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EFFECT OF VIDEO CONFERENCING ON STUDENTS' ACHIEVEMENT AND RETENTION IN GENETICS IN ABUJA, NIGERIA

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Abstract

This study determined the "effects of video conferencing instructional strategy on students' achievement and retention in genetics in Abuja, Nigeria." The study adopted quasi-experimental research of post-test and post post-test, non-equivalent, non-randomized, control groups design. The population for the study consists of 2,948 (1300 males and 1648 females) SS III students. Simple random sampling techniques was used to select a sample 147 students, (68 Experimental and 79 control group students) for the study. Two instruments, namely Genetics Interest Rating Scale (GIRS) and Genetics Achievement Test (GAT)items were validated and found reliable for the study. Four research questions were raised, and four null hypotheses were formulated for the study. Descriptive statistics of mean and standard deviation were used to answer research questions, while inferential statistics of ANCOVA was used to test the null hypotheses at 0.05 level of significant. The findings revealed that there is significant difference on the achievement and retention of students exposed to video conferencing instructional strategy and their counterparts exposed to conventional method in favour of the experimental group. Also, the findings revealed that there is no significant difference in male and female student's achievement in genetics using the video conferencing instructional strategy. Hence the researcher recommended that the use of video conferencing as an instructional strategy should be adopted for teaching Genetics concepts in the secondary schools and in-service training program for biology. Teachers in the form of workshops, seminars, and conferences should be organized to focus more on how to use the video conferencing instructional strategy in teaching genetics concepts, among others.

Keyword: Video Conferencing Instructional Strategy, Genetics, Achievement, Retention and Conventional Method

Introduction

Biology is a branch of natural science that studies living things. How the world is organized, how it functions and what these functions are, how it evolves, how living creatures came into being, and how they interact with one another and their environment (Umar, 2016). Medicines, pharmacy, nursing, agriculture, forestry, biotechnology, nanotechnology, and a variety of other fields are included (Ahmed & Abimbola, 2015). Biology is regarded as one of the most important subjects in secondary school. Biology attracted more pupils than other science subjects in the senior secondary school certificate examination (SSCE) because of its importance (West African Examination Council, 2023). Biology is taught to students in senior secondary school as a foundation for human development, where career skills are honed and potentials and talents are identified and developed (Federal Republic of Nigeria, 2013). Secondary school students receive science instruction that is geared toward training future scientists, technologists, engineers, and related professionals (Kareem, 2015).

Despite the importance and popularity of biology among Nigerian students, senior secondary school students have performed poorly (Ahmed, 2018). Nigeria may face personnel shortages in scientific and technology-related subjects as a result of this educational failure. Many researchers have advocated for innovative teaching strategies that are students centred and could increase interest among learners leading to higher achievement and retention. For instance, Researchers like Jirgba, Eriba and Achor (2018); Ode and Tartenger (2021); Tartenger, Omaga and Enemaria (2023); Tartenger, Enemaria and Yusuf (2024) and Muhammad, Bichi, Babangida and Kpadaji (2024) called for a shift from the teacher-based method of teaching Science especially concepts like genetics to activity-based students centred strategies. Also, in order to improve science teaching and learning, the constructivist approach was adopted by the National Policy on Education (FRN, 2013) which stated that teaching shall be practical, activity-based and experiential, Information Technology (IT) supported, which shall be learner-centred. In line with this, it is beneficial if teachers can utilize effective and innovative strategies that are ICT inclined such as video conferencing, pre-recorded lectures, peer tutoring, thinking maps, role play among others for effective teaching and learning outcomes.

