American Journal of Integrated STEM Education, 2024, 1-10
https://publishingjournals.com/IJATM
Volume: 1 | Number: 2 (2024) April

Effect of virtual learning strategy on biology students' achievement in Gwagwalada Area Council, FCT-Abuja

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Received: 11-03-2024
Accepted: 26-03-2024
Published: 02-04-2024

Abstract

The study examined the effect of Virtual Learning Strategy on Biology students' achievement in Gwagwalada Area Council, FCT-Abuja. The study was carried out using quasi-experimental design using a pretest post-test non-equivalent control group. The sample size of the study was 92 senior secondary II students' who offered Biology in the study area. The instrument used was Biology Achievement Test (BAT). The reliability of the instruments was established using Kuder-Richardson formula (KR-21) for BAT which yielded a reliability index of 0.80. Data was analyzed using mean and standard deviation for research questions while t-test was used to test the hypotheses at 0.05 level of significance. The results indicated that VLS was found to be significant which improved students' academic achievement. Effect of VLS on the achievement of male and female SS II Biology students was found to be insignificant. The study recommended among others that learning method such as VLS be adopted as it is a student-centered teaching method.

Keywords: Virtual learning strategy, Academic achievement, Biology Students, Strategy

Introduction

Education is the total foundation of economic and social development. It is the key to success and the only way to achieve sustainable economic development. Education is the most powerful instrument to reduce poverty, inequality, crime and violence. It helps to reduce poverty and inequality by providing access to better jobs, higher wages, good attitudinal behaviours and improved quality of human life. Education reduces crime and violence by providing people with the best skills and knowledge needed to make informed decisions and to participate in the global economy. A critical component of education that is capable of transforming an individual and the society at large is science education (Wiginton, 2013). According to Abubakar and Olamoyegun, (2023) science education is a fundamental component of a nation's progress and development, serving as a catalyst for advancements in various fields. Science education is therefore essential to the development of any nation that is the reason each nation must take it intense at all levels of learning (Abubakar & Olamoyegun, 2023).

Science has been regarded as the bedrock of modern-day technological breakthrough in that, it is the basis for all technological ideas seen in the world today (Babagana, Yaki & Abubakar, 2021). It is an organized body of knowledge that is self-directed towards solving human problems and also, providing solution to human needs. Science is viewed as the foundation of modern development and the connection among innovation technology and socio-economic development (Abubakar et al, 2021). According to them, Science programme is viewed as programmes that are involved in practicals. It includes Mathematics, Physics, Chemistry, Biology, Further Mathematics, Technology, Environmental Science, and Technical Drawing (Abubakar & Olamoyegun, 2023).

Biology is an important component of science programme because it provides students with a foundation of knowledge on the structure and function of living organisms. It teaches students the fundamentals of genetics, evolution, and ecology, as well as the basics of cellular and molecular biology. Through the study of biology, students are able to understand the complex interactions between organisms and their environment, as well as the role of humans in the natural world. Furthermore, biology is essential for students to understand the implications of current scientific research, technological advances, and environmental issues. A strong foundation in biology can help students make informed decisions about their future career paths and how to best contribute to society. Biology is therefore, very important to the social economic and technological development of a nation (Abubakar, Ogunseye & Ogunode, 2021).

Despite the importance of Biology, observed trends in the performance of students in the subject still leave room for improvement. Davies, (2020) affirmed that there are many potential causes for poor performance in biology. These include lack of interest in the subject, difficulty understanding the material, inadequate study skills, lack of access to resources, lack of motivation, and lack of teacher support. To buttress it, Vasquez & Sheppard (2020), argues that if the issue is lack of interest, the student could be encouraged to explore the subject further through books, videos, or online resources. If the issue is difficulty understanding the material, the student could benefit from additional support from the tutor. If the issue is inadequate study skills, the student could benefit from studying with a group or taking a study skills course. If the issue is lack of access to resources, the student could be provided with access to a library or virtual learning resources. If the issue is lack of motivation, the student could benefit from setting goals and developing a reward system for meeting them. Finally, if the issue is lack of teacher support, the student could benefit from more frequent one-on-one meetings with the teacher.

