Effect of E-Learning Method on Academic Achievement of Senior Secondary School Students in Biology in Aguata Education Zone, Anambra State

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Abstract

The study investigated the effect of e-learning method on academic achievement of senior secondary school students in Biology in Aguata Education Zone, Anambra State. One research question was answered in study while one null hypothesis was tested at 0.05 level of significance. The study employed quasi-experimental research design. Purposive and Simple random Sampling techniques were deployed in selecting a sample size of 85 (40 males and 45 females) SS2 students from two intact classes from a population of 2,072 (926 males and 1146 females) SS2 Biology students who participated in the study. The instrument for data collection was a 50-multiple choice objective items Biology Achievement Test (BAT) which was validated by three experts in science education and measurement and evaluation. The internal consistency of BAT was established using Kuder Richardson 20 formula and a reliability coefficient of 0.95 was obtained. Mean and standard deviation were used to answer the research questions while the Analysis of Covariance was used to test the null hypothesis. The findings of the study revealed among others that the use of ELM is more effective in enhancing students' academic achievement in Biology than CLM. Furthermore, there was no significant difference between the mean achievement scores of male and female senior secondary school students taught Biology using E-learning method (ELM). Based on the findings, recommendations were made which include that; Biology teachers should be encouraged to use the e-learning in teaching and learning more often as it helps to improve the achievement of students and give them flexibility in learning.

Keywords: Effect, E-learning Method, Academic Achievement, Senior Secondary School, Biology Students

Introduction

Education remains the driving force behind the growth and development of any nation, including Nigeria. Education is undeniably one of the most far-reaching prerequisites for development. It plays a pivotal role in alleviating poverty, improving health outcomes, enhancing the quality of life, reducing gender and social disparities, and boosting economic productivity. This, in turn, contributes significantly to economic growth and societal stability by nurturing individuals equipped with both cognitive and life skills essential for sustaining their livelihoods and actively participating in the productive sector. Whether formal or informal, education is the recognized means through which a person acquires most of their ideas, beliefs, and attitudes and Biology education is an integral part of the general education at the secondary school level.

Biology is described as the study of life, delving into how living organisms operate, evolve, and interact within their environment. Akande, Mogbo, Bello and Yaki (2018) posited that the subject is taught to senior secondary school students in Nigeria and stands as one of the country's three core science subjects. Biology education involves the act of teaching and learning to impart knowledge of Biology to students (Okenyi, 2018). Biology education plays a pivotal role in shaping the workforce and fostering scientific thinking, which are both essential for a country's sustainable growth and development. The insights gained from Biology education are directly applied to improve human health, advance agricultural practices, develop new drugs, and address global challenges such as climate change and biodiversity loss (Johnson, 2019). In essence, Biology education transcends the boundaries of classrooms and textbooks; it empowers individuals to contribute to society, make informed decisions about their health and the environment, and participate in the scientific advancements that shape our world. Incorporating Biology into the school curriculum is essential because it equips students with a profound understanding of life on Earth. It enables them to explore the intricacies of living organisms, from the smallest microorganisms to complex ecosystems. Graduates of biology education often emerge as innovative entrepreneurs, creating job opportunities for themselves and others in fields such as healthcare, agriculture, and biotechnology (Kola, 2019). In the midst of all, students' academic achievement in Biology is always a cause of concern.

Research studies have shown efforts made to improve students' academic achievement in biology, such as provision of more laboratories, availability of standard libraries, adoption of teaching methodologies etcetera (Ihejiamazu, Obi & Neji, 2020). These educational efforts made towards improving students' achievement in Biology, the performance of students in biology still exhibits a fluctuating trend, with a slight improvement above the average in the years that recorded the highest percentage, reaching 61.68%. While this improvement is notable, it remains uncertain whether it is sufficient for a country like Nigeria, which urgently requires a solid foundation in scientific knowledge such as biology. In addition, reports from WAEC chief examiners (2013-2021) have consistently revealed that students often encounter challenges in comprehending certain biology concepts, including genetics, ecology, pathogenesis, and parasitology. These difficulties may arise from both teachers and students predominantly favouring a theoretical approach to teaching and learning. Expressing concern about performance of students in Biology, Rabiu Ali, Toriman and Gasim (2018) argued that the difficulties may arise from both teachers and students predominantly favouring a theoretical approach to teaching and learning, instead of a more student-friendly approach, like e-learning.