Genetics is the study of heredity and variation in organisms. It is the science which seeks to account for the resemblances and differences exhibited among organisms related by descent. Children inherit their biological parents' genes that express specific traits, such as some physical characteristics, natural

talents, and genetic disorders. Parents pass traits to their young ones through gene transmission and these genes are located on chromosomes that consist of DNA. Chromosomes contain specific instruction for protein synthesis (Tamarin, cited in Paul 2018). Genetics is the field of Biology which basically deals with the study of genes, genetic variation, and heredity in living organisms. Genetics generally intersects frequently with many other life sciences and is strongly linked with the study of information systems. Historically, geneticists have worked in three different areas, each with its own particular problems, terminology, tools, and organisms. These areas are classical genetics, molecular genetics, and evolutionary genetics. Classical genetics is concerned with the chromosomal theory of inheritance; that is, the concept that genes are located linearly on chromosomes and the relative positions of genes can be determined by their frequency in offspring. Molecular genetics on the other hand is the study of genetic materials: its structural replication and expression, as well as information emanating from the discoveries of recombinant DNA techniques. Evolutionary genetics deals with the mechanisms of evolutionary changes in gene frequencies in populations. Darwin's concept of evolution by natural selection finds firm genetic footing in this area of the study of inheritance as in the Table below as cited from Tamarin in Paul (2018).

Video conferencing platforms such as Zoom, Microsoft Teams, and Google Meet have become integral to the virtual classroom, offering features that promote real-time engagement, collaborative learning, and accessibility. These tools have enabled educators to deliver live lectures, conduct virtual meetings, and utilize interactive functionalities like screen sharing and breakout rooms, thereby simulating the dynamics of a physical classroom in a virtual environment. The flexibility afforded by video conferencing has been particularly beneficial for students in remote or underserved areas, allowing them to access quality education without the constraints of physical attendance. Video conferencing has opened up new possibilities for learning, by making it more collaborative through face-to-face communications, allowing for instant feedback and engagement.

Achievement is another variable in this study; achievement can be described as the outcome of educational objectives, the extent to which students, teachers or institution achieved their stated educational objectives or goals. Academic achievement refers to the extent to which students attain their learning goals and outcomes in formal education settings. According to Wang (2020); Hattie (2020) and

Conley (2022), Academic achievement encompasses various aspects, including; academic performance (grades, scores, and marks earned by students in their courses or subjects); learning outcomes: (knowledge, skills, attitudes, and values acquired by students as a result of their academic experiences); educational attainment: (certificates, diplomas, degrees, or other credentials earned by students upon completing their academic programs); cognitive development: (growth in critical thinking, problem-solving, and communication skills) and Academic success: (students' ability to meet academic expectations, progress through their programs, and achieve their educational goals).

Student achievement remains a central focus in educational discourse, as it reflects the effectiveness of teaching methodologies and the overall quality of the learning environment. In recent years, various pedagogical strategies have been explored to enhance students' academic performance, particularly in the Nigerian educational context. One such strategy is the activity-based teaching method, which emphasizes hands-on learning and student engagement. Oribhabor (2020) conducted a study evaluating the impact of this method on Nigerian secondary school students' achievement in mathematics. The findings revealed a significant improvement in students' performance when taught using activity-based approaches compared to traditional lecture methods.

Retention, also a variable in this study, is the act or power of remembering things; it is the memory, and what is retained in the mind (The English Dictionary Online 2019). Retention is the ability to keep or retain what has been taught in the classroom and learned by the students and the ability to recall what has been learned whenever it is required (Safo, Ezenwa & Wushishi, 2013). Reason (2022) sees retention as a complex and multifaceted construct, requiring a comprehensive approach to support student success.

Retention of knowledge is essential for long-term learning and the successful application of concepts. Student retention is a critical indicator of the effectiveness of the Teaching and learning process, reflecting the extent to which learners persist and succeed within academic programs. A study by Adamu and Usman (2023) compared the retention rates of students who received traditional classroom instruction with those who utilized pre-recorded lectures and online learning resources in a genetics course. Their results indicated that the technology-enhanced group demonstrated better retention of key concepts over an extended period. Ode and Tartenger (2021) and Tartenger, Enemarie and Yusuf

(2024) in their separate studies found that learners exposed to innovative teaching strategies outperformed their counterparts exposed to the conventional methods.