However, the teaching and learning of Biology at Secondary schools is getting more challenging in Nigeria. The population of students is always large in the classroom and in laboratory for practical. In addition, textual materials are always in short supplies. This situation became serious with the advent of COVID-19 pandemic.

During the COVID-19 outbreak, several countries including Nigeria applied strict social distancing, wearing of face masks, restriction of community gathering and a lockdown policy as a way of preventing the spread of the pandemic and keeps promoting an agenda of: teach from home, work from home, study from home and worship at home. Obviously, this pandemic has had a tremendous effect on schools, parents, teachers and students. To address these issues, it is important to identify the root cause of the problem and create a plan of action such as integration of technology in the teaching learning process. With the invention of technology in education and the internet, many educational institutions have shifted remotely to virtual learning.

The introduction of virtual learning strategy in science (Biology) teaching has opened new dimension for science teachers to have more interactive and learner-centered classroom environment (Chou, 2010). Virtual learning is an online learning environment that allows for live interaction between the tutor and the learners as they are participating in learning activities all in an online setting. The term virtual learning refers to instruction in an online learning environment where teachers and students are separated by time or space or both and the teacher provides course content through course management applications (e-learning or sharing portals multimedia resources), the internet and video conferencing (Rashid, 2014).

In a broader term, virtual learning is a teaching and learning environment or a shared online learning space that facilitates meaningful interaction, communication, view and engagement with learning resources between students and materials, students and lecturers or teachers and students that promotes exchange of meaningful ideas together at the same time all in an online setting.

With the recent advancement, using technology in education has become inevitable due to personal and social reasons (Usta, 2011). It is crystal clear that virtual learning is a popular and unique way of obtaining instruction (Demiralay, 2016). However, in line with this, Huang and Liu, (2020) suggest that virtual learning could be used to bridge students learning difficulties. Virtual learning is a form of education that takes place online, usually through a virtual learning environment (VLE). It is a type of distance learning that allows students to access educational material and resources, participate in online discussions, and collaborate with other students and teachers in real time at their own comfort all in an online setting. Virtual learning can be used to supplement traditional classroom instruction or to provide an entirely virtual educational experience. It can be used for both synchronous and asynchronous instruction, and can involve a variety of technologies, such as web-based platforms, virtual classrooms, video conferencing, and social media.

Virtual learning is one of the approaches through which teachers introduce technology to students in a learning environment thereby encouraging self-directed learning and active engagement. The Federal Republic of Nigeria (FRN, 2008) in the National Policy on Education (NPE) agreed that teaching has to be practical, activity-based, experimental and ICT supportive. Students may be instructed to study some new materials in the internet for the next class instruction, review teacher-created video content outside the classroom or read a section of a textbook. The class time is used for more engaging, interactive activities facilitated by the teacher. In this instance, students are encouraged to take charge of their own learning since they are actively engaged in the learning process. The VLS changes the environment of initial introduction of new topic to an interactive class where every student is capable of contributing to the topic. It incorporates formative and diagnostic evaluations, as well as promotes meaningful face-to-face learning activities (Natalie 2015). The FRN also emphasized that teaching has to be participatory, exploratory, and child-centred. In relation to this view, Ausubel (1968) pointed out that learning occurs best when students interact in the classroom. This promotes interest, retention and participation in the subject studied. The VLS provides the teacher with a means of achieving the desired student-centred learning environment where students participate actively and not passive listeners

Recent study conducted by Partridge & Moore (2020) asserts that virtual learning has been shown to improve student engagement and motivation, which can lead to higher academic achievement. Virtual learning can also provide students with more opportunities for collaboration and peer-to-peer learning, which can help them better understand and apply concepts. Additionally, virtual learning can provide students with more control over their learning environment, allowing them to move at their own pace and focus on topics they are most interested in. Virtual learning can be an effective tool for improving student achievement in biology. It is important, however, for educators to ensure that students have access to the right resources and support to ensure that they are successful in their virtual learning environment.

