

INTEGRATION ON SECONDARY EXAMINING THE EFFECT OF ARTIFICIAL INTELLIGENCE SCHOOL STUDENTS' ACADEMIC PERFORMANCE AND ENGAGEMENT IN BIOLOGY IN TARABA STATE.

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ABSTRACT

This study investigated the effect of artificial intelligence on students' academic performance and engagement in Biology. Two research questions and two hypotheses guided the study. A Quasi experimental design specifically, the non-equivalent control group type was adopted for the study. One hundred and forty three (143) SS11 students drawn using simple random sampling was used a sample for the study. The experimental group was taught using artificial intelligence and the control group was taught using conventional method. The treatment lasted for eight weeks. Instrument for data collection was Biology performance Test (BPT) and Biology Engagement Questionnaire (BEQ), were used for pre-test and post-test. Mean and Standard Deviation was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level significance. The findings of the study revealed that there was a significant main effect for instructional method on mean achievement of score of students in Biology F(1,143)=200.332, P <. 000, there was a statistical main difference in the engagement ratings of students in Biology. In line with the findings, the educational implications of the findings were highlighted and recommendations were equally proffered amongst others artificial intelligence proved effective in teaching Biology and enhancing students' engagement in the lesson, teachers should strive to use this method more often, Biology teachers should be trained on how to involve students more during instructions (that is, how to use Artificial Intelligence) so as to facilitate students' performance and engagement in the lesson. This could be achieved through seminars and workshops for teachers in secondary schools.

INTRODUCTION

The rate of awareness and quest towards digitalization in every sphere of life (political, social, economic and education) is increasing rapidly, this is because every country desires to be regarded as a developed country. The introduction of artificial intelligence into the field of science education (Biology inclusive) is driving a fundamental shift in the approaches of teaching and educational practice that are presently in use. Biology is a natural science that studies living things, life processes and inter-relationship between organisms and their immediate environment. According to Umoru and Itodo (2018) Biology as study of living things is central to many disciplines such as Medicine, Pharmacy, Nursing, Agriculture, among others. It is worthy to note that, Biology is compulsory subject that no student intending to study any of the aforementioned courses can do without a credit pass in Biology. Serge, e.tal (2019) pointed out that the teaching of Biology is significant because it equips students to comprehend the world around them as well as grant them the necessary skills to build a progressive society. In same line, Umoru and Itodo (2018) in another study claimed that the study of Biology provides platform for teaching students to develop abilities and apply Biological concepts and principles in solving everyday life problems.

Despite the importance of Biology to man and society enumerated above, students' performance and engagement in the subject continues to retrogress as a result of teachers over reliance on the traditional method which has not yielded any positive progress. Owen (2016) posited that science Education (Biology inclusive) is revolving away from memorization, recognition and regurgitation of scientific concepts and shifting towards actively immersing students in discovering and knowing meaning of scientific concepts/events in their daily lives. According to Ainaku, Onwu and Eze (2018) the conventional method is a unidirectional method of teaching hereby learners are expected to listen to the teacher as he/she defines or explains, dictates notes with little or no contribution from the student in the learning process. The authors further buttressed that Biology is inquiry in nature and actively oriented as such will perform and engage well if they are exposed to practical activities as well as the practical aspect. Hence, the need to introduce innovative strategies such as artificial intelligence which allow students to learn more effectively and improve their academic performance and engagement through personalized learning which is tailored towards

students' individual needs. Academic performance as defined by Okwara and Upu (2017) is the exhibition of knowledge attained or skills developed by students in subjects as determined by test scores of students assigned by teachers. In another assertion by Tukura, etal (2020) described performance as a composite of students' behavior underlying several abilities which include previous knowledge, interest, attitude and engagement among others. The concept of students' engagement is very crucial in the context of education especially in teaching and learning process. Newmman in Tuyishime and Tukahabwa (2020) defined students' engagement in learning as behavioral engagement (level of efforts that is dedicated to learning) and as emotional engagement (interest); going by this definition, students engagement in learning process is considered dimensional construct. The relationship between students' academic performance and engagement reveals positive relationship as noted by GUNU (2014) Lee, Song and Hong (2019) emphasized that students' engagement is an antecedent of students' performance. The authors further argued that the more students are engaged in the learning process, the better the performance irrespective of the subject. Biology is a complex subject that requires students to understand a great level of information and interactions between living organisms and their environment which the use of artificial intelligence can help. Artificial intelligence tools can help students gain a deeper understanding of these concepts by providing interactive visualizations, simulations and other Virtual Reality (VR) simulations can provide students the opportunity to explore complex biological systems in a three dimensional environment, allowing them to understand the spatial relationships between structure and organisms better Chang etal (2018).