In e-learning, curriculum content takes on various forms, including text, visuals such as images, posters, videos, audio/sound, multicolored images, maps, and graphics, which can be simultaneously delivered online to students, whether they are in close physical proximity (akin to the classroom model of e-learning) or dispersed across various geographical distances (as seen in the Distance Education model of e-learning). It offers opportunities for educational experiences through simulation and modeling (Alkhawaldeh, Khasawneh & Alsarayreh, 2023). This approach introduces specialized methods for cultivating cognitive skills in early-age learners, thereby mitigating the challenges associated with the educational process. This is a testament to the fact that the integration of technology into the educational process creates intelligent learning environments that inspire students to explore subjects beyond the confines of the curriculum. Akande, Mogbo, Bello and Yaki (2018) lamented that while e-learning may be an attractive teaching method for both teachers and students, several challenges, such as electrical instability, inadequate funding, the high cost of biology software and bandwidth, insufficient ICT skills, and student attitudes, can detract from the effectiveness of the teaching process in secondary schools. This might pose a challenge to students' academic achievement.

Achievement in the school context refers to the level of attainment in a specific discipline, representing the degree of knowledge and skills a student acquires after a period of learning (Egwu & Okigbo, 2021). Different disciplines employ various methods and instruments to measure achievement, with tests and examinations commonly used in school settings to assess students' achievement. Feedback in the form of scores and grades is provided to students based on these assessments. Similarly, Rhode (2019) defines academic achievement as the overall accomplishment obtained by students from lessons, encompassing experiences, knowledge, skills, and more. This definition aligns with Bragdon and Dowler (2016) who emphasizes that academic achievement is a central element of the educational system, influencing its operations and outcomes, and holding significance for teachers, learners, and parents alike.

There is a great concern on how e-learning, in the midst of challenges could enhance academic performance. This underscores the rationale for the present study, which aims to investigate the effect of e-learning method on the academic achievement of senior secondary school students in Biology within the Aguata Education Zone of Anambra state.

Statement of the problem

In the realm of teaching and learning within schools, the primary objective is to equip learners with the skills and knowledge necessary to perform tasks and, ideally, apply their acquired experiences to solve real-life problems. Over a span of nine years, from 2013 to 2021, records from WAEC indicate a consistent fluctuation in percentage which consistently drops in academic achievement by the year. This persistent fluctuations raise questions about the effectiveness of the teaching methods employed by biology teachers in conveying biological concepts. The academic performance of biology students appears to be influenced by a multitude of factors which include; method of instructional delivery, lack of motivation among teachers, inadequate infrastructure, students' attitudes towards learning, insufficient teaching skills and competence among science educators, and limited opportunities for the professional development of science teachers. The lesson delivery approach which most teachers of Biology adopt does not seem to be yielding effective result, hence the need for a more student friendly method. It is against this backdrop that this study is necessitated to investigate the effect of e-learning method on academic achievement of secondary school male and female students in

biology in Aguata Education Zone.

Research question

The research question was provided answer to in the study:

1. What is the difference in the mean achievement scores of secondary school students taught Biology using e-learning method (ELM) and that of those taught using conventional lecture method (CLM)?

Hypothesis

The null hypothesis was tested at 0.05 level of significance:

1. There is no significant difference in the mean achievement scores of secondary school students taught Biology using e-learning method (ELM) and that of those taught using conventional lecture method (CLM).

Methods

This study adopted quasi-experimental research, specifically; the pre-test post-test non randomized control group design will be used. Shrutika (2023) opined that quasi-experimental research design is frequently used when it is not logistically feasible or ethical to conduct a randomized controlled trial. This research design was used based on the utilization of intact classes for the experiment, as the school administrators prohibited the random assignment of students to experimental and control conditions due to concerns about potential disruptions to the school setting and timetable.

The design of the study is symbolically represented in Figure 2

Group	Pretest	Treatment	Posttest
E	O_1	X_1	O_2
C	O_1	X_2	O_2

Design of the experiment

Where;

E=Experimental group

C= Control group

O_1 =Pretest on Biology Achievement Test

O_2 =Posttest on Biology Achievement Test

X_1 =Treatment with E-learning method

X_2=Treatment with Conventional Learning method

_ _ _ _ Equality of the two groups (E and C) not assured.

