a reflection of student capabilities but may also be indicative of deeper issues such as ineffective teaching methods, lack of adequate resources, insufficient teacher training, and low student motivation (Mohammed & Joda, 2017). What could be responsible for cause of poor performance of students' in Biology? There is a need to explore innovative pedagogical approaches, such as analogies strategy, to stimulate interest and improve understanding of biology as a subject from what is familiar.

Analogy can be described as comparison between a familiar phenomenon or concept to students and unfamiliar concepts in science which the facilitators may help the students' to acquire through learning. The aim of analogy is to transfer ideas from a familiar concept to an unfamiliar one (Nworgu & Otum, 2013). Analogy as an instructional strategy may assist students to build understandings either through hands-on interactions with various educational resources or describing things that are not known in terms of things that are known, in their resemblance so that understanding can be achieved (Abimbola, 2013; Richland & Simms, 2015). This may enhance students' performance by making conceptual links with familiar objects, scenarios or events to understand present biological concepts. Akintola (2019) and Oniya

(2020) in their various studies showed a significant difference of academic achievements of students taught Biology using analogies strategy better than the control group irrespective of gender.

Gender is another factor which may affect students' academic performances in Biology.

WHO (2011) asserts that social and cultural structures assign different expectations and responsibilities to males and females, shaping their understanding of appropriate behaviors, values, and ways of interacting with each other across various settings such as the home, community and schools. There is a general belief that men perform better than women especially in science based subjects like Physics and Mathematics while female perform better than male in subject like Biology. Sakiyo and Kala (2018) opined that, biology students have better academic achievement irrespective of gender in science, technology, society, guided-inquiry and analogy teaching methods. Gender, as a concept, has captured the interest of science educators in Nigeria, especially at gender equity and inclusion is being emphasized in part of North-east Nigeria. Eze and Okoro (2010) revealed that males outperform females in physics. On the contrary, Mohammed (2020) found a significant difference of gender on the students' biology outcomes when using analogy strategy. These contradictory findings have prompted the need to investigate whether effective use of analogy strategy would improve students' learning outcome in biology in Adamawa state.

Statement of the problems

Students' academic achievements in biology have been declining over the years in the North-east Nigeria. The poor students' learning outcome in biology may be linked to abstract concepts used in respiratory system, skeleton system, genetics and circulatory system among others in teaching biology. Joda (2024) observed that biology education provided by Nigerian schools is more examination oriented than of life practical value, which results to poor performance of students.

Many reasons may account for students' poor academic performance in science based subjects as reported by different researchers. Oviawe, Ezeji and Uwameiye (2015); Abkpa and Iji (2011) identified poor teaching instructional strategy; inadequate instructional resources, lack of confidence in the subject; poor learning physical environment (Olunloye, 2010) as reasons for students under performance. Aduda (2003) noted that Nigerians have negative attitude towards sciences and vocational subjects as compared to arts subjects. This ugly trend of high failure rate in biology in the North-east region is a national disaster which should be managed and controlled. To overcome this problem, teachers need to adopt innovative teaching strategies which may improve students' performance in biology. It is against this background that this study is design to find out whether analogy strategy would improve students' performance in biology.

Purpose of the Study

The purpose of the study is to investigate the effect of analogy instructional strategy on students' performance in senior secondary school in biology in Adamawa State, Nigeria. Specifically, the study sort to:

1. Compare students' academic performance in biology using the analogy instructional strategy and

traditional teaching method in Adamawa state.

2. Determine the influence of gender on students' academic performance when taught biology with analogy strategy.

Research Questions

The research questions were used to guide the research;

1. What are the pretest and posttest mean performance score of students taught using the analogy instructional strategy and traditional teaching method in biology in Adamawa state?
2. What are pretest and posttest mean performance score of students taught using analogy instructional strategy by gender in biology in Adamawa state?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study:

H01: There is no significant effect between academic performance of students taught using the analogy instructional strategy and traditional method in biology in Adamawa state.

H02: There is no significant difference between academic performance of male and female students taught using analogy instructional strategy in biology in Adamawa state.