Gender, another variable in this study, is a biological anatomy that differentiates a male from a female. Gender is a major issue in education; gender factor is a central and an important factor in educational research, it is observed to influence students' engagement, success, and persistence in secondary school teaching and learning process. Gender pertains to a range of characteristics that differentiate between masculinity and femininity. Globally and in Nigeria, disparities in achievement, and retention between male and female students significantly shape educational outcomes and equity (Oluyemo et al., 2020). Gender disparities in education remain a significant concern in Nigeria, particularly regarding students' interest and achievement in secondary schools. Understanding the influence of gender on educational outcomes is crucial for developing effective strategies to promote equity and enhance academic performance across all subjects. Research indicates that gender differences can impact students' academic interests and achievements, though findings vary across subjects and regions. For instance, a study in Niger State revealed that male students exhibited higher interest and achievement in mathematics compared to their female counterparts, suggesting the need for teaching methods that engage all genders equally (Oluyemo et al., 2020).

It is against this background that the researcher was spurred to investigate whether innovative teaching strategies like video conferencing can bridge gender gaps in terms of students' achievement and retention.

Statement of the Problem

Today, biology education appears to be failing. The results of biology students' Senior Secondary School Certificate Examination (SSSCE) in Nigeria are extremely concerning, especially given that the students are expected to become future scientists. According to the West African Examination Council's 2019-2022 Annual Report, for the past five years (2015-2021), the number of students passing biology at credit level (A1-C6) in Nigeria has continuously been less than 50%. Over the years, students' achievement in biology has remained consistently abysmal. Observations and reports from various examination bodies across board have revealed that a high percentage of students continue to achieve poorly in biology, one of the important subjects at the senior secondary school level. For instance, the WAEC Chief Examiner's Reports (West Africa Examination Council, 2023) has it that, in the years 2019, 2020,

2021, 2022 and 2023 students achieved 45.67%, 43.68%, 50.2%, 49.79% and 49.68% passes at credit level respectively in Biology. This development has generated concerns among parents, teachers, educational planners, policymakers, researchers, and government, especially considering the huge financial investment in the educational sector over the years. One of the aspects of biology where failure rate is so high as shown by various past studies is genetics. Many researchers have attributed this to the ineffective method of teaching adopted by teachers in the classroom which has not really taken into cognizance students' interest, individual differences, but only often result to rote learning. As a result, students struggle to develop genuine interest and understanding, as well as capacity for retention of concepts taught, leading to poor academic achievement. Researchers through outcomes of various studies have advocated for effective and appropriate utilization of students centred instructional strategies that can motivate, encourage and stimulate learning as a way to improve on achievement and retention.

It is against this backdrop that this study was carried out, to determine the effect of Video conferencing instructional strategy on student achievement and retention in genetics in Abuja, Nigeria to see to the current situation.

Objective of the Study

This Study determined the effects of video Conferencing instructional strategy on students' achievement and retention in Genetics in Abuja, Nigeria.

Specifically, objectives of the study are to:

1. investigate the achievement of students taught Genetics using Video Conferencing instructional strategy and Conventional method.
2. Find out the achievement of male and female students taught genetics using Video Conferencing instructional strategy.
3. Determine the retention of students taught Genetics using Video Conferencing instructional strategy and Conventional method.
4. Find out the retention of male and female students taught generics using Video Conferencing instructional strategy.

Research Questions

To achieve the stated objectives of the study, the following research questions were asked to guide the study:

1. What are the mean achievement scores of students taught genetics using Video Conferencing instructional strategy and those taught using Conventional Method?
2. What are the mean achievement scores of Male and female students

taught genetics using Video Conferencing instructional strategy?

3. What are the mean retention scores of students taught genetics using Video Conferencing instructional strategy and those taught using Conventional Method?
4. What are the mean retention scores of male and female students taught genetics using Video Conferencing instructional strategy?

Research Hypotheses

Based on the research questions, the following null hypotheses were formulated and tested at 0.05 level of significance

Ho_1: There is no significant difference in the mean achievement scores of students taught genetics using video Conferencing instructional strategy and those exposed to Conventional Method.

Ho_2: There is no significant difference in the mean achievement scores of male and female students taught genetics using video Conferencing instructional strategy.

Ho_3: There is no significant difference in the mean retention scores of students taught genetics using video Conferencing instructional strategy and those exposed to Conventional Method.

Ho_4: There is no significant difference in the mean retention scores of male and female students taught genetics using video Conferencing instructional strategy.