The population of the study consists of all senior secondary year two (SS2) students offering Biology in the 52 government owned secondary schools in Aguata Education Zone of Anambra State, Nigeria. The total population of SS2 students offering Biology in Aguata Education Zone public schools is 2,072, consisting of 926 male students and 1146 female students. (Source: Post Primary Schools Services Commission, Aguata Zonal Office, 2023). The sample size consists of 85 SS2 biology students, with 40 males and 45 females. These students were drawn from two secondary schools out of the 2072 SS2 biology students in the 52 public senior secondary schools in Aguata Education Zone, Anambra State. The sample was obtained

through a multistage sampling procedure, which was employed as follows:

Firstly, 48 co-educational public secondary schools were purposively selected from the 52 public secondary schools in Aguata Education Zone of Anambra state. The selection of co-educational secondary schools was done to consider gender variable in the study. Using Stratified random sampling technique the researcher spited the 48 co-educational schools into strata (homogenous subgroups) based on the availability of ICT gadgets and one school each from two local government areas was selected. Furthermore, Out of the two selected schools, one school was randomly assigned to the experimental group (ELM), and the other to the control group (CLM), using simple random sampling technique (toss of a coin). In each of the two selected schools, the various arms (A-E) of SS2 (intact) classes offered in the schools were listed on different pieces of paper, folded, and one intact class from   the various arms (A-E) of SS 2(intact)classes was randomly drawn by balloting without replacement. The experimental group consists of 55 students (20 boys and 35 girls) in SS2, while the control group consists of 30 students (20 boys and 10 girls) in SS2, making a total sample of 85 students, as mentioned earlier.

The instrument that was used for data collection was the Biology achievement test (BAT).The Biology Achievement Test was adapted by the researcher and will be used to measure students' achievement in Biology in both the control and experimental group. The items in the BAT were adapted from West African Senior School Certificate (WASSCE) past questions (2011-2020) and compiled based on the topics that were taught during the period of the research using a well –planned table of specifications to ensure an even coverage of content. The topics are pollution, pests and diseases of crops. The BAT is a 50 multiple choice objective items with four options A-D and two sections A and B. Section A sought information on the personal information of the participants such as name of student, school and gender while section B consists of the test items. Eight sets of lesson plans were used by the researcher as instructional tool. Four sets of the lesson plans which are on the use of E-learning method of teaching were used in teaching the experimental group. While the other four sets of lesson plans for teaching the control groups were written to address the use of conventional lecture method.

Initial drafts of the instrument (BAT) and a letter of request along with the lesson plans for the two groups, the topic of the study, purpose of the study, research questions, hypotheses and table of specifications were sent to three experts: two from the Department of Science Education and One in Measurement and Evaluation, Department of Educational Foundations, all from Nnamdi Azikiwe University, Awka. The validators were requested to assess the items in the BAT in terms of relevance, clarity of purpose and expressions used in the test, extent of coverage of the instrument on the topics under study and plausibility of the distractors. They were also required to write 'R'-retain, 'M'-modify or 'D'-delete against questions that should be retained, modified or deleted. Corrections and suggestions given by the validators guided the production of the final drafts of the instrument.

The reliability of BAT was that of internal consistency established using Kuder Richardson 20 (KR-20) formula. The KR-20 was used because of two reasons: The levels of difficulty in the question items are not equal and the instrument is a multiple-choice question

dichotomously scored. To ascertain the reliability coefficient of BAT, the instrument (BAT) was administered to an intact class of 30 SS2 students, similar to the experimental group in one of the schools in (outside the zone under study). Reliability coefficient of 0.95 was obtained for BAT when the collected data were analyzed using the stated statistical tools. The researcher thus concluded that the instrument was reliable and could be used for the research.

Before the commencement of the study, the researcher wrote to the school principals in both the experimental and control groups seeking for their permission from the school management to use their senior secondary two (SS2) students and their biology teachers in carrying out the study in their schools and when the permission was granted, the procedure employed in carrying out the experiment was outlined in four stages:

Stage1: Teachers' Training Program

The study started with the training of two biology teachers from the selected intact classes (the experimental and control groups) in the two selected schools who served as research assistants for two weeks before the experiment. The researcher ensured that all instructional materials that would be used to teach the experimental group were ready. The training which lasted for two weeks involved two biology teachers (the experimental and control group teachers). The biology teachers met with the researcher twice in a week for one hour each after school hours for the two weeks using both schools as the venue for the training interchangeably. This was to ensure that the training did not disrupt their school activities.