Methodology

This study adopted pre-test, post-test, non-equivalent, control group, Quasi-experimental research design. The area of the study was Adamawa State which is a state in North-East Nigeria. The population of this study comprised the entire twenty-five thousand three hundred and seventy-five (25,375) SSII students consisting of fifteen thousand five hundred and seventy two (15,572) male students and Nine thousand eight hundred and three (9,803) female students offering biology in all the 384 public Schools in Adamawa state. The sample of the study was 172 students from two schools in Adamawa state using simple random sampling techniques. A multistage sampling technique was used and Yola education zone was selected out of five education zone using lucky dip technique. Then, two schools within Yola zone were selected through simple random sampling by balloting method. The first class picked from the first selected school was assigned as experimental group and the second picked class from the second selected school was assigned as control group. A 50 items Biology Performance Test (BPT) adopted from WAEC past question papers 2022-2024 was used as instrument for data collection. The instrument had four (A-D) options with one correct answer and three distracters. The instrument was subjected to face and content validity by two experts in the department of Environmental and Life Sciences Education, Modibbo Adama University, Yola and one senior master from Government Day Senior Secondary School Jambutu (GDSS) Jimeta Yola. The instrument was trial tested on 65 SSII Biology students from GDSS Gwadabawa, Jimeta Yola a non-participating school to obtained the internal consistency of the instrument. Split-half method was utilized and the coefficient was computed using Kuder-Richardson (KR-21) formula and the reliability coefficient index of 0.83 was obtained. The data

collected using Biology Performance Test. Descriptive statistics of mean and standard deviation were used to answer research questions and Analysis of Covariance (ANCOVA) was used at a 0.05 level of significance**.** If the P-value ≤ 0.05 then reject the null hypotheses or otherwise do not reject.

Results

Research Question One: What are the pretest and posttest mean performance score of students taught using the analogy instructional strategy and traditional teaching method in biology in Adamawa state?

Table 1. Descriptive Analysis of Students' Pretest and Posttest Scores of Analogy Instructional Strategy and Traditional Teaching Method

		Pretest		Posttest		Mean Difference
Methods	**N**	$\bar{X}$	**SD**	$\bar{X}$	**SD**	$\overline{X}$
Analogy	89	16.12	9.15	35.21	10.63	19.09
Lecture	83	15.34	7.63	27.30	3.04	11.96

The descriptive statistics on Table 1 shows that 172 students participated in the study. The pret-test mean score of students taught biology with analogy instructional strategy is 16.12, standard deviation of 9.15 while the post-test mean score of students taught biology with analogy instructional strategy is 35.2, standard deviation of 10.63 with mean score difference of 19.09. Also, the pre-test mean score of students taught biology with traditional teaching method is 15.34 with a standard deviation of 7.63 while the post-test mean score of students taught biology with traditional teaching method is 27.30 with a standard deviation of 3.04 with a mean score difference of 11.96. The mean score difference between pre-test and post-test is higher in analogy instructional strategy than traditional teaching method with 7.13. This implies that, there is a mean achievement score difference between the two groups. And the two teaching methods were important at improving students' academic achievement at different levels.

Research Question 2: What are pretest and posttest mean performance score of students taught using analogy instructional strategy by gender in biology in Adamawa state?

Table 2. Descriptive Analysis of Male and Female Mean Scores taught Using the Analogy Instructional Strategy

			Pre-test		Post-test		Mean Difference
Methods	**Gender**	**N**	$\bar{X}$	**SD**	$\bar{X}$	**SD**	$\overline{X}$
Analogy	M	47	17.13	4.87	21.62	7.01	4.49

F	42	16.72	6.13	23.54	6.49	6.82

The descriptive statistics on Table 2 shows that 47 male and 42 female students participated in the study. The pre-test mean score of male 17.13 with standard deviation 4.87 taught biology using analogy while the post-test mean score of male 21.62, standard deviation 7.01 taught biology with analogy strategy with mean score difference of 4.49. The pre-test mean score of female 16.72 with standard deviation 6.13 students taught biology using analogy instructional strategy while the post-test mean score of female 23.54 with standard deviation 6.49 students taught biology using analogy instructional method with mean score difference of 6.82. The performance difference between pre-test and post-test score is higher in female than in male when taught analogy instructional strategy.

Hypothesis One: H01: There is no significant effect between academic performance of students taught using the analogy instructional strategy and traditional method in biology in Adamawa state.

Table 3: ANCOVA of the mean Performance scores of students in taught Biology using Analogy Instructional Strategy and those taught using Lecture Method.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	13611.058a	2	5805.529	216.216	.000
Intercept	2289.294	1	2289.294	69.416	.000
Pretest	2343.697	1	2343.697	84.461	.000
Methods	4657.612	1	4657.612	147.350	.000
Error	3545.164	170	12.738		
Total	325243.000	172			
Corrected Total	16157.23	171			

The result in Table 3 shows that an F-ratio of 147.350 with associated probability value of 0.00 was obtained with regards to the mean performance score of students taught Biology using analogy instructional strategy and traditional method. Since the associated probability (0.00) is less than 0.05 set at level of significance, therefore, the null hypothesis which states that, no significant effect in the performance of students' taught biology analogy instructional strategy and traditional teaching method is rejected.