Artificial Intelligence refers to simulation of human intelligence in machines that are programmed to think and learn like humans. The goal of artificial intelligence is to develop systems that can perform tasks that typically require human intelligence such as perception, speech recognition, decision making and language translation. The application of artificial intelligence in the field of education has recently generated a lot of interest in todays' world which is characterized by rapid development (Melo, 2022, Hanysha, 2023 and Alfalah, 2023). The authors further highlighted the importance of artificial intelligence as a device that can help students develop critical-thinking, problem solving, creativity and creating environment where students can work together to

solve problems and develop projects. The need for the use of artificial intelligence is necessitated according to Salido (2023) that a paradigm shift has emerged in the approach that is taken to both teaching and learning as a result of the incorporation of artificial intelligence in educational environment, This is a welcome development in the classroom settings as the previous pedagogical method (traditional) used has not changed and the narrative consistent poor performance and active participation/engagement. In Biology as observed by Joda and Umoru, (2022). In the same vein, Chief Examiners' Report (2020-2023) lamented on the underperformance of students in Biology in West African Senior School Certificate Examination which has become worrisome and calls for urgent attention. Francesccui and Rohani (2018) reported a positive association between students' engagement and academic success using artificial intelligence to learn. Selvam (2024) in another study demonstrated that artificial intelligence supported systems take account of both cognitive and affective aspects of students' engagement and performance.

However, Kaleido, Robert and Frank (2024) posited that there is a potential risk of over reliance on artificial intelligence technologies, leading to a passive learning experience for the students. It is on this note that the researchers in this study, sought to find the effectiveness of artificial intelligence on students' academic performance and engagement in Biology in Taraba State.

STATEMENT OF THE PROBLEM

The poor performance of students in Biology external examination such as West African Senior School Certificate Examination (WASSCE), National Examination Council (NECO) among others is becoming worrisome on a daily basis. Science learning (Biology inclusive) is expected to produce individuals that are capable of solving immediate problems as well as that of the society. Biology educators and educational stakeholders are continuously exploring ways to alleviate this ugly situation of underperformance in the subject and the situation remain unchanged which has created a need for more effective method. Thus, it has become imperative to explore alternative method of addressing this situation. A lot of studies have been carried on Artificial Intelligence but there seems to be no empirical evidence so far of such study conducted in Taraba state on the effect of Artificial Intelligence on students' performance and engagement. The problem of this study is

therefore, posed as could Artificial Intelligence improve students' performance and engagement in Biology? Hence, the need for the study.

The specific objectives of this study were to;

Research Objectives

- Determine the effect of artificial intelligence integration on students' academic performance in Biology
- Examine the effect of artificial intelligence integration on students' engagement in Biology

Research Questions

- What are the mean performance scores of students exposed artificial intelligence tools compared to those taught those taught using Conventional method?
- What are the mean ratings of students' engagement exposed artificial intelligence tools compared to those taught those taught using Conventional method?

Research Hypotheses

- There are no significant differences in the mean performance scores of students exposed to artificial intelligence tools and those taught using Conventional method.
- There are no significant differences in the mean rating of students' engagement exposed to artificial intelligence tools and those taught those taught using Conventional method.

METHODOLOGY

Quasi-experimental design was employed in this study to determine the level of performance and engagement of students of Senior Secondary school students in Biology in Taraba State. Specifically, a pre-test post-test non-equivalent control group type. The population of the study consists of all Government owned senior Secondary School made up of 1570, SS2 secondary school students in Northern Education Zone of Taraba State. A sample size of 143 was drawn from the entire population. The instrument which was 40 made multiple choice questions were developed from the Biology syllabus. The instruments were given to three (3) specialists; two from the Science Education Department and one from Department of Measurement and Evaluation. Forty students were trial tested in Government Secondary

School, Numan which was outside the study area. Pearson Product Moment Correlation (PPCM) formula was used to determine the reliability co-efficient of the instrument which gave a co-efficient value of 0.97.Before the commencement of treatment with the two groups; the researchers administered the instrument as a pre-test. The study lasted for 8 weeks. Thus, the first week was for administration of the instrument while the actual study lasted for six (6) weeks. At the end of all the treatment, the researchers administered the instrument again to the students with the help of research assistants. Mean and Standard deviation were used in answering the research questions while Analysis of Co-variance was used to test the hypotheses

RESULTS

Research Question one: What are the mean performance scores of students exposed artificial intelligence tools compared to those taught using Conventional method? The pre-test and post-test scores of students were analyzed to answer the research questions one to two as shown on Tables 1-4

Table 1: Mean (X) and Standard Deviation (SD) of students' performance scores in Biology.