Stage 2: Pretest administration

In the same second week, after the briefing and prior to the commencement of the treatment, the research assistants (classroom biology teachers), for the experimental and control group administered the BAT as pretest to both groups after which students' scripts were collected , scored and recorded by the researcher.

Stage 3: Teaching of the students

From the 1st to the 4th week, the research assistants taught the biology lesson contents on pollution, pests and diseases of crops to both the experimental and control group following strictly what was contained in the lesson plans. The experimental group was taught using the lesson plans on E-Learning method provided by the researcher to the research assistant while the control group was taught using Conventional lecture Method lesson plans also adapted by the researcher and given to the research assistant.

Stage 4: Posttest administration

At the end of the teaching (four weeks), in the 5th week revision was conducted for the two groups after which in the same week ,the items of the test instrument were re-arranged, produced in a coloured question paper and re-administered to both groups as posttest by the research assistants under the same classroom condition. The students' scripts were also collected, scored and recorded.

Stage 5: Scoring

The BAT is a multiple choice objective item with four options (A-D) which consists of

50 items. Each item has only one correct answer and the correct answer was 2 marks as no mark is given to incorrect answer.

Control of Extraneous Variables

The extraneous variables that can exert some influence over the dependent variables are identified and measures that were taken by the researcher to control these variables are as follows:

a. **Experimenter Bias:** When a researcher involves external teachers in the experiment, the students become aware that they are being used for a study. Hence, the students tend to fake their actions to suite the researcher's intent. This will introduce Experimenter Bias. To avoid this, the classroom biology teachers were trained and used for the experiment under the researcher's supervision occasionally.

b. **Initial Group Difference:** Randomization is one of the procedures for controlling initial group differences in experimental studies. But this will not be done in this research since the procedure will disrupt normal school administration. Therefore, there was no random assignment of subject to experimental or control group, rather intact classes were used. Thus, to control the initial differences of participants in this intact classes, ANCOVA was used in this study for data analysis.

c. **Teacher variable:** When different teachers were used in an experiment, the problem of the teacher variable will arise because different teachers possess different standards in terms of knowledge of the content and methodology. In order to control this variable in the present study, the teachers were trained on how to make use of prepared lesson plan to ensure uniformity of purpose. The Biology teachers used are graduates.

d. **Subjects' interaction:** This occurs when students in the experimental group relate or intermingle with those in the control group over the content of the study or otherwise. The schools used for the study had considerable distance from each other since the researcher is aware of possible interaction between the students in the experimental group and the control group.

e. **Test knowledge:** This is a situation where the knowledge of pretest may help the students know the answers to the posttest. In order to minimize influence of remembering and forgetfulness, the time lag between the pretest and posttest was five weeks which is considered neither too short nor too long. Also, the researcher did not give the students feedback on their pretest, and the question items were re-arranged.

Before the treatment, BAT was administered to all the students in the two groups as pretest by research assistants. At the end of the teaching process (treatment), for both the control and experimental group, BAT was reshuffled and administered to the students again as posttest. The scores obtained from the administered tests were recorded and analyzed.

The research questions were answered using mean and standard deviation while the hypotheses was tested at 0.05 alpha level using Analysis of Covariance (ANCOVA). The adoption of this statistical tool (ANCOVA) was to take care of error due to initial differences in ability among the research participants (students). In taking decisions, a null hypothesis is rejected if the probability (p) value is less than or equal to the level of significance 0.05 ($p \leq 0.05$). On the other hand if the probability value (P-value) is greater than significant value of

0.05 (P>0.05), null hypothesis is not   rejected.

Results

Research Question 1: What is the difference in the mean achievement scores of   secondary school students taught Biology using e-learning method (ELM) and that of those taught using conventional lecture method (CLM)?

