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Effect of Artificial Intelligence in Cooperative Learning on Biology Students' Performance in Rivers State, Nigeria

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Abstract

This study investigated the effect of artificial intelligence (AI)-supported cooperative learning on the academic performance of secondary school Biology students in Port Harcourt Local Government Area, Rivers State, Nigeria. A quasi-experimental pretest-posttest design was adopted. The study involved 92 Biology students drawn from two purposively selected co-educational public secondary schools. Students in the experimental group were taught using an AI-supported cooperative learning strategy, specifically the think-pair-share approach, while those in the control group were taught using the conventional lecture method. Data were collected using a Biology Performance Test (BPT), which was validated by two experts and yielded a reliability coefficient of 0.76 using the Kuder-Richardson 20 (KR-20) procedure. Two research questions and two null hypotheses guided the study. Data were analysed using mean, standard deviation, and analysis of covariance (ANCOVA) at the 0.05 level of significance. The findings indicated a statistically significant effect of AI-supported cooperative learning on students' academic performance in Biology compared with the lecture method ($F = 11.530$, $p < .05$, partial $\eta^2 = .089$). Although female students recorded a slightly higher mean gain than male students under the AI-supported cooperative learning strategy, the analysis revealed no statistically significant difference in performance attributable to gender ($p > .05$). The study concludes that AI-supported cooperative learning can enhance students' academic performance in Biology and provides a learner-centred approach that promotes active participation and collaborative learning. Biology teachers are therefore encouraged to integrate appropriately designed AI-supported cooperative learning activities into classroom instruction.

Keywords: Artificial Intelligence, Cooperative, Learning and Performance

Introduction

Biology Education prepares students for further studies in the field of science-related courses, especially at higher institutions. The knowledge of Biology is necessary for national growth and development. Nevertheless, the adoption of wrong methods by Biology teachers during the classroom process has led to the poor performance of students in external examinations. Therefore, in helping students to have a good understanding of the subject, Artificial Intelligence (AI) in cooperative learning was employed in the study.

Learning in the era of emerging technology has changed the way students learn. According to Kelvin (2020), learning requires an active process which includes students' participation, engagement and involvement. The teaching-learning environment has changed from teacher-centred to learner-centred, using digital tools to enhance effective learning. One such tool is artificial intelligence, which has to do with the use of computer machines that can perform tasks that technically require human understanding, especially in teaching and learning. AI has numerous applications in education. It has what it takes to improve education, making teaching and learning easy by

improving overall teacher productivity. The use of artificial intelligence (AI) in the classroom guarantees powerful potential for science and technological education. Millions of students use AI on different platforms, both on YouTube and WhatsApp. Students access educational materials via online AI platforms from any location in the world.

In recent developments, various AI learning tools have been increasingly utilised in academic research. In conducting academic research. According to Finik (2022), artificial intelligence instruction with various illustrations can be used to present content in ways that are not possible within the confines of the traditional method. Therefore, this study used AI to support cooperative learning in the experimental group, while the AI instructional package was not used in the control group, where the lecture method was used. It is on this note that the aim of science education is how we can achieve the aim of science education, particularly at the secondary school level. especially at the secondary school level. The teaching of biology at the secondary school will call for rapt attention, with special emphasis on cooperative learning, which encourages the participation of students in the teaching and learning environment. Cooperative learning involves learning in groups. It encourages positive interaction among group members in terms of thinking and sharing possible answers to a question posed by a teacher. It also emphasises working together to maximise each other's shared knowledge. According to Don (2020), students in cooperative learning settings improve in knowledge. Based on these findings, the paper studied the effect of artificial intelligence in cooperative learning on biology students' interest and performance in Rivers State.

Poor performance of biology students in examinations in Rivers State and in the Port Harcourt Local Government Area in particular has remained worrisome to parents and educators. The use of inappropriate instructional strategies by biology teachers has been widely reported as one of the major factors contributing to the poor performance of students (Esogwa, 2021). These inappropriate instructional strategies do not encourage interest in learning biology concepts; rather, students struggle to memorise concepts, only to forget them shortly afterwards. Preliminary findings show that being unable to expose students to practical exercises has been one of the factors that lead to poor performance in the subject (Ehirim, 2020).