1						
Group	Ν	Pre-Test	S.D	Post-Test	S.D	Gain Score
Experimental	71	10.05	4.15	24.27	3.44	13.69
Control	72	8.36	3.31	15.42	3.58	7.06

The data on students' performance in Table 1 revealed that students taught Biology using Artificial Intelligence had a gain score ofg13.69, while their counterpart taught using conventional method had a gain score of 7.06

Research Question Two: What are the mean ratings of students' engagement exposed artificial intelligence tools compared to those taught using Conventional method?

Table:2 Mean (X) and Standard Deviation (S.D) students engagement ratings in Biology

J-	33					
Group	Ν	Pre-Eng	S.D	Post Eng	S.D	Gain
score						
Experimental	71	24.27	3.44	24.45	3.45	0.18
Control	72	15.42	3.58	15.56	3.64	0.14

The data in table 2revealed that students' engagement taught Biology using Artificial intelligence had a mean rating of 24.45 and a gain score of 0.18, while their counterparts taught Biology using conventional method had a mean rating of 15.56 and had a gain score of 0.14.

Hypothesis Testing

Table: 3 Analysis of Co-variance of students' Mean Performance score in Biology.

Sources of Variation	Sum of Squares	Df	Mean Square	F S	ig D	ecision
Corrected Model	3190.300	4	797.575	81.554	.000	Sig
Intercept	4695.719	1	4695.719	480.148	.000	Šig
Pre-test	277.652	1	277.652	28.391	.000	Sig
Method	1959.192	1	1959.192	200.332	.000	Sig
Gender	.167	1	.167	.896	.000	Not Sig
Method x Gender	45. 878	1	45.878	4.691	.000	Sig
Error	1349.602	138	9.780			
Total	60665.000	143				
Corrected Total	4539. 902	142				

a R .Squared=.703(adjusted R Squared=.694)

Data in performance Table 3 showed that there is significant effect of instructional strategy on students' in Biology f(1, 143) = 200.332 P < .000. The null hypothesis was therefore rejected.

Table: 3 Analysis of Co-variance of students' Engagement ratings in Biology.

Sources of Variati	on Sum of Squares	Df	Mean Square	F	Sig	Decision
Corrected Model	2934.811	4	978.270	85.787	.000	Sig
Intercept	53077.181	1	53077.181	4654.49	.000	Sig
Method	2886.135	1	2886.135	253.093	.000	Sig
Gender	25.548	1	25.548	2.240	.137	Not Sig
Method x Gender	r 84.022	1	84.022	7.368	.007	Not Sig
Error	1585.0777	139	11.403			
Total	61560.000	143				
Corrected Total	4519.888	142				

A R Squared=.649(Adjusted R Squared=.642)

Data in Table 4 showed there is significant effect of instructional strategy on the engagement ratings in Biology f(1,143)=253,093, P< .000.The null hypothesis is thus rejected

Discussion of Results

Artificial intelligence was superior to the conventional method in facilitating students' performance and engagement in Biology. The test of hypothesis showed that instructional strategy is a significant factor in

the mean performance scores of students in Biology. Artificial intelligence was probably effective because the instructions were characterized by student's involvement, thereby capturing the students' interest and maximizing comprehension of subject matter. The students also find it easier to learn ask questions and learn from their colleagues. These findings are in line with the findings of Melo, 2022, Hanysha, 2023 and Alfalah, 2023, who reported that artificial intelligence as a device that can help students develop critical-thinking, problem solving, creativity and creating environment where students can work together to solve problems and develop projects.

The results of the study showed that students taught Biology using artificial intelligence had higher engagement ratings in Biology than their counterparts taught using conventional method. The difference was however, no statistically significant. The apparent difference in the engagement might be as a result of the use of artificial intelligence where all students had equal chances to learn and construct their knowledge with the accompanying interactive exchange of information with peers unlike the situation where teachers just give information. This finding is in line with that of Selvam (2024) who reported in a study demonstrated that artificial intelligence supported systems take account of both cognitive and affective aspects of students' engagement and performance. However, the findings differed from the findings of Kaleido, Robert and Frank (2024) which stated that there is a potential risk of over reliance on artificial intelligence technologies, leading to a passive learning experience for the students.

CONCLUSION

The study revealed that:

- Students taught Biology using artificial Intelligence performed better than their counterparts, taught using the conventional method.
- Students taught Biology using artificial Intelligence had higher engagement ratings than their counterparts, taught using conventional method.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made;

* In view of the fact that artificial intelligence proved effective in teaching Biology and enhancing students' engagement in the lesson, teachers should strive to use this method more often.

* Biology teachers should be trained on how to involve students more during instructions (that is, how to use Artificial Intelligence) so as to facilitate students' performance and engagement in the lesson. This could be achieved through seminars and workshops for teachers in secondary schools.

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