Research evidence from international context shows that virtual learning has been effective in improving students' academic achievement in most science subjects including biology (Wiginton, 2013). However, there is dearth of research on its effect on students' participation but given the activity-based nature of virtual learning; it might enhance students' participation, interest and attitude which could culminate in high academic achievement. For this reason, therefore, there is the need to ascertain its effects on secondary school's students' academic achievement in Biology in Gwagwalada Area Council, FCT-Abuja.

Statement of the Problem

Information and communication technologies have become a powerful force in transforming the educational settings around the whole world. The pandemic has been an important factor in transferring traditional physical classrooms settings through adopting information and communication technologies and has also accelerated the transformation. A well-known fact is that learning environments connected to information and communication technologies highly satisfy students. Therefore, we need to keep interest in technology-based learning environments. Clearly, technology has had a huge impact on young people's lives. This digital revolution can synergize the educational ambitions and interests of digitally addicted students. In essence, COVID-19 has provided us with an opportunity to embrace online learning as education systems have to keep up with the rapid emergence of new technologies

The present instructional approach used by most biology teachers seems to be teacher-centred type of instruction. The direct method of instruction mainly used in secondary schools seems not to give students enough opportunity to actively participate in classroom activities. This may affect their ability to gain processing and reasoning skills in biology, which are necessary for application in the world presently. Based on the above view, it becomes pertinent that a study on an innovative, collaborative and participative approach, which can help students become more active in the learning process, be introduced.

The rapid technological advancements of the 21st century have led to the emergence of virtual learning strategy as an alternative to traditional face-to-face instruction. This new form of instruction has provided students with the opportunity to access educational material from the comfort of their own homes. However, it is unclear how virtual learning strategy affects the academic performance of students in biology. This study therefore seeks to investigate the effect of virtual learning strategy on the academic achievement of secondary school's students in biology in Gwagwalada Area Council, FCT Abuja.

Purpose of the Study

The purpose of this study is to investigate the effect of virtual learning strategy on the academic achievement of biology students in secondary schools in Gwagwalada Area Council, FCT Abuja. Specifically, the study seeks to;

i. find out the achievement level between students who are exposed to Virtual Learning Strategy and their counterpart exposed to conventional teaching method in Gwagwalada Area Council, FCT Abuja.
ii. determine whether gender has any effect on students' academic achievement when exposed to Virtual Learning Strategy in Gwagwalada Area Council, FCT Abuja.

Research Questions

The following research questions guided the study;

1. What is the difference in students' achievement level in Biology between those exposed to Virtual Learning Strategy and their counterparts taught with the conventional teaching method in Gwagwalada Area Council, FCT Abuja?
2. What is the difference between male and female students' academic achievement in Biology when exposed to Virtual Learning Strategy in Gwagwalada Area Council, FCT Abuja?

Hypotheses

The following hypotheses were tested at 0.05 level of significance

HO1: There is no significant difference in students' academic achievement level in Biology between those exposed to Virtual Learning Strategy and their counterparts taught with the conventional teaching method in Gwagwalada Area Council, FCT Abuja.

HO2: There is no significant difference in the academic achievement of male and female students taught Biology concepts using Virtual Learning Strategy in Gwagwalada Area Council, FCT Abuja.

Methodology

The study adopted quasi-experimental research design. As an experimental study, the samples for the study were grouped into experimental and the control groups. The experimental group was taught biology concepts using Virtual Learning Strategy while the control group was taught the same biology concept using the traditional method of teaching. Classes that were already established (intact classes) were used for the study in order to avoid distortion on the normal class settings and the school timetables.