Hypothesis Two: There is no significant difference between academic performance of male and female students taught using analogy instructional strategy in biology in Adamawa state.

Table 4: ANCOVA of the mean Performance scores of Male and Female Students in taught Biology using Analogy Instructional Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1267. 105a	2	4052.122	205.325	.002
Intercept	1276.290	1	2287.294	57.237	.000
Pretest	2142.645	1	2041.542	88.200	.000
Gender*Analogy	352.561	1	350.334	6.301	.002
Error	3324.063	170	10.547		
Total	314043.031	172			
Corrected Total	16156.24	171			

From table 4, it can also be seen that F-ratio of 6.301 with associated probability value of 0.003 was obtained with regards to the mean performance score of gender taught biology with analogy instructional, P=0.002. Since the P< 0.05 level of significant, the null hypothesis was rejected.

Finds of the Study

1. There is a significant effect in the performance of biology students taught biology with analogy instructional strategy and traditional teaching method.
2. There is significant effect of male and female students taught biology with analogy instructional strategy.

Discussion of findings

From The findings of this study, there is a significant difference in the mean performance scores of biology students taught biology with analogy strategy and traditional method. This result is in line with Adioha and Innocent (2024) who found a significant difference in achievement scores of Biology students taught with analogy and conventional teaching method, with those taught under analogy having a higher mean gain. Jeynes (2020) investigate the effects of analogy-based instruction strategy on Biology students' conceptual understanding of genetics in Nairobi, Kenya. The study indicated that the experimental group significantly outperformed the control group in genetic concepts. On the contrary, Yusuf (2022) show that guided inquiry is better than analogy strategy in improving students' performance in biology. Similarly, Abubakar (2022) revealed that guided inquiry yielded the highest retention performance scores than analogy-based instruction in Biology. This implies that analogy instructional strategy helped students relate abstract biological concepts to familiar real- life situations, which enhanced comprehension and improved students' academic performance. This finding highlights the effectiveness of analogies in promoting comprehension. By bridging the gap between prior knowledge and new content, analogy instruction supports meaningful learning and deepens conceptual understanding, which translates into improved academic achievement. Therefore, the analogy strategy offers a more interactive and cognitively supportive approach that enhances learning outcomes in biology

This study also shows a significant effect male and female students taught Biology with analogy strategy. This result agrees with Eze and Okoro (2010) who indicated that male outperform the female in physics. Similarly, Olowe (2010) found that females achieved higher than males in the science subjects. In the same vein, Gongdon (2016) revealed a significant difference between the posttest mean scores of gender when taught using analogies in favour of the male students. On the contrary, Adioha and Innocent (2024) show no significant difference in the mean scores of male and female Biology students when exposed to analogy strategy. Mohammed (2020) found no significant effect of gender on the students' biology learning outcomes when taught using analogy strategy. Similarly, Okoronka and Wada (2014) found that gender had no significant main effect on students' performance in physics when taught with analogy teaching strategy. This implies that the effectiveness of the analogy instructional strategy varied between male and female students, with one gender benefiting more from the approach. Indicating that gender effects may be context-dependent, influenced by factors such as teaching approach, subject matter, and learner characteristics. This suggests that the gender-related impact of analogy instruction may not be uniform and could be influenced by learner preferences, prior knowledge, and engagement levels. Nonetheless, the significant interaction effect observed in this study indicates that gender can moderate the effectiveness of analogy instruction, reinforcing the importance of considering gender differences in instructional planning for optimal learning outcomes.

Conclusion

Based on the findings of this study, students' academic performance improved at different levels when taught Biology with analogy teaching method having a higher mean gain, this implies that teaching Biology with analogy affects students' performance. There is a significant difference in the performance scores of male and female Biology students when exposed to analogy strategy. The observed difference between male and female was due to female students' were more in interaction with peers, communicating and relating with their facilitator and their male counterpart.

Recommendations

The following recommendations were made as:

1. Biology teachers in Adamawa state should be encouraged to teach biology content with analogy instructional strategy putting gender into consideration.
2. Government should organized workshops, seminars and workshops for biology teachers to improve their teaching effectiveness.

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