Table 1: Difference in the Mean Achievement scores of students taught Biology using e-learning

method (ELM)and those taught using Conventional Lecture method (CLM)

Subjects		Pretest		Posttest		Mean gain	Mean diff.
	№	X	SD	X	SD		
ELM	55	48.11	16.11	64.58	15.10	16.47	
CLM	30	46.67	14.02	53.50	14.46	6.53	9.94

Table 1 shows the mean, mean gain, mean difference and standard deviation scores of students taught using e-learning method (ELM) and those taught biology using conventional Learning Method (CLM). Those taught with ELM had mean gain scores 16.47 from the pretest and posttest achievement scores while those taught with CLM had mean gain score of 14.46. A mean difference of 9.94 was obtained from the mean gain scores of students taught with ELM and CLM. The mean gain of 9.94 was in favour of students taught with ELM, which showed that ELM improved the achievement of students taught with it in biology.

Hypothesis 1: There is no significant difference in the mean achievement scores of secondary school students taught Biology using e-learning method (ELM) and that of those taught using conventional lecture method (CLM).

Table 2: Analysis of Covariance (ANCOVA) Test of Significance difference between the
Achievement scores of Students taught Biology using ELM and CLM

Dependent Variable: posttest

Source	Type III sum of square	df	Mean of square	F	Sig
Corrected model	15791.43[a]	2	7895.72	130.66	.000
Intercept	3138.92	1	3138.92	51.94	.000
Pretest	13407.54	1	13407.43	221.87	.000
Method	1895.60	1	1895.60	31.37	.000
Error	4955.35	82	60.43		
Total	333625.00	85			
Corrected total	20746.78	84			

Table 2 shows the main effect of teaching method on the academic achievement of students of students taught biology using ELM and CLM. Result obtained shows that $F(1,82)=31.37$, $P = 0.00 <\alpha=0.05$, there is a significant difference in the mean achievement scores of students taught biology using ELM and those taught using CLM. This implied that

students taught using ELM had better achievement mean scores than their counterparts in CLM group. Therefore the null hypothesis that there is no significant difference in the mean achievement scores of secondary school students taught Biology using e-learning method (ELM) and that of those taught using conventional lecture method (CLM) is not accepted however, the alternative hypothesis holds.

Discussion of findings

The study reported that students who were taught biology using e-learning method had achievement mean scores, mean difference and mean gain much higher than students who were taught the same concepts in biology using conventional learning method. There was a significant effect of method on achievement of students when tends to favour students who were taught using ELM. This implied that teaching and learning of biology using e-learning method has significant impact on the achievement of students and can be used as a method to improve achievement among Biology students. This is because e-learning gives the students flexibility in learning where they have the ability to access resources and tools beyond what was given in the classroom. It also gives them a wide range of coverage to resources that will help them navigate through the learning experience in Biology and also give them autonomy in learning which the modern teaching advocates.

E-learning environment can make learning more practical to the students. this is because they contain a set of interactive educational simulations in learning in general, this simulation enable the students to thing deeper beyond what is taught and develop a good understanding of scientific concepts which they can apply in their daily life thereby making learning more meaningful. Also in e-learning environment, learning materials are presented in a logical form whereby students develop mastery over a giving content of knowledge before moving to another one. By this e-learning environment encourage mastery of the learning process and content which in turn lead to improvement in achievement.

The finding of this study agrees with the work of Osuji and Charley (2022). The findings of the study showed that there is a positive relationship between E-learning Platforms and Postgraduate students' academic performance during COVID-19 Pandemic in State Owned Universities in Rivers State. Also the work of Zolochevskaya, Zubanova, Fedorova and Sivakova (2021) revealed that ICT has a major statistically favourable effect on the academic success of students in universities which is line with the finding of this study. Moses, Akporehwe and Agah (2020) in their study also showed that students taught with e-learning method has higher achievement mean score more than those which were taught using modified lecture method. They concluded that learning had significant effect on student's academic achievement in basic science and their findings is in line with the findings of this study.

Conclusion

Based on finding of the investigation and discussions made, the study concludes that E-learning method improved the academic achievement of senior secondary school students taught Biology using the method more than the senior secondary school students who were taught Biology using the conventional lecture method. There was a significant difference in the mean achievement scores of senior secondary school students taught Biology using e-learning method (ELM) and that of those taught using Conventional lecture method (CLM).

Recommendations

Based on the findings of this study, the following recommendation is made:

1. Biology teachers should be encouraged by curriculum planners, school authority and the government to use the e-learning method in teaching and learning process more often as it helps to improve the achievement of students and give them flexibility in learning. There is also need to educate the students on the proper use of e-learning facilities as this will help them maximize the full potential e-learning has in improving their academic achievement and sharpening their focus.

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