The population of this study consisted of 1,821 senior secondary two (SS2) students offering Biology in all the public secondary schools in Gwagwalada Area Council of FCT Abuja for the 2022/2023 academic session. The population is made up of 766 males and 1,055 females SS2 Biology students. The reason for the choice of this class was that SSII students were not new to biology and as such would have acquired the basic pre-requisite knowledge in the subject. Also, at this level they are not likely to face any imminent external examination. In addition, they are not affected by new environment into the new level of education like the SS1 class. Based on this consideration, the SS2 Biology students were considered more appropriate for the study. But, the sample size for this study consisted of nine-two (92) SS2 Biology students (45 males and 47 females). A multistage sampling procedure was used to draw the sample. At the first stage, purposive sampling technique was used to select two senior secondary schools (GSS Gwagwalada and GSS Hajj-Camp) out of total public secondary schools in the study area. In the second stage, simple random sampling technique was used to select one intact class of SSII Biology students from each sampled schools in Gwagwalada Area Council, making a total of 92 students (males 45 and females 47) which formed the sample size. Finally, one school was randomly assigned experimental group while the other school as control group using balloting.

The instruments used for data collection was Biology Achievement Test (BAT) and a lesson plan. BAT consisted of 32 multiple choice questions with four option items (A, B, C and D) selected from West African Senior School Certificate Examination (WASSCE) and National Examination Council (NECO) past questions and standard Biology text books. The items were based on concepts of digestive system, transport system, respiratory system, excretory system, nutrient cycling, decomposition in nature, ecological management and pollution. Instruments were face and Content validated using table of specification. A split half method was used to compute the reliability of the Biology Achievement Test (BAT). A pilot test involving thirty-five (35) senior secondary II biology students (18 males and 17 females) was conducted with the aim to determine the reliability of the instrument. The school used for the pilot test was Government Day Secondary School Gwagwalada, Abuja which was not part of the sampled schools for the study. Kuder Richardson formula 21 (K-R 21) was used to calculate the internal consistency of the BAT. The reliability coefficient of BAT was calculated to be 0.80. Thus, BAT was considered to be reliable. Data was analyzed using mean, standard deviation to answered the research questions while the hypotheses were tested using t-test at 0.05 level of significance as the mean of two variables are being compared.

Result and Discussions

The data obtained from the study have been analyzed and presented using mean, standard deviation and t-test statistical analysis.

The characteristics of the subjects that constitute the sample in respect of groups and gender were presented in Table 1.

Table 1: Distribution of Experimental & Control Group According to Gender

Gender	No. of Students in the Experimental Group	Percentage	No. of Students in the Control Group	Percentage
Male	25	56.0	20	43.0
Female	20	44.0	27	57.0
Total	45	100	47	100

Table 1 indicates the distribution of students who were exposed to experimental and control group according to gender. A break down reveals that of the forty-five students, twenty-five students representing 56.0% were male students in the experimental group while twenty students representing 46.0% constituted their female counterparts. Also, a break down reveals that of the forty-seven students, twenty students representing 43.0% were male students in the control group while twenty-seven students representing 57.0% constituted their female counterparts. It then means that male students were in the majority in the experimental group while female students were in the majority in the control group.

Research Question One

What is the difference in students' achievement level in Biology between those exposed to Virtual Learning Strategy and their counterparts taught with the conventional teaching method in Gwagwalada Area Council, FCT Abuja?

To answer this research question, frequency count, mean and standard deviation were used and the result set out on table 2

Table 2: Mean and Standard Deviation of SS II Students' Achievement in Biology for Experimental and Control Groups

Group	Number of Students' N	Mean Scores Pre-test $\bar{X}$	Mean Scores Post-test $\bar{X}$	Standard Deviation SD	Mean Gain $\bar{X}$
Experimental	45	13.98	19.51	3.30	5.53
Control	47	13.72	14.54	3.03	0.82
Mean Difference		0.26	4.97		4.71
Total	92				

Source: Field Survey, 2023

The result presented on Table 2 shows that students' who were taught Biology with Virtual Learning instruction method had pre-test achievement mean score of 13.98, post-test mean score of 19.51 and achievement mean gain score of 5.53. On the other hand, the students' that were taught Biology with conventional method had pre-test achievement mean score of 13.72, post-test achievement mean score of 14.54. However, the overall mean difference between the groups was 4.71 and this favoured students in experimental group taught using Virtual Learning instruction method.