Methodology

This study adopted quasi-experimental research design of pre-test, post-test and nonrandomized control group. The population for this study comprised of 2,948 SS III students of which 1300 are males and 1648 are females in 2024/2025 academic session in Abuja, Nigeria. Purposive random sampling techniques was use in selection of the 147 SS III students of which 68 for experimental group (21 male and 47 female) and 79 control group (27 male and 52 female) as sample for the study.

Genetics Achievement Test (GAT) and Ecology Retention Test (GRT) were the instruments for the study. GAT and GRT items consist of 30 multiple choice questions. The instruments were validated by three expert and found reliable for the study with the reliability index of 0.78 for GAT and GRT respectively.

Research assistant was trained on how to use video conferencing instructional strategy in teaching genetics. Post-test was conducted and treatment lasted for 3 weeks for

experimental and control groups simultaneously. The Experimental group was taught genetics using video conferencing instructional strategy while the control group was taught using conventional method. Post Post-test was administered and the data generated were subjected to descriptive statistics of mean and standard deviation to answer research questions while inferential statistics of ANCOVA was used to test the null hypotheses at 0.05 level of significance.

Results

The data is presented according to the research questions asked and null hypotheses formulated for the study. The analysis of the data was done using Statistical Package for Social Science (SPSS) Version 26.

Research Question One: What are the mean achievement scores of students taught genetics through video conferencing, and conventional method?

The result of the effect is shown in Table 1.

Table 1: Mean and Standard Deviation of Achievement Scores of Students Taught Genetics Using Video Conferencing and Conventional Method

Teaching Method	Type of Test	N	Mean	Std. Div.
Video Conf.	Pre-test	68	11.88	4.42
	Post-test	68	18.26	4.56
Conventional	Pre-test	79	13.04	3.62
	Post-test	79	13.49	3.39

Table 1 shows the pre-test and post-test mean achievement scores and standard deviation of students taught genetics using video conferencing (N= 68, M= 11.88, SD = 4.42) and (N= 68, M= 18.26, SD = 4.56) and pre-test and post-test mean achievement scores and standard deviation of students taught genetics using Conventional method are (N= 79, M= 13.04, SD = 3.62) and (N= 79, M= 13.49, SD = 3.39) respectively.

Null Hypothesis One: There is no significant difference in mean achievement scores of students taught genetics using video conferencing and the conventional method.

The test for this hypothesis is presented in Table 2.

Table 2: Results of ANCOVA on Achievement Scores of Students' Taught Genetics Using Video Conferencing and those Taught Using Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6312.397[a]	3	2104.132	177.933	0.000	0.724
Intercept	6491.974	1	6491.974	548.985	0.000	0.730
Pretestachievement	8.356	1	8.356	0.707	0.402	0.003
Methods	**6242.989**	**2**	**3121.494**	**263.965**	**0.000**	**0.722**
Error	2400.559	144	11.825			
Total	83326.000	147				
Corrected Total	8712.957	146				

a. R Squared = 0.724 (Adjusted R Squared = 0.720)

Table 2 shows a significant difference in the mean achievement scores of students exposed to Video conferencing and Conventional Groups. The value of $F_{(1, 144)} = 263.965$ was obtained with associated exact probability value of 0.000. Since the associated probability 0.000 is less than 0.05 level of significance, the null hypothesis is rejected. This result implies that, the video conferencing teaching strategy produced a significant effect on the post-test achievement scores of students' when covariate effect (pre-test) is controlled. Hence, there was a significant difference among the two groups of Video conferencing and Conventional Group.

Research Question Two: What are the mean achievement scores of male and female students taught genetics using video conferencing?

Table 3: Mean and Standard Deviation on Achievement Scores of Male and Female Students' Taught Genetics Using Video Conferencing

Gender	Type of Test	N	Mean	Std. Div
Male	**Pre-test**	**21**	**11.71**	**4.51**
	Post-test	**21**	**19.43**	**4.02**
Female	**Pre-test**	**47**	**11.96**	**4.42**
	Post-test	**47**	**17.74**	**4.73**

Table 3 shows the results of pre-test and post-test mean and standard deviation of achievement scores of male students' taught genetics using Video conferencing are (N = 21, M = 11.71, SD = 4.51) and (N = 21, M = 19.43, SD = 4.02), while pre-test and post-test mean and standard deviation of achievement scores of female students' taught genetics using Video conferencing are (N = 47, M = 11.96, SD = 4.42) and (N = 47, M = 17.74, SD = 4.73) respectively.