The method of presenting the content may contribute to the problem of poor performance in biology in the West African Examinations Council (WAEC). This ugly situation prompted Okebukola (2014) to frown at the quality of science education in Nigeria, describing it as way below the mark. Sequel to these findings, this paper investigated the effect of artificial intelligence in cooperative learning on biology students' interest and performance in Rivers State.

The study focused on the effect of artificial intelligence in cooperative learning on Biology students' performance in Rivers State. Specifically, the objectives of the study are to:

1. ascertain the academic performance of students taught Biology using AI-based cooperative learning
2. ascertain the academic performance of male and female students taught Biology using AI-based cooperative learning

The following research questions guided the study.

1. What is the academic performance of students taught Biology using AI-based cooperative learning and the lecture method?
2. What is the academic performance of male and female students taught Biology using AI-based cooperative learning?

The following hypotheses were tested at the 0.05 level of significance:

H₀₁: There is no significant difference in the academic performance of students taught Biology using AI-based cooperative learning and lecture method.

H₀₂: There is no significant difference in the academic performance of male and female students taught Biology using AI-based cooperative learning

Methodology

The study adopted a quasi-experimental pretest–posttest design involving experimental and control groups. The design was considered appropriate because intact classes were used, making random assignment of individual students to treatment conditions impracticable. The experimental group received instruction through an artificial intelligence (AI)-supported cooperative learning strategy, while the control group was taught using the conventional lecture method. The participants comprised 92 Biology students drawn from two co-educational public secondary schools in Port Harcourt Local Government Area, Rivers State, Nigeria. The two schools were purposively selected for participation in the study. The experimental group consisted of 44 students, while the control group comprised 48 students.

The experimental group was taught Biology using an AI-supported cooperative learning strategy based on the think-pair-share instructional approach. The strategy was designed to facilitate students' active participation, interaction, discussion, and collaborative construction of knowledge, with AI-supported resources incorporated into the learning activities. The control group was taught the same Biology content using the conventional lecture method. Thus, the principal difference between the two groups was the instructional strategy employed during the intervention. Data were collected using the Biology Performance Test (BPT). The instrument was subjected to validation by two experts to establish its appropriateness for measuring students' performance in Biology. The reliability of the instrument was determined using the Kuder–Richardson 20 (KR-20) procedure, which yielded a reliability coefficient of 0.76. The coefficient was considered adequate for the purpose of the study.

A pretest was administered to the students in both the experimental and control groups before the commencement of the instructional intervention. The experimental group was subsequently taught using AI-supported cooperative learning, whereas the control group received instruction through the lecture method. Following the intervention, the Biology Performance Test was administered as a posttest to determine changes in students' performance. The data obtained from the study were analysed using descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions, while analysis of covariance (ANCOVA) was employed to test the null hypotheses at the 0.05 level of significance. ANCOVA was used to account for differences in students' pretest scores when comparing posttest performance between the instructional groups. The effect of gender on students' performance under the AI-supported cooperative learning strategy was also examined.

Results

Table 1: Mean and Standard deviation of pre-test and post-test performance of students using AI in Cooperative learning (AI-CL) and lecture method

Group	n	Pretest	SD	Posttest	SD	Mean Difference
AI-CL	44	69.80	3.57	75.50	7.20	5.7
LM	48	64.60	4.52	67.80	5.60	3.2

In Table 1, students taught Biology using AI in cooperative learning had a pre-test mean of 69.80 and a post-test mean of 75.50. Students in the control group taught using the lecture method had a pre-test mean score of 64.60 and a post-test mean score of 67.80. Looking at the mean gain, the result revealed that the mean gain for students in the experimental group was 5.7, while for the control group it was 3.2. This means that AI in cooperative learning significantly improved the academic performance of students in Biology more than the lecture method.

Table 2: Mean and Standard deviation of pretest and posttest of male and female students taught using AI-based cooperative learning

Group	Gender	Pretest	SD	Posttestn	SD	Mean Gain
AI-CL	Male	38.62	3.03	62.22	26	5.01
	Female	43.12	4.88	66.90	29	6.33

From the results in Table 2, it was also clear that male students taught Biology using the AI-cooperative learning strategy had pretest and posttest mean of 38.62 and 62.22, respectively, resulting in a mean gain of 23.60, while female students taught with the same strategy had pretest and posttest mean of 43.12 and 66.90, respectively, which

implies a mean gain of 23.78. AI-cooperative learning strategy enhanced the performance of female students in Biology more than male students.