In essence the achievement mean scores of students' who were taught Biology using Virtual Learning instruction method was higher than their counterparts taught using conventional method with a mean gain of 4.71 which favoured the experimental group. Therefore, there was a difference in achievement between the group taught using Virtual Learning instruction teaching method and those taught with conventional teaching method. The students' who were taught using Virtual Learning instruction method achieved higher than the other students' who were taught in the control group. This result indicates that the teaching of Biology with Virtual Learning instructional method increased achievement in Biology of the students' than using conventional teaching method. This means that

Virtual Learning instruction is effective in the improvement of students' achievement in Biology.

Research Question Two

What is the difference between male and female students' academic achievement in Biology when exposed to Virtual Learning Strategy in Gwagwalada Area Council, FCT Abuja?

To answer this research question, frequency count, mean and standard deviation were used and the result set out on table 3

Table 3: Mean and Standard Deviation on Achievement of Male and Female Students taught Biology using Virtual Learning instructional

Gender	No. of Students'	Mean Scores Pre-test	Post-test	Standard Deviation	Mean Gain
	N	$\overline{X}$	$\overline{X}$	SD	$\overline{X}$
Male	26	14.20	21.27	3.59	7.07
Female	15	13.80	19.87	2.97	6.07
Mean Difference		0.40	1.40		1.00
Total	41				

The result presented on Table 3 indicates the means and standard deviation of experimental groups according to gender. The male students' who were taught Biology with Virtual Learning instruction teaching method had pre-test and post-test achievement mean score of 14.20 and 21.27 respectively with mean gain of 7.07 while the Female students' taught Biology with same method was 13.80 pre-test and post-test of 19.87 with mean gain of 6.07. The overall mean difference between the groups was 1.00. The implication is that the mean achievement scores of male and female SS II students' taught Biology using Virtual Learning instruction were almost at par. It therefore, means there was no difference in the achievement mean scores of male and female students' exposed to Virtual Learning instruction method of teaching.

Testing of Hypotheses

In this study, two hypotheses were formulated and tested at 0.05 level of significance as follows:

Hypothesis One

Ho1: There is no significant difference in students' academic achievement level in Biology between those exposed to Virtual Learning Strategy and their counterparts taught with the conventional teaching method in Gwagwalada Area Council, FCT Abuja.

To test for the hypothesis, t-test statistic was used and results presented in table 4.

Table 4: t-test Showing Significant Difference between the Achievement Mean Scores between the Experimental and Control Groups

Groups	No. of Students	Mean Scores	Standard Deviation	t-value	df	P-value	Decision
Experimental	45	19.51	3.30				
				6.88	78	0.000	Significant
Control	47	14.54	3.02				

*Significant at P-value > less than 0.05; and df = 90

Table 4 shows that the calculated t-value of the test was 6.88; df was 78 while the p-value was 0.000. Therefore, Since the P-value of 0.000 is less than 0.05 level of significance, the null hypothesis is rejected which indicates that there was significant difference in the achievement mean scores of students taught Biology with Virtual Learning Strategy and those taught with conventional teaching method. This implies that respondents from both groups differed significantly in their achievement mean scores which favored the experimental group who were taught using Virtual Learning Strategy.

Hypothesis Two

Ho2: There is no significant difference in the academic achievement of male and female students taught Biology concepts using Virtual Learning Strategy in Gwagwalada Area Council, FCT Abuja.

To test for this hypothesis, t-test statistic was used and results presented in table 5.

Table 5: t-test Showing Significant Difference between the Achievement of Male and Female Students taught using Virtual Learning Instructional Strategy

Groups	No. of Students	Mean Scores	Standard Deviation	t-value	df	P-value	Decision
Male	22	21.27	3.59	1.59	39	0.135	Not Significant
Female	23	19.87	2.97				

*Significant at P-value > greater than 0.05; and df = 43

Analysis from Table 5 shows that the calculated t-value was 1.59 and degree of freedom (df) was 39 while the P-value was 0.135 which is greater than 0.05 level of significance indicating that there was no significant difference in the achievement mean scores of male and female students taught Biology with Virtual LearningInstructional Strategy. Therefore, based on the analysis, the second null hypothesis was retained. However, it then means that male and female students did not differ significantly in their mean achievement scores.