Null Hypothesis Two: There is no significant difference in the mean achievement scores of male and female

students taught through video conferencing. The test for this hypothesis is presented in Table

Table 4: Results of ANCOVA on Achievement Scores of Male and Female Students' Taught Genetics Using Video Conferencing

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	**94.086[a]**	**2**	**47.043**	**2.354**	**0.103**	**0.068**
Intercept	**3532.574**	**1**	**3532.574**	**176.744**	**0.000**	**0.731**
Prevideoachievment	**52.930**	**1**	**52.930**	**2.648**	**0.109**	**0.039**
Gender 1	**38.773**	**1**	**38.773**	**1.940**	**0.168**	**0.029**
Error	**1299.149**	**65**	**19.987**			
Total	**24078.000**	**68**				
Corrected Total	**1393.235**	**67**				

R Squared = 0.068 (Adjusted R Squared =0.039)

Table 4 reveals that, there is no significant difference in the mean achievement scores of male and female students exposed to Video conferencing. The value of $F_{(1, 65)} = 1.940$ is obtained with associated exact probability value of 0.168 is greater than 0.05 level of significance, the null hypothesis is retained.

Research Question Three: What are the mean retention scores of students taught genetics using video conferencing and conventional method?

The result of the effect is shown in Table 5.

Table 5: Mean and Standard Deviation of Retention Scores of Students Taught Genetics Using Video Conferencing and Conventional Method

Teaching Method	Type of Test	N	Mean	Std. Div.
Video Conf.	Post-test	68	18.26	4.56
	Post post-test	68	21.12	5.76
Conventional	Pre-test	79	13.49	3.39
	Post-test	79	14.05	1.23

Table 5 shows the post-test and post-post-test mean retention scores and standard deviation of students taught genetics using video conferencing are (N= 68, M=18.26 , SD = 4.56) and (N= 68, M= 21.12, SD = 5.76) and post-test and post-post-test mean retention scores and standard deviation of students taught genetics using Conventional method are (N= 79, M= 13.49, SD = 3.39) and (N= 79, M= 14.05, SD = 1.23) respectively.

Null Hypothesis Three: There is no significant difference in mean retention scores of students taught genetics using video conferencing and the conventional method.

The test for this hypothesis is presented in Table 6.

Table 6: Results of ANCOVA on Retention Scores of Students' Taught Genetics Using Video Conferencing and those Taught Using Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7825.934[a]	3	2608.645	210.026	0.000	0.756
Intercept	2599.519	1	2599.519	209.291	0.000	0.508
Posttretention	2.881	1	2.881	0.232	0.631	0.001
Methods	**2740.444**	**1**	**1370.222**	**110.319**	**0.000**	**0.521**
Error	2521.380	144	12.421			
Total	87642.000	147				
Corrected Total	10347.314	146				

a. R Squared = 0.756 (Adjusted R Squared = 0.753)

Table 6 shows a significant difference in the mean retention scores of students exposed to Video conferencing, pre-recorded lectures and Conventional Groups. The value of $F_{(1, 144)} = 110.319$ was obtained with associated exact probability value of 0.000. Since the associated probability 0.000 is less than 0.05 level of significance, thus, the null hypothesis is rejected. The results implied that, the video conferencing teaching strategy produced a

significant effect on the post-post-test retention scores of students' when covariate effect (post-test) is controlled. Hence, there is a significant difference among the two groups of Video conferencing and Conventional Group.

Research Question Four: What are the mean retention scores of male and female students taught genetics through video conferencing?