Table 3 Analysis of Covariance of mean academic Performance of students taught Biology using AI-Cooperative learning and lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2489.658 ^a	2	1244.829	7.148	.001	.108
Intercept	5700.520	1	5700.520	32.732	.000	.217
Pretest	176.873	1	176.873	1.016	.316	.009
Group	2007.991	1	2007.991	11.530	.001	.089
Error	20550.789	90	174.159			
Total	523018.000	92				
Corrected Total	23040.446	91				

a. R Squared = .108 (Adjusted R Squared = .093)

The result in Table 4 revealed an $F_{1,90} = 11.530$, partial eta squared = 0.089 ($p < 0.05$) for the instructional strategy on students' performance in Biology. The hypothesis is therefore rejected. This indicated that there is a significant effect of AI-cooperative learning on the mean performance score of students in Biology, with a partial eta squared value showing that the strategy has a large effect on students' performance in Biology.

Table 4: Analysis of Covariance of Performance of male and female students taught Biology using AI-cooperative learning

Source	SS	Df	MS	F	Sig.
Corrected Model	99.649 ^a	2	24.91	.518	.723
Intercept	2493.33	1	2493.34	51.86	.000
Pre-interest	38.74	1	38.72	.81	.372
Group	22.32	1	22.32	.46	.497
Gender	4.68	1	4.67	.09	.756
Group * Gender	39.22	1	39.22	.82	.368
Error	5144.27	54	48.08		
Total	57145.00	55			
Corrected Total	5243.92	53			

Table 4 showed the Summary of ANCOVA on the performance of male and female students taught Biology using the AI-cooperative learning strategy. There was no significant difference between the performance of male and female students taught Biology using the AI-cooperative learning strategy ($F_{1, 54} = .09$, $p = .756$). The null hypothesis was accepted at the 0.05 significance level.

Discussion

In Table 1, it was observed that AI in cooperative learning had a significant effect on the performance of students in Biology. Table 4 showed that there was a significant difference between the mean performances of students taught Biology using AI in cooperative learning. This finding is in agreement with the study of Don (2020), who found that AI-enabled cooperative learning affected students' academic performance more than the lecture method. However, the present finding agrees with the earlier findings of Bello (2022), who found that AI in cooperative learning has a more significant effect on students' academic performance than the conventional method.

Results in Table 2, it was observed that the AI-cooperative learning strategy had a greater effect on the performance of female students in Biology than male students. Table 4 showed that there was no significant difference between the performance of male and female students taught Biology using the AI-cooperative learning strategy. This finding is in agreement with the study of Pedro (2020), who found that being a male or female does not affect students' performance when taught using the same teaching method. However, the present finding contradicts the earlier

findings of Bello (2016), who found that gender has a significant effect on students' performance when taught using the same interactive teaching strategy.

Conclusion

The study concludes that artificial intelligence (AI)-supported cooperative learning has a significant positive effect on the academic performance of secondary school students in Biology compared with the conventional lecture method. The findings demonstrate that integrating AI into cooperative learning can provide a more learner-centred instructional environment that promotes students' active participation, interaction, and engagement in the learning process. Although female students recorded a slightly higher mean gain than their male counterparts under the AI-supported cooperative learning strategy, the difference in performance between male and female students was not statistically significant. This suggests that the effectiveness of AI-supported cooperative learning in improving Biology students' performance is not significantly dependent on gender. The findings support the integration of AI-supported cooperative learning into Biology instruction as an alternative to predominantly lecture-based teaching. Appropriate use of AI within cooperative learning can contribute to improved academic performance and provide Biology students with opportunities for more active and collaborative learning.

Recommendations

The study recommended that:

1. Biology teachers should be encouraged to adopt the use of artificial intelligence (AI) in cooperative learning settings to improve students' academic performance in Biology
2. Government should organize seminars for Biology teachers on the use of artificial intelligence (AI) in cooperative learning during teaching.

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