Discussion of Findings

Judging from the findings, it is evident and was clearly indicated that the treatment was statistically significant on the students' achievement. The data presented in table 2 provide answer to research question one from the result, revealed that mean gain of students' taught Biology using Virtual Learning Strategy was 5.53 which is higher than 0.82 the mean scores of those taught with conventional method. The overall mean difference between the groups was 4.71 which favoured students taught Biology with Virtual Learning Strategy. Therefore, a significant difference existed between the group taught using Virtual Learning Strategy and their counterpart taught using conventional method. This shows that the students taught with Virtual Learning instruction performed better than those taught with conventional method.

The result of t-test as reported in table 4 showed that there was significant difference in the achievement mean scores of students' taught Biology with Virtual Learning Strategy and those taught with conventional teaching method. As a result, the first null hypothesis was rejected. In other words, students from both groups differed significantly in their achievement mean scores which favoured the experimental group taught using Virtual Learning Strategy. This implies that Virtual Learning instruction is a good instructional method relative to conventional method, and that it can be used to improve students' achievement in Biology. The findings of this study are in affirmation with the result of Wiginton, (2013) who reported that experimental group (virtual learning) performed better than the control group.

The findings also lend support to that of Yujing (2015) whose study found that students taught English writing course with Virtual Learning instructional method had significantly higher mean achievement scores than the control group taught with conventional method. Result indicated that students taught using Virtual Learning instruction package performed significantly better than their counterparts taught using the conventional method of instruction. Students taught using Virtual Learning instruction performed better than the control group in retention test. The similarities in the findings could be attributed to the effectiveness power of the teaching method over lecture method. Also the reasons for this difference could be because Virtual Learning Strategy is learner centered and activity oriented which encourage active participation of students in class room activities.

The result presented in table 3 provided answer to research question two; findings from the result showed the mean gain of male students taught Biology using Virtual Learning instruction method was 7.07 and their female counterparts who were taught Biology with same method was 6.07. The overall mean difference between the groups was 1.00. It then revealed in this study that the mean score of the male students taught with Virtual Learning Strategy was higher than that of the female students, though this difference was not significant. This implies that Virtual Learning Strategy enhances the performances of both male and female students. Virtual Learning Strategy concretizes learning to both male and female. The small mean difference could be as a result of chance factor.

The analysis of t-test in table 5 showed that there was no significant differences between the achievements mean scores of male and female students taught Biology with Virtual Learning Strategy. Consequently, the second null hypothesis was accepted in the light of this result. In other words, respondents from both genders did not differ significantly in their achievement mean scores. This is to say that Virtual Learning Strategy favours both sexes as long as achievement in Biology is concerned; hence Virtual Learning Strategy is an effective teaching Strategy.

The finding supported previous assertion by Shih and Tsai (2017) whose study revealed that there was no statistically significant difference in the performances of both male and female students taught with Virtual Learning instruction method which implies that Virtual Learning instruction is gender friendly and both male and female students perceive Virtual Learning as effective in improving their achievement in science. Result also indicated that there was no significant difference in the post-test performance scores of male and female students taught using virtual learning. The non-significant effect of gender on students' academic achievement may be that the Virtual Learning instruction produced the same learning effect on both gender. Hence, there is no difference in their achievement.

Recommendations

The following recommendations were made based on the findings that the use of Virtual Learning Strategy has been found to enhance the achievement in Biology and engage students in learning activities among others:

1. Biology teachers in secondary schools should be encouraged to incorporate Virtual Learning Strategy in the teaching of the subject. By so doing, the achievement of students in the subject could be increased.

2. Enlightenment campaign, workshops and seminars should be organized for science teachers especially Biology teachers by Education Authorities such as Science Teachers Association of Nigeria (STAN) – Federal and State Ministries of Education, institutes and Colleges of Education to create awareness of the efficacy of the Virtual Learning Strategy and then sensitize the adoption of the strategy in their various schools since it produced the same learning effect on both gender.

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