Table 7: Mean and Standard Deviation on Retention Scores of Male and Female Students' Taught Genetics Using Video Conferencing

Gender	Type of Test	N	Mean	Std. Div
Male	**post-test**	**21**	**19.43**	**4.01**
	post-post-test	**21**	**23.52**	**3.26**
Female	**post-test**	**47**	**17.74**	**4.73**
	Post-post-test	**47**	**20.02**	**6.31**

Table 7 shows the results of post-test and post-post-test mean and standard deviation of retention scores of male students' taught genetics using Video conferencing are (N = 21, M = 19.43, SD = 4.01) and (N = 21, M = 23.52, SD = 3.26), while post-test and post-post-test mean and standard deviation of retention scores of female students' taught genetics using Video conferencing are (N = 47, M = 17.74, SD = 4.73) and (N = 47, M = 20.02, SD = 6.31) respectively.

Null Hypothesis Four: There is no significant difference in the mean retention scores of male and female students taught through video conferencing.

The test for this hypothesis is presented in Table 8

Table 8: Results of ANCOVA on Retention Scores of Male and Female Students' Taught Genetics Using Video Conferencing

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	68.552[a]	2	34.276	1.424	0.248	0.042
Intercept	1610.660	1	1610.660	66.936	0.000	0.507
Posttestvideoretention	8.775	1	8.775	0.365	0.548	0.006
Gender1	**66.026**	**1**	**66.026**	**2.744**	**0.102**	**0.041**
Error	1564.080	65	24.063			
Total	26371.000	68				
Corrected Total	1632.632	67				

a. R Squared = 0.042 (Adjusted R Squared = 0.013)

Table 8 reveals that; there is no significant difference in the mean retention scores of male and female students exposed to Video conferencing. The value of $F_{(1, 65)} = 2.744$ is obtained with associated exact probability value of 0.102 is greater than 0.05 level of significance, the null hypothesis is retained. The result implied that, male and female students retained at par when taught genetics using video conferencing strategy.

Discussion of Findings

The findings of this research revealed that teaching method has significant effects on achievement, it showed that students taught genetics through video conferencing performed better in terms of achievement than those exposed to the conventional method. This finding is in agreement with the findings of Ezeobi, Obialor and Aluko (2020) and Micheal-Aondoaseer, Adejoh, Okwara and Uduaka (2023) who reported that is significant effects on students' achievement when taught genetics compared to conventional method.

The results also revealed that, there is no significant difference in achievement of male and female students in the experimental groups. This finding is in agreement with the findings of Abubakar (2024) and Eze, Okeke and Ukeh (2020) who jointly opined that, gender has no significance in the achievement of students in Biology but in disagreement with the findings of Nkok (2022) and Adaeriba and Toryem (2020), who reported that gender has significant effects on students' achievement. Male students' achievement did not differ from their female counterparts when exposed to Video conferencing.

The results also revealed that, there is no significant difference in retention of male and female students in the experimental groups. This finding is in agreement with the findings

of Abubakar (2024) and Eze, Okeke and Ukeh (2020) who jointly opined that, gender has no significance in the achievement and retention of students in Biology but in disagreement with the findings of Nkok (2022) and Adaeriba and Toryem (2020), who reported that gender has significant effects on students' achievement. Male students' achievement and retention did not differ from their female counterparts when exposed to Video conferencing probably because the male students did not explore their learning environment more than their female students, also probably because the females did not find it difficult to do practical activities using the smart applications like their male counterparts; this could have improved their achievement and retention.

Conclusion

This study concludes that, video conferencing instructional strategy enhanced and improved students' achievement and retention in genetics than the conventional method. Video conferencing instructional strategy improved students understanding of genetics, also the strategy is gender friendly, that is both male and female students benefited from the instructional strategy.

Recommendations

The following recommendations were made based on the findings of the study:

1. Biology teachers be encouraged to adopt Video Conferencing Instructional strategy in teaching genetics in secondary schools in FCT Abuja
2. Biology teachers be trained on how to employ the use of video conferencing Instructional Strategy to teach genetics and Biology in general.
3. Biology teachers should be encouraged to use video conferencing instructional strategy to handle concepts like genetics and other concepts perceived as difficult to understand by students.
4. Biology Curriculum should be structured to provide for adoption of student-centred approaches like video conferencing instructional strategy in teaching and learning of certain concepts in biology.

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